Edexcel Maths Core 1

Mark Scheme Pack

2005-2014

GCE

Edexcel GCE

Core Mathematics C1(6663)

Summer 2005

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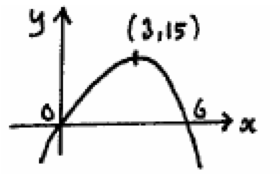
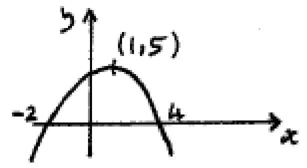
Mark Scheme (Results)

Edexcel GCE
Core Mathematics C1 (6663)

June 2005
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
1. (a)	$\underline{2}$ Penalise $\pm$	B1 (1)
(b)	$8^{-\frac{2}{3}} = \dfrac{1}{\sqrt[3]{64}}$ or $\dfrac{1}{(a)^2}$ or $\dfrac{1}{\sqrt[3]{8^2}}$ or $\dfrac{1}{8^{\frac{2}{3}}}$ Allow $\pm$ $= \dfrac{1}{4}$ or 0.25	M1 A1 (2) **(3)**
(b)	M1 for understanding that "-" power means reciprocal $8^{\frac{2}{3}} = 4$ is M0A0 and $-\dfrac{1}{4}$ is M1A0	
2. (a)	$\dfrac{dy}{dx} = 6 + 8x^{-3}$ $x^n \to x^{n-1}$ both	M1 A1 (2)
(b)	$\int (6x - 4x^{-2})dx = \dfrac{6x^2}{2} + 4x^{-1} + c$	M1 A1 A1 (3) **(5)**
(b)	1st A1 for one correct term in x: $\dfrac{6x^2}{2}$ <u>or</u> $+4x^{-1}$ (or better simplified versions) 2nd A1 for all 3 terms as printed or better in one line.	

Question Number	Scheme	Marks
3. (a)	$x^2 - 8x - 29 \equiv (x-4)^2 - 45$ $(x \pm 4)^2$ $(x-4)^2 - 16 + (-29)$ $(x \pm 4)^2 - 45$	M1 A1 A1 (3)
ALT	Compare coefficients $-8 = 2a$ equation for a $a = -4$ AND $a^2 + b = -29$ $b = -45$	M1 A1 A1 (3)
(b)	$(x-4)^2 = 45$ (follow through their a and b from (a)) $\Rightarrow x - 4 = \pm\sqrt{45}$ $c = 4$ $x = 4 \pm 3\sqrt{5}$ $d = 3$	M1 A1 A1 (3) **(6)**
(a) (b)	M1 for $(x \pm 4)^2$ or an equation for a. M1 for a full method leading to $x - 4 = ...$ or $x = ...$ A1 for c and A1 for d Note Use of formula that ends with $\frac{8 \pm 6\sqrt{5}}{2}$ scores M1 A1 A0 (but must be $\sqrt{5}$) i.e. only penalise non-integers by one mark.	

Question Number	Scheme	Marks
4. (a)	 Shape Points	B1 B1 (2)
(b)	 -2 and 4 max	M1 A1 A1 (3) **(5)**
(a) (b)	Marks for shape: graphs must have curved sides and round top. 1st B1 for $\cap$ shape through (0, 0) and ($(k,0)$ where $k>0$) 2nd B1 for max at (3, 15) and 6 labelled or (6, 0) seen Condone (15,3) if 3 and 15 are correct on axes. Similarly (5,1) in (b) M1 for $\cap$ shape <u>NOT</u> through (0, 0) but must cut x-axis twice. 1st A1 for -2 and 4 labelled or (-2, 0) and (4, 0) seen 2nd A1 for max at (1, 5). Must be clearly in 1st quadrant	
5.	$x=1+2y$ and sub $\rightarrow (1+2y)^2+y^2=29$ $\Rightarrow 5y^2+4y-28(=0)$ i.e. $(5y+14)(y-2)=0$ $(y=)2$ or $-\frac{14}{5}$ (o.e.) (both) $y=2 \Rightarrow x=1+4=5$; $y=-\frac{14}{5} \Rightarrow x=-\frac{23}{5}$ (o.e)	M1 A1 M1 A1 M1A1 f.t. **(6)**
	1st M1 Attempt to sub leading to equation in 1 variable 1st A1 Correct 3TQ (condone = 0 missing) 2nd M1 Attempt to solve 3TQ leading to 2 values for y. 2nd A1 Condone mislabelling x = for y = … but then M0A0 in part (c). 3rd M1 Attempt to find at least one x value 3rd A1 f.t. f.t. only in $x=1+2y$ (3sf if not exact) Both values N.B. False squaring (e.g. $y=x^2+4y^2=1$) can only score the last 2 marks.	

Question Number	Scheme	Marks
6. (a)	$6x+3 > 5-2x \quad \Rightarrow 8x > 2$	M1
	$x > \frac{1}{4}$ or 0.25 or $\frac{2}{8}$	A1
		(2)
(b)	$(2x-1)(x-3) \quad (>0)$	M1
	Critical values $x = \frac{1}{2},\ 3$ (both)	A1
	 Choosing "outside" region	M1
	$x > 3$ or $x < \frac{1}{2}$	A1 f.t.
		(4)
(c)	$x > 3$ or $\frac{1}{4} < x < \frac{1}{2}$	B1f.t. B1f.t.
		(2)
		(8)

(a) M1 Multiply out and collect terms (allow one slip and allow use of = here)

(b) 1st M1 Attempting to factorise 3TQ $\rightarrow x = ...$

2nd M1 Choosing the outside region

2nd A1 f.t. f.t. their critical values N.B.($x>3$, $x > \frac{1}{2}$ is M0A0)

For $p < x < q$ where $p > q$ penalise the final A1 in (b).

(c) **f.t. their answers to (a) and (b)**

1st B1 a correct f.t. leading to an <u>infinite</u> region

2nd B1 a correct f.t. leading to a <u>finite</u> region

Penalise $\le$ or $\ge$ once only at first offence.

e.g.	(a)	(b)	(c)	Mark
	$x > \frac{1}{4}$	$\frac{1}{2} < x < 3$	$\frac{1}{2} < x < 3$	B0 B1
	$x > \frac{1}{4}$	$x > 3,\ x > \frac{1}{2}$	$x > 3$	B1 B0

Question Number	Scheme	Marks
7. (a)	$(3-\sqrt{x})^2 = 9 - 6\sqrt{x} + x$	M1
	$\div by\sqrt{x} \quad \rightarrow 9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}}$	A1 c.s.o.
		(2)
(b)	$\int(9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}})dx = \frac{9x^{\frac{1}{2}}}{\frac{1}{2}} - 6x + \frac{x^{\frac{3}{2}}}{\frac{3}{2}} (+c)$	M1 A2/1/0
	use $y = \frac{2}{3}$ and $x = 1$: $\quad \frac{2}{3} = 18 - 6 + \frac{2}{3} + c$	M1
	c = - 12	A1 c.s..o.
	So $\quad y = 18x^{\frac{1}{2}} - 6x + \frac{2}{3}x^{\frac{3}{2}}$ -12	A1f.t.
		(6)
		(8)
(a)	M1 Attempt to multiply out $(3-\sqrt{x})^2$. Must have 3 or 4 terms, allow one sign error A1 cso Fully correct solution to printed answer. Penalise wrong working.	
(b)	1st M1 Some correct integration: $x^n \rightarrow x^{n+1}$ A1 At least 2 correct unsimplified terms Ignore + c A2 All 3 terms correct (unsimplified) 2nd M1 Use of $y = \frac{2}{3}$ and $x = 1$ to find c. No + c is M0. A1c.s.o. for -12. (o.e.) Award this mark if " $c = -12$ " stated i.e. not as part of an expression for y A1f.t. for 3 simplified x terms with $y = \ldots$ and a numerical value for c. Follow through their value of c but it must be a number.	

Question Number	Scheme	Marks
8. (a)	$y-(-4)=\frac{1}{3}(x-9)$	M1 A1
	$3y-x+21=0$ (o.e.) (condone 3 terms with integer coefficients e.g. $3y+21=x$)	A1
		(3)
(b)	Equation of l_2 is: $y=-2x$ (o.e.)	B1
	Solving l_1 and l_2 : $-6x-x+21=0$	M1
	p is point where $x_p=3$, $y_p=-6$ x_p or y_p	A1
	y_p or x_p	A1f.t.
		(4)
(c)	(l_1 is $y=\frac{1}{3}x-7$) C is (0, -7) or OC = 7	B1f.t.
	Area of $\Delta OCP=\frac{1}{2}OC\times x_p$, $=\frac{1}{2}\times7\times3=10.5$ or $\frac{21}{2}$	M1 A1c.a.o.
		(3)
		(10)
(a)	M1 for full method to find equation of l_1 1stA1 any unsimplified form	
(b)	M1 Attempt to solve two linear equations leading to linear equation in one variable 2^{nd} A1 f.t. only f.t. their x_p or y_p in $y=-2x$	
(c)	B1f.t. Either a correct OC or f.t. from their l_1 M1 for correct attempt in letters or symbols for ΔOCP A1 c.a.o. $-\frac{1}{2}\times7\times3$ scores M1 A0	

Question Number	Scheme	Marks
9 (a)	$(S=)a+(a+d)+\ldots \quad \ldots+[a+(n-1)d]$ $(S=)[a+(n-1)d]+\ldots \quad \ldots+a$ $2S=[2a+(n-1)d]+\ldots \quad \ldots+[2a+(n-1)d]$ } either $2S=n[2a+(n-1)d]$ $S=\frac{n}{2}[2a+(n-1)d]$	B1 M1 dM1 A1 c.s.o (4)
(b)	$(a=149,\ d=-2)$ $u_{21}=149+20(-2)$ = £109	M1 A1 (2)
(c)	$S_n=\frac{n}{2}[2\times149+(n-1)(-2)] \qquad (=n(150-n))$ $S_n=5000\Rightarrow n^2-150n+5000=0$ (*)	M1 A1 A1 c.s.o (3)
(d)	$(n-100)(n-50)=0$ $n=50$ or 100	M1 A2/1/0 (3)
(e)	$u_{100}<0 \qquad \therefore n=100$ not sensible	B1 f.t. (1) **(13)**
(a)	B1 requires at least 3 terms, must include first and last terms, an adjacent term dots and + signs. 1st M1 for reversing series. Must be arithmetic with *a*, *d* (or *a*, *l*) and *n*. 2nd dM1 for adding, must have 2*S* and be a genuine attempt. Either line is sufficient. Dependent on 1st M1 (NB Allow first 3 marks for use of *l* for last term but as given for final mark)	
(b)	M1 for using *a* = 149 and *d* = ± 2 in $a+(n-1)d$ formula.	
(c)	M1 for using their a,d in S_n A1 any correct expression A1cso for putting S_n =5000 and simplifying to given expression. No wrong work	
(d)	M1 Attempt to solve leading to $n=\ldots$ A2/1/0 Give A1A0 for 1 correct value and A1A1 for both correct	
(e)	B1 f.t. Must mention 100 and state u_{100} < 0 (or loan paid or equivalent) If giving f.t. then must have $n\geq 76$.	

Question Number	Scheme	Marks
10 (a)	$x = 3, \quad y = 9 - 36 + 24 + 3 = 0$ (9 – 36 + 27=0 is OK)	B1 (1)
(b)	$\frac{dy}{dx} = \frac{3}{3}x^2 - 2\times 4\times x + 8 \qquad (= x^2 - 8x + 8)$	M1 A1
	When $x = 3$, $\frac{dy}{dx} = 9 - 24 + 8 \Rightarrow m = -7$	M1
	Equation of tangent: $y - 0 = -7(x - 3)$	M1
	$y = -7x + 21$	A1 c.a.o (5)
(c)	$\frac{dy}{dx} = m$ gives $x^2 - 8x + 8 = -7$	M1
	$(x^2 - 8x + 15 = 0)$	
	$(x - 5)(x - 3) = 0$	M1
	$x = (3)$ or 5 $\qquad x = 5$	A1
	$\therefore y = \frac{1}{3}5^3 - 4\times 5^2 + 8\times 5 + 3$	M1
	$y = -15\frac{1}{3}$ or $-\frac{46}{3}$	A1 (5)
		(11)
(b)	1st M1 some correct differentiation ($x^n \to x^{n-1}$ for one term)	
	1st A1 correct unsimplified (all 3 terms)	
	2nd M1 substituting $x_P (= 3)$ in their $\frac{dy}{dx}$ clear evidence	
	3rd M1 using their m to find tangent at p.	
(c)	1st M1 forming a correct equation " their $\frac{dy}{dx}$ = gradient of their tangent"	
	2nd M1 for solving a quadratic based on their $\frac{dy}{dx}$ leading to $x =$	
	3rd M1 for using their x value in y to obtain y coordinate	
MR	For misreading (0, 3) for (3, 0) award B0 and then M1A1 as in scheme. Then allow all M marks but no A ft. (Max 7)	

GENERAL PRINCIPLES FOR C1 MARKING

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to $x = \ldots$

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to $x = \ldots$

2. Formula

Attempt to use correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm p)^2 \pm q \pm c$, $p \neq 0$, $q \neq 0$, leading to $x = \ldots$

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Misreads

A misread must be consistent for the whole question to be interpreted as such.

These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).

Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.

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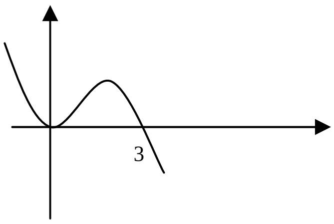
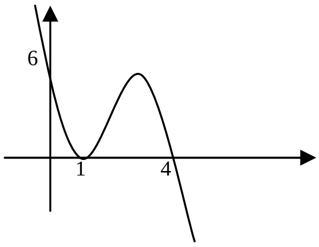
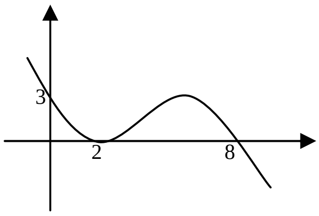
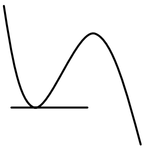
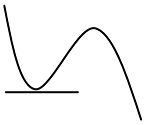
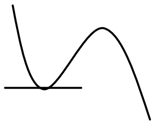
Question number	Scheme		Marks
1.	$x(x^2 - 4x + 3)$	Factor of x. (Allow $(x - 0)$)	M1
	$= x(x-3)(x-1)$	Factorise 3 term quadratic	M1 A1
			(3)
			Total 3 marks
	<u>Alternative:</u> $(x^2 - 3x)(x-1)$ or $(x^2 - x)(x-3)$ scores the <u>second</u> M1 (allow ± for each sign), then $x(x-3)(x-1)$ scores the <u>first</u> M1, and A1 if correct. <u>Alternative:</u> Finding factor $(x-1)$ or $(x-3)$ by the factor theorem scores the <u>second</u> M1, then completing, using factor x, scores the <u>first</u> M1, and A1 if correct. <u>Factors "split":</u> e.g. $x(x^2 - 4x + 3) \Rightarrow (x-3)(x-1)$. Allow full marks. <u>Factor x not seen:</u> e.g. Dividing by $x \Rightarrow (x-3)(x-1)$. M0 M1 A0. If an equation is solved, i.s.w.		

Question number	Scheme		Marks
2.	(a) $u_2 = (-2)^2 = 4$		B1
	$u_3 = 1,\ u_4 = 4$	For u_3, ft $(u_2 - 3)^2$	B1ft, B1
			(3)
	(b) $u_{20} = 4$		B1ft
			(1)
			Total 4 marks
	(b) ft only if sequence is "oscillating". Do <u>not</u> give marks if answers have clearly been obtained from wrong working, e.g. $u_2 = (3-3)^2 = 0$ $u_3 = (4-3)^2 = 1$ $u_4 = (5-3)^2 = 4$		

Question number	Scheme	Marks
3.	(a) $y = 5 - (2 \times 3) = -1$ (or equivalent verification) (*)	B1
		(1)
	(b) Gradient of L is $\frac{1}{2}$	B1
	$y - (-1) = \frac{1}{2}(x - 3)$ (ft from a <u>changed</u> gradient)	M1 A1ft
	$x - 2y - 5 = 0$ (or equiv. with integer coefficients)	A1
		(4)
		Total 5 marks
	(a) $y - (-1) = -2(x - 3) \Rightarrow y = 5 - 2x$ is fine for B1. Just a table of values including $x = 3,\ y = -1$ is insufficient. (b) M1: eqn of a line through (3, –1), with any numerical gradient (except 0 or ∞). For the M1 A1ft, the equation may be in any form, e.g. $\frac{y-(-1)}{x-3} = \frac{1}{2}$. Alternatively, the M1 may be scored by using $y = mx + c$ with a numerical gradient and substituting (3, –1) to find the value of *c*, with A1ft if the value of *c* follows through correctly from a <u>changed</u> gradient. Allow $x - 2y = 5$ or equiv., but must be integer coefficients. The "= 0" can be implied if correct working precedes.	

Question number	Scheme		Marks
4.	(a) $\frac{dy}{dx} = 4x + 18x^{-4}$	M1: $x^2 \to x$ or $x^{-3} \to x^{-4}$	M1 A1
			(2)
	(b) $\frac{2x^3}{3} - \frac{6x^{-2}}{-2} + C$	M1: $x^2 \to x^3$ or $x^{-3} \to x^{-2}$ or $+C$	M1 A1 A1
			(3)
	$\left(= \frac{2x^3}{3} + 3x^{-2} + C \right)$	First A1: $\frac{2x^3}{3} + C$	
		Second A1: $-\frac{6x^{-2}}{-2}$	
			Total 5 marks
	In both parts, accept any correct version, simplified or not. Accept $4x^1$ for $4x$. <u>+ *C* in part (a) instead of part (b):</u> Penalise only once, so if otherwise correct scores M1 A0, M1 A1 A1.		

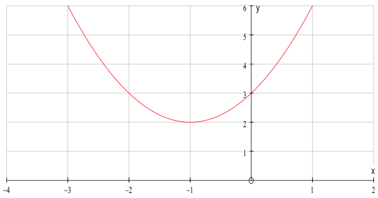
Question number	Scheme	Marks
5.	(a) $3\sqrt{5}$ (or $a = 3$)	B1
		(1)
	(b) $\frac{2(3+\sqrt{5})}{(3-\sqrt{5})} \times \frac{(3+\sqrt{5})}{(3+\sqrt{5})}$	M1
	$(3-\sqrt{5})(3+\sqrt{5}) = 9-5$ (= 4) (Used as or intended as denominator)	B1
	$(3+\sqrt{5})(p \pm q\sqrt{5}) = ...$ 4 terms $(p \neq 0, q \neq 0)$ (Independent)	M1
	or $(6+2\sqrt{5})(p \pm q\sqrt{5}) = ...$ 4 terms $(p \neq 0, q \neq 0)$	
	[Correct version: $(3+\sqrt{5})(3+\sqrt{5}) = 9+3\sqrt{5}+3\sqrt{5}+5$, or double this.]	
	$\frac{2(14+6\sqrt{5})}{4} = 7+3\sqrt{5}$ 1st A1: $b = 7$, 2nd A1: $c = 3$	A1 A1
		(5)
		Total 6 marks
	(b) 2nd M mark for attempting $(3+\sqrt{5})(p+q\sqrt{5})$ is generous. Condone errors.	

Question number	Scheme	Marks
6.	(a)  (See below)	M1
	Clearly through origin (or (0, 0) seen)	A1
	3 labelled (or (3, 0) seen)	A1
		(3)
	(b)  Stretch parallel to *y*-axis	M1
	1 and 4 labelled (or (1, 0) and (4, 0) seen)	A1
	6 labelled (or (0, 6) seen)	A1
		(3)
	(c)  Stretch parallel to *x*-axis	M1
	2 and 8 labelled (or (2, 0) and (8, 0) seen)	A1
	3 labelled (or (0, 3) seen)	A1
		(3)
		Total 9 marks
	(a) M1: 	
	(b) M1:  with at least two of: (1, 0) unchanged (4, 0) unchanged (0, 3) changed	
	(c) M1:  with at least two of: (1, 0) changed (4, 0) changed (0, 3) unchanged	
	<u>Beware</u>: Candidates may sometimes re-label the parts of their solution.	

Question number	Scheme	Marks
7.	(a) 500 + (500 + 200) = 1200 or $S_2 = \frac{1}{2}2\{1000 + 200\} = 1200$ (*)	B1 (1)
	(b) Using a = 500, d = 200 with n = 7, 8 or 9 $a + (n-1)d$ or "listing"	M1
	$500 + (7 \times 200)$ = (£)1900	A1 (2)
	(c) Using $\frac{1}{2}n\{2a + (n-1)d\}$ or $\frac{1}{2}n\{a + l\}$, or listing and "summing" terms	M1
	$S_8 = \frac{1}{2}8\{2 \times 500 + 7 \times 200\}$ or $S_8 = \frac{1}{2}8\{500 + 1900\}$, or all terms in list correct	A1
	= (£) 9600	A1 (3)
	(d) $\frac{1}{2}n\{2 \times 500 + (n-1) \times 200\} = 32000$ M1: General S_n, equated to 32000	M1 A1
	$n^2 + 4n - 320 = 0$ (or equiv.) M1: Simplify to 3 term quadratic	M1 A1
	$(n + 20)(n - 16) = 0$ $n = ...$ M1: Attempt to solve 3 t.q.	M1
	n = 16, Age is 26	A1cso,A1cso
		(7)
		Total 13 marks
	(b) Correct answer with no working: Allow both marks. (c) <u>Some</u> working must be seen to score marks: Minimum working: 500 + 700 + 900 +…(+ 1900) =… scores M1 (A1). (d) Allow ≥ or > throughout , apart from "Age 26". A common <u>misread</u> here is 3200. This gives n = 4 and age 14, and can score M1 A0 M1 A0 M1 A1 A1 with the usual misread rule. <u>Alternative:</u> (Listing sums) (500, 1200, 2100, 3200, 4500, 6000, 7700, 9600,) 11700, 14000, 16500, 19200, 22100, 25200, 28500, 32000. List at least up to 32000 M3 All values correct A2 n = 16 (perhaps implied by age) A1cso Age 26 A1cso If there is a mistake in the list, e.g. 16^{th} sum = 32100, possible marks are: M3 A0 A0 A0 <u>Alternative:</u> (Trial and improvement) Use of S_n formula with n = 16 (and perhaps other values) M3 Accurately achieving 32000 for n = 16 A3 Age 26 A1	

Question number	Scheme	Marks
8.	$\frac{5x^2+2}{x^{\frac{1}{2}}} = 5x^{\frac{3}{2}} + 2x^{-\frac{1}{2}}$ M1: One term correct.	M1 A1
	A1: Both terms correct, and no extra terms.	
	$f(x) = 3x + \frac{5x^{\frac{5}{2}}}{\left(\frac{5}{2}\right)} + \frac{2x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)}$ $(+C)$ (+ C not required here)	M1 A1ft
	6 = 3 + 2 + 4 + C Use of x = 1 and y =6 to form eqn. in C	M1
	C = –3	A1cso
	$3x + 2x^{\frac{5}{2}} + 4x^{\frac{1}{2}} - 3$ (simplified version required)	A1 (ft C)
		(7)
	[or: $3x + 2\sqrt{x^5} + 4\sqrt{x} - 3$ or equiv.]	
		Total 7 marks
	For the integration: M1 requires evidence from just one term (e.g. $3 \to 3x$), but not just "+C". A1ft requires correct integration of at least 3 terms, with at least one of these terms having a fractional power. For the final A1, follow through on C only.	

Question number	Scheme	Marks
9.	(a) -2 (P), 2 (Q) (± 2 scores B1 B1)	B1, B1
		(2)
	(b) $y = x^3 - x^2 - 4x + 4$ (May be seen earlier) Multiply out, giving 4 terms	M1
	$\frac{dy}{dx} = 3x^2 - 2x - 4$ (*)	M1 A1cso
		(3)
	(c) At $x = -1$: $\frac{dy}{dx} = 3(-1)^2 - 2(-1) - 4 = 1$	
	Eqn. of tangent: $y - 6 = 1(x - (-1))$, $y = x + 7$ (*)	M1 A1cso
		(2)
	(d) $3x^2 - 2x - 4 = 1$ (Equating to "gradient of tangent")	M1
	$3x^2 - 2x - 5 = 0$ $(3x-5)(x+1) = 0$ $x = \ldots$	M1
	$x = \frac{5}{3}$ or equiv.	A1
	$y = \left(\frac{5}{3} - 1\right)\left(\frac{25}{9} - 4\right)$, $= \frac{2}{3} \times \left(-\frac{11}{9}\right) = -\frac{22}{27}$ or equiv.	M1, A1
		(5)
		Total 12 marks
	(b) <u>Alternative:</u> Attempt to differentiate by product rule scores the <u>second</u> M1: $\frac{dy}{dx} = \{(x^2 - 4) \times 1\} + \{(x-1) \times 2x\}$ Then multiplying out scores the <u>first</u> M1, with A1 if correct (cso). (c) M1 requires full method: Evaluate $\frac{dy}{dx}$ and use in eqn. of line through $(-1, 6)$, (n.b. the gradient need not be 1 for this M1). <u>Alternative:</u> Gradient of $y = x + 7$ is 1, so solve $3x^2 - 2x - 4 = 1$, as in (d)… M1 to get $x = -1$. A1cso (d) 2nd and 3rd M marks are dependent on starting with $3x^2 - 2x - 4 = k$, where k is a constant.	

Question number	Scheme		Marks	
10.	(a) $x^2+2x+3=(x+1)^2,\ +2$	$(a=1,\quad b=2)$	B1, B1	(2)
	(b) 	"U"-shaped parabola	M1	
		Vertex in correct quadrant (ft from $(-a, b)$)	A1ft	
		(0, 3) (or 3 on y-axis)	B1	(3)
	(c) $b^2-4ac=4-12=-8$		B1	
	Negative, so curve does not cross x-axis		B1	(2)
	(d) $b^2-4ac=k^2-12$	(May be within the quadratic formula)	M1	
	$k^2-12<0$	(Correct inequality expression in any form)	A1	
	$-\sqrt{12}<k<\sqrt{12}$	(or $-2\sqrt{3}<k<2\sqrt{3}$)	M1 A1	(4)
			Total 11 marks	
	(b) The B mark can be scored independently of the sketch. (3, 0) shown on the y-axis scores the B1, but if not shown on the axis, it is B0. (c) "…. no real roots" is insufficient for the 2nd B mark. "…. curve does not touch x-axis" is insufficient for the 2nd B mark. (d) 2nd M1: correct solution method for <u>their</u> quadratic inequality, e.g. $k^2-12<0$ gives k <u>between</u> the 2 critical values $\alpha<k<\beta$, whereas $k^2-12>0$ gives $k<\alpha,\ k>\beta$. "$k>-\sqrt{12}$ and $k<\sqrt{12}$" scores the final M1 A1, but "$k>-\sqrt{12}$ or $k<\sqrt{12}$" scores M1 A0, "$k>-\sqrt{12}$, $k<\sqrt{12}$" scores M1 A0. N.B. $k<\pm\sqrt{12}$ does not score the 2nd M mark. $k<\sqrt{12}$ does not score the 2nd M mark. $\leq$ instead of $<$: Penalise only once, on first occurrence.			

GENERAL PRINCIPLES FOR C1 MARKING

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to $x = \ldots$

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to $x = \ldots$

2. Formula

Attempt to use correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm p)^2 \pm q \pm c$, $p \neq 0$, $q \neq 0$, leading to $x = \ldots$

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

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Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

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The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Misreads

(See the next sheet for a simple example).

A misread must be consistent for the whole question to be interpreted as such.

These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).

Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.

MISREADS

Question 8. $5x^2$ misread as $5x^3$

8. $\dfrac{5x^3+2}{x^{\frac{1}{2}}} = 5x^{\frac{5}{2}} + 2x^{-\frac{1}{2}}$ M1 A0

$\mathrm{f}(x) = 3x + \dfrac{5x^{\frac{7}{2}}}{\left(\frac{7}{2}\right)} + \dfrac{2x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)}$ $(+C)$ M1 A1ft

$6 = 3 + \dfrac{10}{7} + 4 + C$ M1

$C = -\dfrac{17}{7}$, $\mathrm{f}(x) = 3x + \dfrac{10}{7}x^{\frac{7}{2}} + 4x^{\frac{1}{2}} - \dfrac{17}{7}$ A0, A1

GCE

Edexcel GCE

Mathematics

Core Mathematics C1 (6663)

June 2006

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Mark Scheme (Results)

Edexcel GCE

Mathematics

June 2006
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks
1.	$\frac{6x^3}{3}+2x+\frac{x^{\frac{1}{2}}}{\frac{1}{2}} \quad (+c)$	M1
		A1
	$= 2x^3+2x+2x^{\frac{1}{2}}$	A1
	$+c$	B1
		4
	M1 for some attempt to integrate $x^n \rightarrow x^{n+1}$ 1st A1 for either $\frac{6}{3}x^3$ or $\frac{x^{\frac{1}{2}}}{\frac{1}{2}}$ or better 2nd A1 for all terms in x correct. Allow $2\sqrt{x}$ and $2x^1$. B1 for + c, when first seen with a changed expression.	

Question number	Scheme		Marks
2.	<u>Critical Values</u>		
	$(x \pm a)(x \pm b)$ with ab=18 or $x = \dfrac{7 \pm \sqrt{49 - -72}}{2}$ or $\left(x - \frac{7}{2}\right)^2 \pm \left(\frac{7}{2}\right)^2 - 18$		M1
	$(x - 9)(x + 2)$ or $x = \dfrac{7 \pm 11}{2}$ or $x = \dfrac{7}{2} \pm \dfrac{11}{2}$		A1
	<u>Solving Inequality</u> $x > 9$ or $x < -2$	Choosing "outside"	M1
			A1 **4**

1st M1 For attempting to find critical values.
Factors alone are OK for M1, x = appearing somewhere for the formula and as written for completing the square

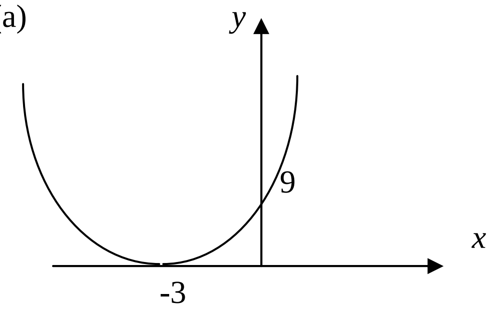
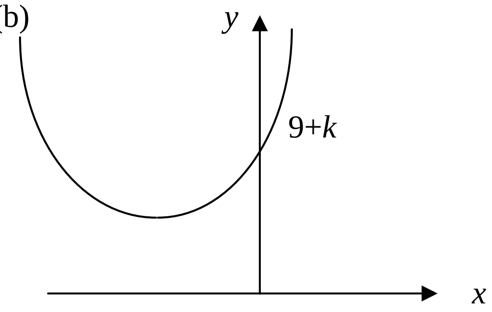
1st A1. Factors alone are OK . Formula or completing the square need x = as written.

2nd M1 For choosing outside region. Can f.t. their critical values.
They must have two different critical values.

$-2 > x > 9$ is M1A0 but ignore if it follows a correct version

$-2 < x < 9$ is M0A0 whatever the diagram looks like.

2nd A1 Use of $\geq$ in final answer gets A0

Question number	Scheme		Marks
3.	(a) 	U shape touching x-axis	B1
		$(-3, 0)$	B1
		$(0, 9)$	B1
			(3)
	(b) 	Translated parallel to y-axis up	M1
		$(0, 9+k)$	B1f.t.
			(2)
			5
(a)	2^{nd} B1	They can score this even if other intersections with the x-axis are given.	
	2^{nd} B1 & 3^{rd} B1	The -3 and 9 can appear on the sketch as shown	
(b)	M1	Follow their curve in (a) up only. If it is not obvious do not give it. e.g. if it cuts y-axis in (a) but doesn't in (b) then it is M0.	
	B1f.t.	Follow through their 9	

Question number	Scheme	Marks
4. (a)	$a_2 = 4$ $a_3 = 3 \times a_2 - 5 = 7$	B1 B1f.t. (2)
(b)	$a_4 = 3a_3 - 5 (= 16)$ and $a_5 = 3a_4 - 5 (= 43)$	M1
	3 + 4 + 7 + 16 + 43	M1
	= 73	A1c.a.o. (3)
		5
(a)	2nd B1f.t. Follow through their a_2 but it must be a value. $3 \times 4 - 5$ is B0 Give wherever it is first seen.	
(b)	1st M1 For two further attempts to use of $a_{n+1} = 3a_n - 5$, wherever seen. Condone arithmetic slips	
	2nd M1 For attempting to add 5 relevant terms (i.e. terms derived from an attempt to use the recurrence formula) or an expression. Follow through their values for $a_2 - a_5$ Use of formulae for arithmetic series is M0A0 but could get 1st M1 if a_4 and a_5 are correctly attempted.	

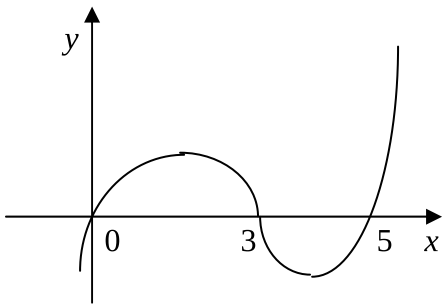
Question number	Scheme	Marks
5. (a)	$(y = x^4 + 6x^{\frac{1}{2}} \Rightarrow y' =)\ 4x^3 + 3x^{-\frac{1}{2}}$ or $4x^3 + \frac{3}{\sqrt{x}}$	M1A1A1 (3)
(b)	$(x+4)^2 = x^2 + 8x + 16$	M1
	$\frac{(x+4)^2}{x} = x + 8 + 16x^{-1}$ (allow 4+4 for 8)	A1
	$(y = \frac{(x+4)^2}{x} \Rightarrow y' =)\ 1 - 16x^{-2}$ o.e.	M1A1 (4)
		7
(a)	M1 For some attempt to differentiate $x^n \to x^{n-1}$ 1st A1 For one correct term as printed. 2nd A1 For both terms correct as printed. $4x^3 + 3x^{-\frac{1}{2}} + c$ scores M1A1A0	
(b)	1st M1 For attempt to expand $(x+4)^2$, must have x^2, x, x^0 terms and at least 2 correct e.g. $x^2 + 8x + 8$ or $x^2 + 2x + 16$ 1st A1 Correct expression for $\frac{(x+4)^2}{x}$. As printed but allow $\frac{16}{x}$ and $8x^0$. 2nd M1 For some correct differentiation, any term. Can follow through their simplification. N.B. $\frac{x^2 + 8x + 16}{x}$ giving rise to $(2x + 8)/1$ is M0A0	
ALT	Product or Quotient rule (If in doubt send to review) M2 For correct use of product or quotient rule. Apply usual rules on formulae. 1st A1 For $\frac{2(x+4)}{x}$ or $\frac{2x(x+4)}{x^2}$ 2nd A1 for $-\frac{(x+4)^2}{x^2}$	

Question number	Scheme	Marks
6. (a)	$16+4\sqrt{3}-4\sqrt{3}-\left(\sqrt{3}\right)^2$ or $16-3$	M1
	$= 13$	A1c.a.o (2)
(b)	$\frac{26}{4+\sqrt{3}} \times \frac{4-\sqrt{3}}{4-\sqrt{3}}$	M1
	$= \frac{26(4-\sqrt{3})}{13} = \underline{8-2\sqrt{3}}$ or $8+(-2)\sqrt{3}$ or a= 8 and b = -2	A1 (2)
		4
(a)	M1 For 4 terms, at least 3 correct e.g. $8+4\sqrt{3}-4\sqrt{3}-\left(\sqrt{3}\right)^2$ or $16\pm 8\sqrt{3}-\left(\sqrt{3}\right)^2$ or 16 + 3 4^2 instead of 16 is OK $(4+\sqrt{3})(4+\sqrt{3})$ scores M0A0	
(b)	M1 For a correct attempt to rationalise the denominator Can be implied NB $\frac{-4+\sqrt{3}}{-4+\sqrt{3}}$ is OK	

Question number	Scheme	Marks
7.	$a+(n-1)d=k$ k = 9 or 11	M1
	$(u_{11}=)$ $a+10d=9$	A1c.a.o.
	$\frac{n}{2}[2a+(n-1)d]=77$ or $\frac{(a+l)}{2}\times n=77$ l = 9 or 11	M1
	$(S_{11}=)$ $\frac{11}{2}(2a+10d)=77$ or $\frac{(a+9)}{2}\times 11=77$	A1
	e.g. $a+10d=9$, $a+5d=7$ or $a+9=14$	M1
	$a=5$ and $d=0.4$ or exact equivalent	A1 A1
		7
	1st M1: Use of u_n to form a linear equation in a and d. $a+nd=9$ is M0A0 1st A1: For $a+10d=9$. 2nd M1: Use of S_n to form an equation for a and d (LHS) or in a (RHS) 2nd A1: A correct equation based on S_n. For 1st 2 Ms they must write n or use $n = 11$. 3rd M1: Solving (LHS simultaneously) or (RHS a linear equation in a) Must lead to a = … or d = …. and depends on one previous M 3rd A1: for $a=5$ 4th A1: for $d=0.4$ (o.e.) <u>ALT</u>: Uses $\frac{(a+l)}{2}\times n=77$ to get $a=5$, gets second and third M1A1 i.e. 4/7 Then uses $\frac{n}{2}[2a+(n-1)d]=77$ to get d, gets 1st M1A1 and 4th A1 <u>MR</u>: Consistent MR of 11 for 9 leading to $a=3$, $d=0.8$ scores M1A0M1A0M1A1ftA1ft	

Question number	Scheme	Marks
8. (a)	$b^2 - 4ac = 4p^2 - 4(3p+4) = 4p^2 - 12p - 16$ (=0)	M1, A1
	or $(x+p)^2 - p^2 + (3p+4) = 0 \Rightarrow p^2 - 3p - 4(=0)$	
	$(p-4)(p+1) = 0$	M1
	p = (-1 or) 4	A1c.s.o. (4)
(b)	$x = \dfrac{-b}{2a}$ or $(x+p)(x+p) = 0 \Rightarrow x = ...$	M1
	x (= $-p$) = $\underline{-4}$	A1f.t. (2)
		6

(a)	1st M1	For use of $b^2 - 4ac$ or a full attempt to complete the square leading to a 3TQ in p. May use $b^2 = 4ac$. One of b or c must be correct.
	1st A1	For a correct 3TQ in p. Condone missing "=0" but all 3 terms must be on one side.
	2nd M1	For attempt to solve their 3TQ leading to p = …
	2nd A1	For p = 4 (ignore p = -1). $b^2 = 4ac$ leading to $p^2 = 4(3p+4)$ and then "spotting" $p = 4$ scores 4/4.
(b)	M1	For a full method leading to a repeated root x = …
	A1f.t.	For x = -4 (- their p)
	<u>Trial and Improvement</u>	
	M2	For substituting values of p into the equation and attempting to factorize. (Really need to get to p = 4 or -1)
	A2c.s.o.	Achieve p = 4. Don't give without valid method being seen.

Question number	Scheme	Marks
9. (a)	$f(x) = x[(x-6)(x-2)+3]$ or $x^3-6x^2-2x^2+12x+3x = x($	M1
	$f(x) = x(x^2-8x+15)$ b= - 8 or c = 15	A1
	both and a = 1	A1 (3)
(b)	$(x^2-8x+15)=(x-5)(x-3)$	M1
	f(x) = x(x – 5)(x – 3)	A1 (2)
(c)	 Shape	B1
	their 3 or their 5	B1f.t.
	both their 3 and their 5 and (0,0) by implication	B1f.t. (3)
		8
(a)	M1 for a correct method to get the factor of x. $x($ as printed is the minimum.	
	1st A1 for b = -8 or c = 15.	
	-8 comes from -6-2 and must be coefficient of x, and 15 from 6x2+3 and must have no xs.	
	2nd A1 for a =1, b = -8 and c = 15. Must have $x(x^2-8x+15)$.	
(b)	M1 for attempt to factorise their 3TQ from part (a).	
	A1 for all 3 terms correct. They must include the x.	
	For part (c) they must have at most 2 non-zero roots of their f(x) =0 to ft their 3 and their 5.	
(c)	1st B1 for correct shape (i.e. from bottom left to top right and two turning points.)	
	2nd B1f.t. for crossing at their 3 or their 5 indicated on graph or in text.	
	3rd B1f.t. if graph passes through (0, 0) [needn't be marked] and both their 3 and their 5.	

Question number	Scheme		Marks
10.(a)	$f(x) = \frac{2x^2}{2} + \frac{3x^{-1}}{-1} (+c)$	$-\frac{3}{x}$ is OK	M1A1
	$(3, 7\frac{1}{2})$ gives $\frac{15}{2} = 9 - \frac{3}{3} + c$	3^2 or 3^{-1} are OK instead of 9 or $\frac{1}{3}$	M1A1f.t.
	$c = -\frac{1}{2}$		A1 (5)
(b)	$f(-2) = 4 + \frac{3}{2} - \frac{1}{2}$ (*)		B1c.s.o. (1)
(c)	$m = -4 + \frac{3}{4}$, $= -3.25$		M1,A1
	Equation of tangent is: $y - 5 = -3.25(x + 2)$		M1
	<u>$4y + 13x + 6 = 0$</u>	o.e.	A1 (4)
			10
(a)	1st M1	for some attempt to integrate $x^n \to x^{n+1}$	
	1st A1	for both x terms as printed or better. Ignore $(+c)$ here.	
	2nd M1	for use of $(3, 7\frac{1}{2})$ or (-2, 5) to form an equation for c. There must be some correct substitution. No $+c$ is M0. Some changes in x terms of function needed.	
	2nd A1f.t.	for a correct equation for c. Follow through their integration. They must tidy up fraction/fraction and signs (e.g. - - to +).	
(b)	B1cso	If (-2, 5) is used to find c in (a) B0 here unless they verify f(3)=7.5.	
(c)	1st M1	for attempting $m = f'(\pm 2)$	
	1st A1	for $-\frac{13}{4}$ or -3.25	
	2nd M1	for attempting equation of tangent at (-2, 5), f.t. their m, based on $\frac{dy}{dx}$.	
	2nd A1	o.e. must have a, b and c integers and = 0.	
		Treat (a) and (b) together as a batch of 6 marks.	

Question number	Scheme	Marks
11.(a)	$m = \dfrac{8-2}{11+1} \quad (= \dfrac{1}{2})$	M1 A1
	$y - 2 = \dfrac{1}{2}(x - -1)$ or $y - 8 = \frac{1}{2}(x - 11)$ o.e.	M1
	$y = \dfrac{1}{2}x + \dfrac{5}{2}$ accept exact equivalents e.g. $\dfrac{6}{12}$	A1c.a.o. (4)
(b)	Gradient of $l_2 = -2$	M1
	Equation of l_2: $y - 0 = -2(x - 10)$ $[y = -2x + 20]$	M1
	$\dfrac{1}{2}x + \dfrac{5}{2} = -2x + 20$	M1
	$\underline{x = 7 \text{ and } y = 6}$ depend on all 3 Ms	A1, A1 (5)
(c)	$RS^2 = (10-7)^2 + (0-6)^2 (= 3^2 + 6^2)$	M1
	$RS = \sqrt{45} = 3\sqrt{5}$ (*)	A1c.s.o. (2)
(d)	$PQ = \sqrt{12^2 + 6^2}, = 6\sqrt{5}$ or $\sqrt{180}$ or $PS = 4\sqrt{5}$ and $SQ = 2\sqrt{5}$	M1,A1
	Area = $\dfrac{1}{2}PQ \times RS = \dfrac{1}{2}6\sqrt{5} \times 3\sqrt{5}$	dM1
	$\underline{= 45}$	A1 c.a.o. (4)
		15

(a)	1st M1	for attempting $\dfrac{y_1 - y_2}{x_1 - x_2}$, must be y over x. No formula condone one sign slip, but if formula is quoted then there must be some correct substitution.
	1st A1	for a fully correct expression, needn't be simplified.
	2nd M1	for attempting to find equation of l_1.
(b)	1st M1	for using the perpendicular gradient rule
	2nd M1	for attempting to find equation of l_2. Follow their gradient provided different.
	3rd M1	for forming a suitable equation to find *S*.
(c)	M1	for expression for *RS* or RS^2. Ft their *S* coordinates
(d)	1st M1	for expression for *PQ* or PQ^2. $PQ^2 = 12^2 + 6^2$ is M1 but $PQ = 12^2 + 6^2$ is M0 Allow one numerical slip.
	2nd dM1	for a full, correct attempt at area of triangle. Dependent on previous M1.

GENERAL PRINCIPLES FOR C1 MARKING

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1. Factorisation

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$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to $x = \ldots$

2. Formula

Attempt to use correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm p)^2 \pm q \pm c$, $p \neq 0$, $q \neq 0$, leading to $x = \ldots$

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Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

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Mark Scheme (Results)

January 2007

GCE

GCE Mathematics

Core Mathematics C1 (6663)

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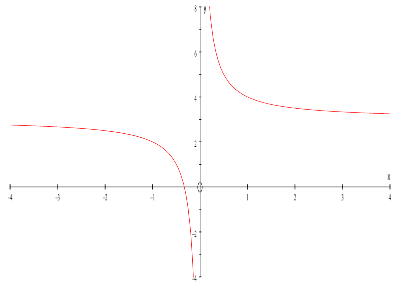
January 2007
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks
1.	$4x^3 \to kx^2$ or $2x^{\frac{1}{2}} \to kx^{-\frac{1}{2}}$ (k a non-zero constant)	M1
	$12x^2, + x^{-\frac{1}{2}}\ldots\ldots,$ $(-1 \to 0)$	A1, A1, B1 (4)
		4
	Accept equivalent alternatives to $x^{-\frac{1}{2}}$, e.g. $\frac{1}{x^{1/2}}$, $\frac{1}{\sqrt{x}}$, $x^{-0.5}$. M1: $4x^3$ 'differentiated' to give kx^2, or… $2x^{\frac{1}{2}}$ 'differentiated' to give $kx^{-\frac{1}{2}}$ (but not for just $-1 \to 0$). 1st A1: $12x^2$ (Do not allow just $3 \times 4x^2$) 2nd A1: $x^{-\frac{1}{2}}$ or equivalent. (Do not allow just $\frac{1}{2} \times 2x^{-\frac{1}{2}}$, but allow $1x^{-\frac{1}{2}}$ or $\frac{2}{2}x^{-\frac{1}{2}}$). B1: -1 differentiated to give zero (or 'disappearing'). Can be given provided that at least one of the other terms has been changed. Adding an extra term, e.g. + C, is B0.	

Question number	Scheme	Marks
2.	(a) $6\sqrt{3}$ $(a = 6)$	B1 (1)
	(b) Expanding $(2-\sqrt{3})^2$ to get 3 or 4 separate terms	M1
	$7,\ -4\sqrt{3}$ $(b = 7,\ c = -4)$	A1, A1 (3)
		4
	(a) $\pm 6\sqrt{3}$ also scores B1. (b) M1: The 3 or 4 terms may be wrong. 1st A1 for 7, 2nd A1 for $-4\sqrt{3}$. Correct answer $7-4\sqrt{3}$ with no working scores all 3 marks. $7+4\sqrt{3}$ with or without working scores M1 A1 A0. Other wrong answers with no working score no marks.	

Question number	Scheme		Marks	
3.	(a) 	Shape of f(x)	B1	
		Moved up ↑	M1	
		Asymptotes: $y = 3$	B1	
		$x = 0$ (Allow “y-axis”)	B1	(4)
		($y \neq 3$ is B0, $x \neq 0$ is B0).		
	(b) $\frac{1}{x} + 3 = 0$	No variations accepted.	M1	
	$x = -\frac{1}{3}$ (or $-0.33\ldots$)	Decimal answer requires at least 2 d.p.	A1	(2)
				6

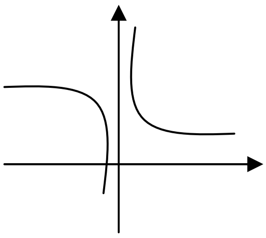
(a) B1: Shape requires both branches and no obvious “overlap” with the asymptotes (see below), but otherwise this mark is awarded generously. The curve may, e.g., bend away from the asymptote a little at the end. Sufficient curve must be seen to suggest the asymptotic behaviour, both horizontal and vertical.

M1: Evidence of an upward translation parallel to the y-axis. The shape of the graph can be wrong, but the complete graph (both branches if they have 2 branches) must be translated upwards. This mark can be awarded generously by implication where the graph drawn is an upward translation of another standard curve (but <u>not</u> a straight line).

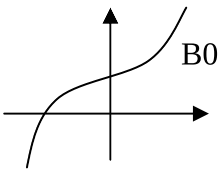
The B marks for asymptote equations are independent of the graph.

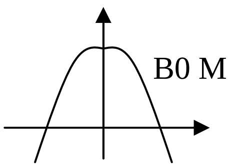
Ignore extra asymptote equations, if seen.

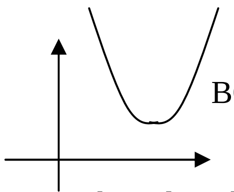
(b) Correct answer with no working scores both marks.
The answer may be seen on the sketch in part (a).
Ignore any attempts to find an intersection with the y-axis.

e.g. 

(a) This scores B0 (<u>clear</u> overlap with horiz. asymp.)
M1 (Upward translation… bod that both branches have been translated).

 B0 M1

 B0 M1

 B0 M0

No marks unless the original curve is seen, to show upward translation.

Question number	Scheme				Marks
4.	$(x-2)^2 = x^2 - 4x + 4$	or	$(y+2)^2 = y^2 + 4y + 4$	M: 3 or 4 terms	M1
	$(x-2)^2 + x^2 = 10$	or	$y^2 + (y+2)^2 = 10$	M: Substitute	M1
	$2x^2 - 4x - 6 = 0$	or	$2y^2 + 4y - 6 = 0$	Correct 3 terms	A1
	$(x-3)(x+1) = 0, \quad x = ...$	or	$(y+3)(y-1) = 0, \quad y = ...$		M1
	(The above factorisations may also appear as $(2x-6)(x+1)$ or equivalent).				
	$x = 3 \quad x = -1$	or	$y = -3 \quad y = 1$		A1
	$y = 1 \quad y = -3$	or	$x = -1 \quad x = 3$		M1 A1 (7)
	(Allow equivalent fractions such as: $x = \frac{6}{2}$ for $x = 3$).				
					7

1st M: 'Squaring a bracket', needs 3 or 4 terms, one of which must be an x^2 or y^2 term.

2nd M: Substituting to get an equation in one variable (awarded generously).

1st A: Accept equivalent forms, e.g. $2x^2 - 4x = 6$.

3rd M: Attempting to solve a 3-term quadratic, to get 2 solutions.

4th M: Attempting at least one *y* value (or *x* value).

If *y* solutions are given as *x* values, or vice-versa, penalise at the end, so that it is possible to score M1 M1A1 M1 A1 M0 A0.

Strict "pairing of values" at the end is <u>not</u> required.

<u>"Non-algebraic" solutions:</u>

No working, and only one correct solution pair found (e.g. $x = 3$, $y = 1$):
M0 M0 A0 M0 A0 M1 A0

No working, and both correct solution pairs found, but not demonstrated:
M0 M0 A0 M1 A1 M1 A1

Both correct solution pairs found, and demonstrated, perhaps in a table of values:
Full marks

<u>Squaring individual terms:</u> e.g.

$y^2 = x^2 + 4$		M0	
$x^2 + 4 + x^2 = 10$		M1 A0	(Eqn. in one variable)
$x = \sqrt{3}$		M0 A0	(Not solving 3-term quad.)
$y^2 = x^2 + 4 = 7$	$y = \sqrt{7}$	M1 A0	(Attempting one *y* value)

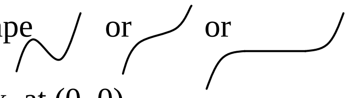
Question number	Scheme	Marks	
5.	Use of $b^2 - 4ac$, perhaps implicit (e.g. in quadratic formula)	M1	
	$(-3)^2 - 4\times 2\times -(k+1) < 0$ $\qquad\left(9 + 8(k+1) < 0\right)$	A1	
	$8k < -17$ (Manipulate to get $pk < q$, or $pk > q$, or $pk = q$)	M1	
	$k < -\frac{17}{8}$ $\qquad\left(\text{Or equiv}: k < -2\frac{1}{8} \text{ or } k < -2.125\right)$	A1cso	(4)
			4
	1st M: Could also be, for example, comparing or equating b^2 and $4ac$. Must be considering the given quadratic equation. There must not be x terms in the expression, but there must be a k term. 1st A: Correct expression (need not be simplified) and correct inequality sign. Allow also $-3^2 - 4\times 2\times -(k+1) < 0$. 2nd M: Condone sign or bracketing mistakes in manipulation. Not dependent on 1st M, but should not be given for irrelevant work. M0 M1 could be scored: e.g. where $b^2 + 4ac$ is used instead of $b^2 - 4ac$. Special cases: 1. Where there are x terms in the discriminant expression, but then division by x^2 gives an inequality/equation in k. (This could score M0 A0 M1 A1). 2. Use of ≤ instead of < loses one A mark only, at first occurrence, so an otherwise correct solution leading to $k \le -\frac{17}{8}$ scores M1 A0 M1 A1. N.B. Use of $b = 3$ instead of $b = -3$ implies no A marks.		

Question number	Scheme	Marks
6.	(a) $(4+3\sqrt{x})(4+3\sqrt{x})$ seen, or a numerical value of k seen, $(k \neq 0)$. (The k value need not be explicitly stated… see below). $16+24\sqrt{x}+9x$, or $k = 24$ (b) $16 \to cx$ or $kx^{1/2} \to cx^{3/2}$ or $9x \to cx^2$ $\int(16+24\sqrt{x}+9x)\,dx = 16x + \frac{9x^2}{2} + C,\ +16x^{3/2}$	M1 A1cso (2) M1 A1, A1ft (3) **5**
	(a) e.g. $(4+3\sqrt{x})(4+3\sqrt{x})$ alone scores M1 A0, (but <u>not</u> $(4+3\sqrt{x})^2$ alone). e.g $16+12\sqrt{x}+9x$ scores M1 A0. k = 24 or $16+24\sqrt{x}+9x$,with no further evidence, scores full marks M1 A1. Correct solution only (cso): any wrong working seen loses the A mark. (b) A1: $16x+\frac{9x^2}{2}+C$. Allow 4.5 or $4\frac{1}{2}$ as equivalent to $\frac{9}{2}$. A1ft: $\frac{2k}{3}x^{3/2}$ (candidate's value of k, or general k). For this final mark, allow for example $\frac{48}{3}$ as equivalent to 16, but do <u>not</u> allow unsimplified "double fractions" such as $\frac{24}{\left(3/2\right)}$, and do <u>not</u> allow unsimplified "products" such as $\frac{2}{3}\times 24$. A single term is required, e.g. $8x^{3/2}+8x^{3/2}$ is not enough. An otherwise correct solution with, say, C missing, followed by an incorrect solution including + C can be awarded full marks (isw, but allowing the C to appear at any stage).	

Question number	Scheme	Marks	
7.	(a) $3x^2 \to cx^3$ or $-6 \to cx$ or $-8x^{-2} \to cx^{-1}$	M1	
	$\mathrm{f}(x) = \frac{3x^3}{3} - 6x - \frac{8x^{-1}}{-1}$ $(+C)$ $\left(x^3 - 6x + \frac{8}{x}\right)$	A1 A1	
	Substitute $x = 2$ <u>and</u> $y = 1$ into a 'changed function' to form an equation in C.	M1	
	$1 = 8 - 12 + 4 + C$ $C = 1$	A1cso	(5)
	(b) $3 \times 2^2 - 6 - \frac{8}{2^2}$	M1	
	$= 4$	A1	
	Eqn. of tangent: $y - 1 = 4(x - 2)$	M1	
	$y = 4x - 7$ (Must be in this form)	A1	(4)
			9
	(a) First 2 A marks: + C is not required, and coefficients need <u>not</u> be simplified, but powers must be simplified. All 3 terms correct: A1 A1 Two terms correct: A1 A0 Only one term correct: A0 A0 Allow the M1 A1 for finding C to be scored either in part (a) or in part (b). (b) 1st M: Substituting $x = 2$ into $3x^2 - 6 - \frac{8}{x^2}$ (must be this function). 2nd M: Awarded generously for attempting the equation of a straight line through (2, 1) or (1, 2) with any value of m, however found. 2nd M: Alternative is to use (2, 1) or (1, 2) in $y = mx + c$ to <u>find a value</u> for c. If calculation for the gradient value is seen in part (a), it must be <u>used</u> in part (b) to score the first M1 A1 in (b). <u>Using (1, 2) instead of (2, 1)</u>: Loses the 2nd method mark in (a). Gains the 2nd method mark in (b).		

Question number	Scheme	Marks
8.	(a) $4x \to k$ or $3x^{3/2} \to kx^{1/2}$ or $-2x^2 \to kx$	M1
	$\frac{dy}{dx} = 4 + \frac{9}{2}x^{1/2} - 4x$	A1 A1 (3)
	(b) For $x = 4$, $y = (4\times 4) + (3\times 4\sqrt{4}) - (2\times 16) = 16 + 24 - 32 = 8$ (*)	B1 (1)
	(c) $\frac{dy}{dx} = 4 + 9 - 16 = -3$ M: Evaluate their $\frac{dy}{dx}$ at $x = 4$	M1
	Gradient of normal = $\frac{1}{3}$	A1ft
	Equation of normal: $y - 8 = \frac{1}{3}(x - 4)$, $3y = x + 20$ (*)	M1, A1 (4)
	(d) $y = 0$: $x = ...$ (-20) and use $(x_2 - x_1)^2 + (y_2 - y_1)^2$	M1
	$PQ = \sqrt{24^2 + 8^2}$ or $PQ^2 = 24^2 + 8^2$ Follow through from (k, 0) May also be scored with $(-24)^2$ and $(-8)^2$.	A1ft
	$= 8\sqrt{10}$	A1 (3)
		11
	(a) For the 2 A marks coefficients need <u>not</u> be simplified, but powers must be simplified. For example, $\frac{3}{2}\times 3x^{1/2}$ is acceptable. All 3 terms correct: A1 A1 Two terms correct: A1 A0 Only one term correct: A0 A0 (b) There must be some evidence of the "24" value. (c) In this part, beware 'working backwards' from the given answer. A1ft: Follow through is just from the candidate's <u>value</u> of $\frac{dy}{dx}$. 2nd M: Is not given if an m value appears "from nowhere". 2nd M: Must be an attempt at a <u>normal</u> equation, not a tangent. 2nd M: Alternative is to use (4, 8) in $y = mx + c$ to <u>find a value</u> for c. (d) M: Using the normal equation to attempt coordinates of Q, (even if using $x = 0$ instead of $y = 0$), <u>and</u> using Pythagoras to attempt PQ or PQ^2. Follow through from (k, 0), but <u>not</u> from (0, k)… A common wrong answer is to use $x = 0$ to give $\frac{20}{3}$. This scores M1 A0 A0. For final answer, accept other simplifications of √640, e.g. 2√160 or 4√40.	

Question number	Scheme	Marks
9.	(a) Recognising arithmetic series with first term 4 and common difference 3. (If not scored here, this mark may be given if seen elsewhere in the solution). $a+(n-1)d = 4+3(n-1) \quad (= 3n+1)$	B1 M1 A1 (3)
	(b) $S_n = \frac{n}{2}\{2a+(n-1)d\} = \frac{10}{2}\{8+(10-1)\times 3\}, \quad = 175$,	M1 A1, A1 (3)
	(c) $S_k < 1750: \frac{k}{2}\{8+3(k-1)\} < 1750 \left(\text{or } S_{k+1} > 1750: \frac{k+1}{2}\{8+3k\} > 1750\right)$	M1
	$3k^2 + 5k - 3500 < 0 \ \left(\text{or } 3k^2 + 11k - 3492 > 0\right)$ (Allow equivalent 3-term versions such as $3k^2+5k=3500$).	M1 A1
	$(3k-100)(k+35) < 0$ Requires use of correct inequality throughout.(*)	A1cso (4)
	(d) $\frac{100}{3}$ or equiv. <u>seen</u> $\left(\text{or } \frac{97}{3}\right)$, $k = 33$ (and no other values)	M1, A1 (2)
		12
	(a) B1: Usually identified by $a = 4$ and $d = 3$. M1: Attempted use of term formula for arithmetic series, or… answer in the form ($3n$ + constant), where the constant is a non-zero value. Answer for (a) does not require simplification, and a correct answer without working scores all 3 marks. (b) M1: Use of correct sum formula with n = 9, 10 or 11. A1: Correct, perhaps unsimplified, numerical version. A1: 175 <u>Alternative</u>: (Listing and summing terms). M1: Summing 9, 10 or 11 terms. (At least 1st, 2nd and last terms must be seen). A1: Correct terms (perhaps implied by last term 31). A1: 175 <u>Alternative</u>: (Listing all sums) M1: Listing 9, 10 or 11 sums. (At least 4, 7, ….., "*last*"). A1: Correct sums, correct finishing value 175. A1: 175 <u>Alternative</u>: (Using last term). M1: Using $S_n = \frac{n}{2}(a+l)$ with T_9, T_{10} or T_{11} as the last term. A1: Correct numerical version $\frac{10}{2}(4+31)$. A1: 175 Correct answer with <u>no</u> working scores 1 mark: 1,0,0. (c) For the first 3 marks, allow <u>any inequality sign</u>, or <u>equals.</u> 1st M: Use of correct sum formula to form inequality or equation in k, with the 1750. 2nd M: (Dependent on 1st M). Form 3-term quadratic in k. 1st A: Correct 3 terms. Allow credit for part (c) if valid work is seen in part (d). (d) Allow both marks for k = 33 seen without working. Working for part (d) must be seen in part (d), not part (c).	

Question number	Scheme		Marks	
10.	(a) 	(i) Shape 	B1	
		Max. at (0, 0).	B1	
		(2, 0), (or 2 shown on x-axis).	B1	(3)
		(ii) Shape 	B1	
		(It need not go below x-axis)		
		Through origin.	B1	
		(6, 0), (or 6 shown on x-axis).	B1	(3)
	(b) $x^2(x-2) = x(6-x)$		M1	
	$x^3 - x^2 - 6x = 0$	Expand to form 3-term cubic (or 3-term quadratic if divided by x), with all terms on one side. The "= 0" may be implied.	M1	
	$x(x-3)(x+2) = 0$ $\quad x = ...$	Factor x (or divide by x), and solve quadratic.	M1	
	$x = 3$ and $x = -2$		A1	
	$x = -2$: $\quad y = -16$	Attempt y value for a non-zero x value by substituting back into $x^2(x-2)$ or $x(6-x)$.	M1	
	$x = 3$: $\quad y = 9$	Both y values are needed for A1.	A1	
	$(-2, -16)$ and $(3, 9)$			
	(0, 0)	This can just be written down. Ignore any 'method' shown. (But must be seen in part (b)).	B1	(7) **13**
	(a) (i) For the third 'shape' shown above, where a section of the graph coincides with the x-axis, the B1 for (2, 0) can still be awarded if the 2 is shown on the x-axis. For the final B1 in (i), and similarly for (6, 0) in (ii): There must be a sketch. If, for example (2, 0) is written <u>separately</u> from the sketch, the sketch must not clearly contradict this. If (0, 2) instead of (2, 0) is shown <u>on the sketch</u>, allow the mark. Ignore extra intersections with the x-axis. (ii) 2^{nd} B is dependent on 1^{st} B. Separate sketches can score all marks. (b) Note the dependence of the first three M marks. A common wrong solution is (-2, 0), (3, 0), (0, 0), which scores M0 A0 B1 as the last 3 marks. A solution using <u>no</u> algebra (e.g. trial and error), can score up to 3 marks: M0 M0 M0 A0 M1 A1 B1. (The final A1 requires both y values). Also, if the cubic is found but not solved algebraically, up to 5 marks: M1 M1 M0 A0 M1 A1 B1. (The final A1 requires both y values).			

GENERAL PRINCIPLES FOR C1 MARKING

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to $x = \ldots$

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to $x = \ldots$

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm p)^2 \pm q \pm c$, $p \neq 0$, $q \neq 0$, leading to $x = \ldots$

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Misreads

(See the next sheet for a simple example).
A misread must be consistent for the whole question to be interpreted as such.
These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).
Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.

MISREADS

Question 7. $3x^2$ misread as $3x^3$

(a) $\mathrm{f}(x) = \dfrac{3x^4}{4} - 6x - \dfrac{8x^{-1}}{-1}$	M1 A1 A0
$1 = 12 - 12 + 4 + C \qquad C = -3$	M1 A0
(b) $m = 3 \times 2^3 - 6 - \dfrac{8}{2^2} = 16$	M1 A1
Eqn. of tangent: $y - 1 = 16(x - 2)$	M1
$y = 16x - 31$	A1

Mark Scheme (Results)

Summer 2007

GCE

GCE Mathematics

Core Mathematics C1 (6663)

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June 2007
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks
1.	$9-5$ or $3^2+3\sqrt{5}-3\sqrt{5}-\sqrt{5}\times\sqrt{5}$ or $3^2-\sqrt{5}\times\sqrt{5}$ or $3^2-\left(\sqrt{5}\right)^2$	M1
	$= \underline{4}$	A1cso (2)
		2
	M1 for an attempt to multiply out. There must be at least 3 correct terms. Allow one sign slip only, no arithmetic errors. e.g. $3^2+3\sqrt{5}-3\sqrt{5}+\left(\sqrt{5}\right)^2$ is M1A0 $3^2+3\sqrt{5}+3\sqrt{5}-\left(\sqrt{5}\right)^2$ is M1A0 as indeed is $9\pm6\sqrt{5}-5$ BUT $9+\sqrt{15}-\sqrt{15}-5(=4)$ is M0A0 since there is more than a sign error. $6+3\sqrt{5}-3\sqrt{5}-5$ is M0A0 since there is an arithmetic error. If all you see is 9 ± 5 that is M1 but please check it has not come from incorrect working. Expansion of $\left(3+\sqrt{5}\right)\left(3+\sqrt{5}\right)$ is M0A0 A1cso for 4 only. Please check that no incorrect working is seen. Correct answer only scores both marks.	

Question number	Scheme		Marks	
2.	(a) Attempt $\sqrt[3]{8}$ or $\sqrt[3]{(8^4)}$		M1	
	= <u>16</u>		A1	(2)
	(b) $\underline{5x^{\frac{1}{3}}}$	$5,\ x^{\frac{1}{3}}$	B1, B1	(2)
				4

(a) M1 for: 2 (on its own) or $\left(2^3\right)^{\frac{4}{3}}$ or $\sqrt[3]{8}$ or $\left(\sqrt[3]{8}\right)^4$ or 2^4 or $\sqrt[3]{8^4}$ or $\sqrt[3]{4096}$

8^3 or 512 or $(4096)^{\frac{1}{3}}$ is M0

A1 for 16 only

(b) 1st B1 for 5 on its own or $\times$ something.

So e.g. $\frac{5x^{\frac{4}{3}}}{x}$ is B1 But $5^{\frac{1}{3}}$ is B0

An expression showing cancelling is not sufficient

(see first expression of QC0184500123945 the mark is scored for the second expression)

2nd B1 for $x^{\frac{1}{3}}$

Can use ISW (incorrect subsequent working)

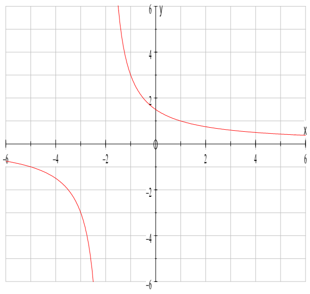
e.g $5x^{\frac{4}{3}}$ scores B1B0 but it may lead to $\sqrt[3]{5x^4}$ which we ignore as ISW.

Correct answers only score full marks in both parts.

Question number	Scheme	Marks
3.	(a) $\left(\frac{dy}{dx}\right) = \underline{6x^1 + \frac{4}{2}x^{-\frac{1}{2}}}$ or $\left(6x + 2x^{-\frac{1}{2}}\right)$	M1 A1 (2)
	(b) $\underline{6 + -x^{-\frac{3}{2}}}$ or $\underline{6 + -1 \times x^{-\frac{3}{2}}}$	M1 A1ft (2)
	(c) $\underline{x^3 + \frac{8}{3}x^{\frac{3}{2}} + C}$ A1: $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ A1: both, simplified and + *C*	M1 A1 A1 (3)
		7

(a)	M1	for <u>some</u> attempt to differentiate: $x^n \to x^{n-1}$ Condone missing $\frac{dy}{dx}$ or $y = \ldots$
	A1	for both terms correct, as written or better. No + *C* here. Of course $\frac{2}{\sqrt{x}}$ is acceptable.
(b)	M1	for some attempt to differentiate again. Follow through their $\frac{dy}{dx}$, at least one term correct or correct follow through.
	A1f.t.	as written or better, follow through must have 2 <u>distinct</u> terms and simplified e.g. $\frac{4}{4} = 1$.
(c)	M1	for some attempt to integrate: $x^n \to x^{n+1}$. Condone misreading $\frac{dy}{dx}$ or $\frac{d^2y}{dx^2}$ for *y*. (+*C* alone is not sufficient)
	1st A1	for either $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ (or better) $\frac{2}{3} \times 4x^{\frac{3}{2}}$ is OK here too but not for 2nd A1.
	2nd A1	for <u>both</u> x^3 and $\frac{8}{3}x^{\frac{3}{2}}$ or $\frac{8}{3}x\sqrt{x}$ i.e. simplified terms <u>and</u> +*C* all on one line. $2\frac{2}{3}$ instead of $\frac{8}{3}$ is OK

Question number	Scheme	Marks
4.	(a) Identify a = 5 and d = 2 (May be implied)	B1
	$(u_{200} =) a + (200-1)d$ (= 5 + (200 – 1)×2)	M1
	= <u>403</u>(p) or (£) <u>4.03</u>	A1 (3)
	(b) $(S_{200} =) \frac{200}{2}[2a + (200-1)d]$ or $\frac{200}{2}(a + \text{"their 403"})$	M1
	$= \frac{200}{2}[2\times5 + (200-1)\times2]$ or $\frac{200}{2}(5 + \text{"their 403"})$	A1
	= <u>40 800</u> or <u>£408</u>	A1 (3)
		6
(a)	B1 can be implied if the correct answer is obtained. If 403 is <u>not</u> obtained then the values of a and d must be clearly identified as a = 5 and d = 2. **This mark can be awarded at any point.** M1 for attempt to use nth term formula with n = 200. Follow through their a and d. Must have use of n = 200 and one of a or d correct or correct follow through. Must be 199 not 200. A1 for 403 or 4.03 (i.e. condone missing £ sign here). Condone £403 here.	
N.B.	a = 3, d = 2 is B0 and a + 200d is M0 <u>BUT</u> $3 + 200\times2$ is B1M1 and A1 if it leads to 403. Answer only of 403 (or 4.03) scores 3/3.	
(b)	M1 for use of correct sum formula with n = 200. Follow through their a and d and their 403. Must have <u>some</u> use of n = 200,and some of a, d or l correct or correct follow through. 1st A1 for any correct expression (i.e. must have a = 5 and d = 2) but can f.t. their 403 still. 2nd A1 for 40800 or £408 (i.e. the £ sign is required before we accept 408 this time). 40800p is fine for A1 but £40800 is A0.	
ALT	<u>Listing</u>	
(a)	They might score B1 if a =5 and d = 2 are clearly identified. Then award M1A1 together for 403.	
(b)	$\sum_{r=1}^{200}(2r+3)$. Give M1 for $2\times\frac{200}{2}\times(201) + 3k$ (with k >1), A1 for k = 200 and A1 for 40800.	

Question number	Scheme	Marks	
5.	(a) 		
	Translation parallel to x-axis	M1	
	Top branch intersects +ve y-axis; Lower branch has no intersections; No obvious overlap	A1	
	$\left(0, \frac{3}{2}\right)$ or $\frac{3}{2}$ marked on y- axis	B1	(3)
	(b) $x = -2, \quad y = 0$	B1, B1	(2)
S.C.	[Allow ft on first B1 for $x = 2$ when translated "the wrong way" but must be compatible with their sketch.]		
			5

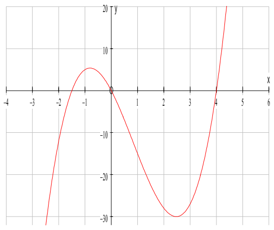
(a)	M1 for a horizontal translation – two branches with one branch cutting y – axis only. If one of the branches cuts both axes (translation up and across) this is M0. A1 for a horizontal translation to left. Ignore any figures on axes for this mark. B1 for correct intersection on positive y-axis. More than 1 intersection is B0. x=0 and y = 1.5 in a table alone is insufficient unless intersection of their sketch is with +ve y-axis. A point marked on the graph overrides a point given elsewhere.
(b)	1st B1 for $x = -2$. NB $x \neq -2$ is B0. Can accept x = +2 if this is compatible with their sketch. Usually they will have M1A0 in part (a) (and usually B0 too) 2nd B1 for y = 0.
S.C.	If x = -2 and y =0 and some other asymptotes are also given award B1B0 The asymptote equations should be clearly stated in part (b). Simply marking x =-2 or y =0 on the sketch is insufficient <u>unless</u> they are clearly marked "asymptote x = -2" etc.

Question number	Scheme	Marks
6.	(a) $2x^2 - x(x-4) = 8$	M1
	$x^2 + 4x - 8 = 0$ (*)	A1cso (2)
	(b) $x = \dfrac{-4 \pm \sqrt{4^2 - (4\times 1\times -8)}}{2}$ or $(x+2)^2 \pm 4 - 8 = 0$	M1
	$x =$ - 2 $\pm$ (any correct expression)	A1
	$\sqrt{48} = \sqrt{16}\sqrt{3} = 4\sqrt{3}$ or $\sqrt{12} = \sqrt{4}\sqrt{3} = 2\sqrt{3}$	B1
	$y = (-2 \pm 2\sqrt{3}) - 4$ M: Attempt at least one y value	M1
	$\underline{x = -2 + 2\sqrt{3},\quad y = -6 + 2\sqrt{3}}$ $\underline{x = -2 - 2\sqrt{3},\quad y = -6 - 2\sqrt{3}}$	A1 (5)
		7
(a)	M1 for correct attempt to form an equation in x only. Condone sign errors/slips but attempt at this line must be seen. E.g. $2x^2 - x^2 \pm 4x = 8$ is OK for M1. A1cso for correctly simplifying to printed form. No incorrect working seen. The = 0 is required. **These two marks can be scored in part (b). For multiple attempts pick best.**	
(b)	1st M1 for use of correct formula. If formula is not quoted then a fully correct substitution is required. Condone missing x = or just + or – instead of $\pm$ for M1. For completing the square must have as printed or better. If they have $x^2 - 4x - 8 = 0$ then M1 can be given for $(x-2)^2 \pm 4 - 8 = 0$. 1st A1 for -2 $\pm$ any correct expression. (The $\pm$ is required but x = is not) B1 for simplifying the surd e.g. $\sqrt{48} = 4\sqrt{3}$. Must reduce to $b\sqrt{3}$ so $\sqrt{16}\sqrt{3}$ or $\sqrt{4}\sqrt{3}$ are OK. 2nd M1 for attempting to find at least one y value. Substitution into one of the given equations and an attempt to solve for y. 2nd A1 for correct y answers. Pairings need not be explicit but they must say which is x and which y. Mis-labelling x and y loses final A1 only.	

Question number	Scheme	Marks
7.	(a) Attempt to use discriminant b^2-4ac	M1
	$k^2-4(k+3)>0 \;\Rightarrow\; k^2-4k-12>0$ (*)	A1cso (2)
	(b) $k^2-4k-12=0 \;\Rightarrow$	
	$(k\pm a)(k\pm b)$, with $ab=12$ or $(k=)\dfrac{4\pm\sqrt{4^2--4\times12}}{2}$ or $(k-2)^2\pm2^2-12$	M1
	$k=-2$ and 6 (both)	A1
	$\underline{k<-2,\;\; k>6}$ or $\underline{(-\infty,-2);(6,\infty)}$ M: choosing "outside"	M1 A1ft (4)
		6
(a)	M1 for use of b^2-4ac, one of b or c must be correct. Or full attempt using completing the square that leads to a 3TQ in k e.g. $\left(\left[x+\frac{k}{2}\right]^2=\right)\frac{k^2}{4}-(k+3)$ A1cso Correct argument to printed result. Need to state (or imply) that $b^2-4ac>0$ and no incorrect working seen. Must have >0. If > 0 just appears with $k^2-4(k+3)>0$ that is OK. If >0 appears on last line only with no explanation give A0. b^2-4ac followed by $k^2-4k-12>0$ only is insufficient so M0A0 e.g. $k^2-4\times1\times k+3$ (missing brackets) can get M1A0 but $k^2+4(k+3)$ is M0A0 (wrong formula) Using $\sqrt{b^2-4ac}>0$ is M0.	
(b)	1st M1 for attempting to find critical regions. Factors, formula or completing the square. 1st A1 for $k=6$ and -2 only 2nd M1 for choosing the outside regions 2nd A1f.t. as printed or f.t. their (non identical) critical values $6<k<-2$ is M1A0 but ignore if it follows a correct version $-2<k<6$ is M0A0 whatever their diagram looks like Condone use of x instead of k for critical values and final answers in (b). Treat this question as 3 two mark parts. If part (a) is seen in (b) or vice versa marks can be awarded.	

Question number	Scheme	Marks	
8.	(a) $(a_2 =)\underline{3k+5}$ [must be seen in part (a) or labelled $a_2 =$]	B1	(1)
	(b) $(a_3 =)3(3k+5)+5$	M1	
	$= \underline{9k + 20}$ (*)	A1cso	(2)
	(c)(i) $a_4 = 3(9k+20)+5$ $(= 27k+65)$	M1	
	$\sum_{r=1}^{4} a_r = k+(3k+5)+(9k+20)+(27k+65)$	M1	
	(ii) $= 40k + 90$	A1	
	$= \underline{10(4k + 9)}$ (or explain why divisible by 10)	A1ft	(4) **7**

(b)	M1 for attempting to find a_3, follow through their $a_2 \neq k$.
	A1cso for simplifying to printed result with no incorrect working seen.
(c)	1st M1 for attempting to find a_4. Can allow a slip here e.g. $3(9k + 20)$ [i.e. forgot +5]
	2nd M1 for attempting sum of 4 relevant terms, follow through their (a) and (b). Must have 4 terms starting with k. Use of arithmetic series formulae at this point is M0A0A0
	1st A1 for simplifying to $40k + 90$ or better
	2nd A1ft for taking out a factor of 10 or dividing by 10 or an explanation in words true $\forall k$. Follow through their sum of 4 terms provided that both Ms are scored and their sum <u>is</u> divisible by 10. A comment is <u>not</u> required. e.g. $\frac{40k+90}{10} = 4k+9$ is OK for this final A1.
S.C.	$\sum_{r=2}^{5} a_r = 120k + 290 = 10(12k + 29)$ can have M1M0A0A1ft.

Question number	Scheme	Marks
9.	(a) $f(x) = \frac{6x^3}{3} - \frac{10x^2}{2} - 12x\ (+C)$	M1 A1
	$x = 5$: $250 - 125 - 60 + C = 65$ $C = 0$	M1 A1 (4)
	(b) $x(2x^2 - 5x - 12)$ or $(2x^2 + 3x)(x - 4)$ or $(2x + 3)(x^2 - 4x)$	M1
	$= x(2x + 3)(x - 4)$ (*)	A1cso (2)
	(c) 	
	Shape	B1
	Through origin	B1
	$\left(-\frac{3}{2}, 0\right)$ and $(4,0)$	B1 (3)
		9
(a)	1st M1 for attempting to integrate, $x^n \to x^{n+1}$ 1st A1 for all x terms correct, need not be simplified. Ignore + C here. 2nd M1 for some use of x = 5 and f(5)=65 to form an equation in C based on their integration. There must be some visible attempt to use x = 5 and f(5)=65. No +C is M0. 2nd A1 for C = 0. This mark cannot be scored unless a suitable equation is seen.	
(b)	M1 for attempting to take out a correct factor or to verify. Allow usual errors on signs. They must get to the equivalent of one of the given partially factorised expressions or, if verifying, $x(2x^2 + 3x - 8x - 12)$ i.e. with no errors in signs. A1cso for proceeding to printed answer with no incorrect working seen. Comment not required. This mark is dependent upon a fully correct solution to part (a) so M1A1M0A0M1A0 for (a) & (b). Will be common or M1A1M1A0M1A0. To score 2 in (b) they must score 4 in (a).	
(c)	1st B1 for positive x^3 shaped curve (with a max and a min) positioned anywhere. 2nd B1 for any curve that passes through the origin (B0 if it only touches at the origin) 3rd B1 for the two points clearly given as coords or values marked in appropriate places on x axis. Ignore any extra crossing points (they should have lost first B1). Condone (1.5, 0) if clearly marked on –ve x-axis. Condone (0, 4) etc if marked on +ve x axis. Curve can stop (i.e. not pass through) at (-1.5, 0) and (4, 0). A point on the graph overrides coordinates given elsewhere.	

Question number	Scheme		Marks	
10.	(a) $x=1:\ y=-5+4=\underline{-1}$, $x=2:\ y=-16+2=\underline{-14}$	(can be given in (b) or (c))	1st B1 for – 1 2nd B1 for - 14	
	$PQ=\sqrt{(2-1)^2+(-14-(-1))^2}=\sqrt{170}$	(*)	M1 A1cso	(4)
	(b) $y=x^3-6x^2+4x^{-1}$		M1	
	$\frac{dy}{dx}=3x^2-12x-4x^{-2}$		M1 A1	
	$x=1:\ \frac{dy}{dx}=3-12-4=-13$	M: Evaluate at one of the points	M1	
	$x=2:\ \frac{dy}{dx}=12-24-1=-13$ $\therefore$ Parallel	A: Both correct + conclusion	A1	(5)
	(c) Finding gradient of normal $\left(m=\frac{1}{13}\right)$		M1	
	$y--1=\frac{1}{13}(x-1)$		M1 A1ft	
	$\underline{x-13y-14=0}$	o.e.	A1cso	(4)
				13

(a)	M1 for attempting PQ or PQ^2 using their P and their Q. Usual rules about quoting formulae. We must see attempt at $1^2+(y_P-y_Q)^2$ for M1. $PQ^2=\sqrt{\ldots}$ etc could be M1A0. A1cso for proceeding to the correct answer with no incorrect working seen.
(b)	1st M1 for multiplying by x^2, the x^3 or $-6x^2$ must be correct. 2nd M1 for some correct differentiation, at least one term must be correct as printed. 1st A1 for a fully correct derivative. **These 3 marks can be awarded anywhere when first seen.** 3rd M1 for attempting to substitute x = 1 or x = 2 in their derivative. Substituting in y is M0. 2nd A1 for -13 from both substitutions <u>and</u> a brief comment. The – 13 must come from their derivative.
(c)	1st M1 for use of the perpendicular gradient rule. Follow through their – 13. 2nd M1 for full method to find the equation of the normal or tangent at P. If formula is quoted allow slips in substitution, otherwise a correct substitution is required. 1st A1ft for a correct expression. Follow through their – 1 and their changed gradient. 2nd A1cso for a correct equation with = 0 and integer coefficients. This mark is dependent upon the – 13 coming from their derivative in (b) hence cso. Tangent can get M0M1A0A0, changed gradient can get M0M1A1A0orM1M1A1A0. Condone confusion over terminology of tangent and normal, mark gradient and equation.
MR	Allow for $-\frac{4}{x}$ or (x+6) but not omitting $4x^{-1}$ or treating it as 4x.

Question number	Scheme	Marks
11.	(a) $y = -\frac{3}{2}x(+4)$ Gradient $= -\frac{3}{2}$	M1 A1 (2)
	(b) $3x + 2 = -\frac{3}{2}x + 4$ $x = \ldots,\ \underline{\frac{4}{9}}$	M1, A1
	$y = 3\left(\frac{4}{9}\right) + 2 = \underline{\frac{10}{3}}\ \left(= 3\frac{1}{3}\right)$	A1 (3)
	(c) Where $y = 1$, $l_1 : x_A = -\frac{1}{3}$ $l_2 : x_B = 2$ M: Attempt one of these	M1 A1
	Area $= \frac{1}{2}(x_B - x_A)(y_P - 1)$	M1
	$= \frac{1}{2} \times \frac{7}{3} \times \frac{7}{3} = \underline{\frac{49}{18} = 2\frac{13}{18}}$ o.e.	A1 (4)
		9
(a)	M1 for an attempt to write $3x + 2y - 8 = 0$ in the form $y = mx + c$ or a full method that leads to $m =$, e.g find 2 points, and attempt gradient using $\frac{y_2 - y_1}{x_2 - x_1}$ e.g. finding $y = -1.5x + 4$ alone can score M1 (even if they go on to say $m = 4$) A1 for $m = -\frac{3}{2}$ (can ignore the $+c$) or $\frac{dy}{dx} = -\frac{3}{2}$	
(b)	M1 for forming a suitable equation in one variable and attempting to solve leading to x= ..or y= 1st A1 for any exact correct value for x 2nd A1 for any exact correct value for y (These 3 marks can be scored anywhere, they may treat (a) and (b) as a single part)	
(c)	1st M1 for attempting the x coordinate of A or B. One correct value seen scores M1. 1st A1 for $x_A = -\frac{1}{3}$ and $x_B = 2$ 2nd M1 for a full method for the area of the triangle – follow through their x_A, x_B, y_P. e.g. determinant approach $\frac{1}{2}\begin{vmatrix} 2 & -\frac{1}{3} & \frac{4}{9} & 2 \\ 1 & 1 & \frac{10}{3} & 1 \end{vmatrix} = \frac{1}{2}\left\|2 - \ldots - (-\frac{1}{3}\ldots)\right\|$ 2nd A1 for $\frac{49}{18}$ or an exact equivalent. All accuracy marks require answers as single fractions or mixed numbers not necessarily in lowest terms.	

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Mark Scheme (Results)

January 2008

GCE

GCE Mathematics (6663/01)

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January 2008
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks	
1.	$3x^2 \to kx^3$ or $4x^5 \to kx^6$ or $-7 \to kx$ (k a non-zero constant)	M1	
	$\frac{3x^3}{3}$ or $\frac{4x^6}{6}$ (Either of these, simplified or unsimplified)	A1	
	$x^3 + \frac{2x^6}{3} - 7x$ or equivalent unsimplified, such as $\frac{3x^3}{3} + \frac{4x^6}{6} - 7x^1$	A1	
	$+ C$ (or any other constant, e.g. $+ K$)	B1	(4)
			4
	M: Given for increasing by one the power of x in one of the three terms. A marks: 'Ignore subsequent working' after a correct unsimplified version of a term is seen. B: Allow the mark (independently) for an integration constant appearing at any stage (even if it appears, then disappears from the final answer). This B mark can be allowed even when no other marks are scored.		

Question number	Scheme	Marks	
2.	(a) 2	B1	(1)
	(b) x^9 seen, or $(\text{answer to (a)})^3$ seen, or $(2x^3)^3$ seen.	M1	
	$8x^9$	A1	(2)
			3
	(b) M: Look for x^9 first… if seen, this is M1. If not seen, look for $(\text{answer to (a)})^3$, e.g. 2^3… this would score M1 even if it does not subsequently become 8. (Similarly for other answers to (a)). In $(2x^3)^3$, the 2^3 is implied, so this scores the M mark. <u>Negative answers</u>: (a) Allow -2. Allow ± 2. Allow '2 or -2'. (b) Allow $\pm 8x^9$. Allow '$8x^9$ or $-8x^9$'. N.B. If part (a) is wrong, it is possible to 'restart' in part (b) and to score full marks in part (b).		

Question number	Scheme	Marks
3.	$\frac{(5-\sqrt{3})}{(2+\sqrt{3})}\times\frac{(2-\sqrt{3})}{(2-\sqrt{3})}$	M1
	$=\frac{10-2\sqrt{3}-5\sqrt{3}+(\sqrt{3})^2}{\ldots}$ $\left(=\frac{10-7\sqrt{3}+3}{\ldots}\right)$	M1
	$(=13-7\sqrt{3})$ $\left(\text{Allow } \frac{13-7\sqrt{3}}{1}\right)$ 13 (a = 13)	A1
	$-7\sqrt{3}$ (b = −7)	A1 (4)
		4
	1st M: Multiplying top and bottom by $(2-\sqrt{3})$. (As shown above is sufficient). 2nd M: Attempt to multiply out numerator $(5-\sqrt{3})(2-\sqrt{3})$. Must have at least 3 terms correct. Final answer: Although 'denominator = 1' may be implied, the $13-7\sqrt{3}$ must obviously be the final answer (not an intermediate step), to score full marks. (Also M0 M1 A1 A1 is not an option). The A marks cannot be scored unless the 1st M mark has been scored, but this 1st M mark could be implied by correct expansions of both numerator and denominator. It is possible to score M1 M0 A1 A0 or M1 M0 A0 A1 (after 2 correct terms in the numerator). Special case: If numerator is multiplied by $(2+\sqrt{3})$ instead of $(2-\sqrt{3})$, the 2nd M can still be scored for at least 3 of these terms correct: $10-2\sqrt{3}+5\sqrt{3}-(\sqrt{3})^2$. The maximum score in the special case is 1 mark: M0 M1 A0 A0. Answer only: Scores no marks. Alternative method: $5-\sqrt{3}=(a+b\sqrt{3})(2+\sqrt{3})$ $(a+b\sqrt{3})(2+\sqrt{3})=2a+a\sqrt{3}+2b\sqrt{3}+3$ M1: At least 3 terms correct. $5=2a+3b$ $-1=a+2b$ $a=\ldots$ or $b=\ldots$ M1: Form and attempt to solve simultaneous equations. a = 13, b = −7 A1, A1	

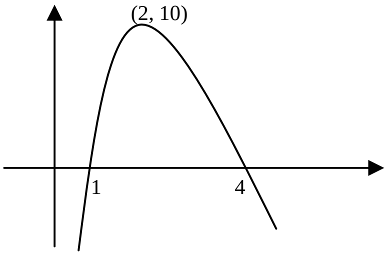
Question number	Scheme	Marks
4.	(a) $m = \frac{4-(-3)}{-6-8}$ or $\frac{-3-4}{8-(-6)}$, $= \frac{7}{-14}$ or $\frac{-7}{14}$ $\left(= -\frac{1}{2}\right)$	M1, A1
	Equation: $y - 4 = -\frac{1}{2}(x-(-6))$ or $y-(-3) = -\frac{1}{2}(x-8)$	M1
	$x + 2y - 2 = 0$ (or equiv. with <u>integer</u> coefficients… must have '= 0')	A1 (4)
	(e.g. $14y + 7x - 14 = 0$ and $14 - 7x - 14y = 0$ are acceptable)	
	(b) $(-6-8)^2 + (4-(-3))^2$	M1
	$14^2 + 7^2$ or $(-14)^2 + 7^2$ or $14^2 + (-7)^2$ (M1 A1 may be implied by 245)	A1
	$AB = \sqrt{14^2 + 7^2}$ or $\sqrt{7^2(2^2+1^2)}$ or $\sqrt{245}$	
	$7\sqrt{5}$	A1cso (3)
		7
	(a) 1st M: Attempt to use $m = \frac{y_2 - y_1}{x_2 - x_1}$ (may be implicit in an equation of L). 2nd M: Attempting straight line equation in any form, e.g $y - y_1 = m(x - x_1)$, $\frac{y - y_1}{x - x_1} = m$, with any value of m (except 0 or ∞) and either (–6, 4) or (8, –3). N.B. It is also possible to use a different point which lies on the line, such as the midpoint of AB (1, 0.5). Alternatively, the 2nd M may be scored by using $y = mx + c$ with a numerical gradient and substituting (–6, 4) or (8, –3) to find the value of c. Having coords the <u>wrong way round</u>, e.g. $y-(-6) = -\frac{1}{2}(x-4)$, loses the 2nd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$. (b) M: Attempting to use $(x_2 - x_1)^2 + (y_2 - y_1)^2$. <u>Missing bracket</u>, e.g. $-14^2 + 7^2$ implies M1 if no earlier version is seen. $-14^2 + 7^2$ with no further work would be M1 A0. $-14^2 + 7^2$ followed by 'recovery' can score full marks.	

Question number	Scheme	Marks
5.	(a) $\left(2x^{-\frac{1}{2}}+3x^{-1}\right)$ $\qquad p=-\frac{1}{2},\qquad q=-1$	B1, B1 (2)
	(b) $\left(y=5x-7+2x^{-\frac{1}{2}}+3x^{-1}\right)$	
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)$ $\quad 5\quad \left(\text{or}\quad 5x^0\right)$ $\qquad$ ($5x-7$ correctly differentiated)	B1
	Attempt to differentiate either $2x^p$ with a fractional *p*, giving kx^{p-1} $(k\neq 0)$, (the fraction *p* could be in decimal form) or $3x^q$ with a negative *q*, giving kx^{q-1} $(k\neq 0)$.	M1
	$\left(-\frac{1}{2}\times 2x^{-\frac{3}{2}}-1\times 3x^{-2}=\right)$ $\qquad -x^{-\frac{3}{2}},\ -3x^{-2}$	A1ft, A1ft (4)
		6
	(b): N.B. It is possible to 'start again' in (b), so the *p* and *q* may be different from those seen in (a), but note that the M mark is for the attempt to differentiate $\underline{\underline{2}}x^p$ or $\underline{\underline{3}}x^q$. However, marks for part (a) <u>cannot</u> be earned in part (b). 1st A1ft: ft their $2x^p$, but *p* must be a fraction and coefficient must be simplified (the fraction *p* could be in decimal form). 2nd A1ft: ft their $3x^q$, but *q* must be negative and coefficient must be simplified. 'Simplified' coefficient means $\frac{a}{b}$ where *a* and *b* are integers with no common factors. Only a single + or – sign is allowed (e.g. – – must be replaced by +). Having +*C* loses the B mark.	

Question number	Scheme	Marks	

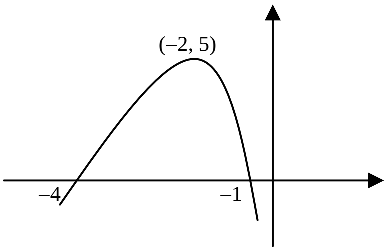
6.

(a)



Scheme	Marks	
Shape: Max in 1st quadrant and 2 intersections on positive x-axis	B1	
1 and 4 labelled (in correct place) or clearly stated as coordinates	B1	
(2, 10) labelled or clearly stated	B1	(3)

(b)



Scheme	Marks	
Shape: Max in 2nd quadrant and 2 intersections on negative x-axis	B1	
–1 and –4 labelled (in correct place) or clearly stated as coordinates	B1	
(–2, 5) labelled or clearly stated	B1	(3)

Scheme		Marks	
(c) $(a =)\ 2$	May be implicit, i.e. $\mathrm{f}(x+2)$	B1	(1)

Beware: The answer to part (c) may be seen on the first page.

7

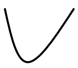
(a) and (b):

1st B: 'Shape' is generous, providing the conditions are satisfied.

2nd and 3rd B marks are dependent upon a sketch having been drawn.

2nd B marks: Allow (0, 1), etc. (coordinates the wrong way round) if the sketch is correct.

Points must be labelled correctly and be in appropriate place (e.g. (–2, 5) in the first quadrant is B0).

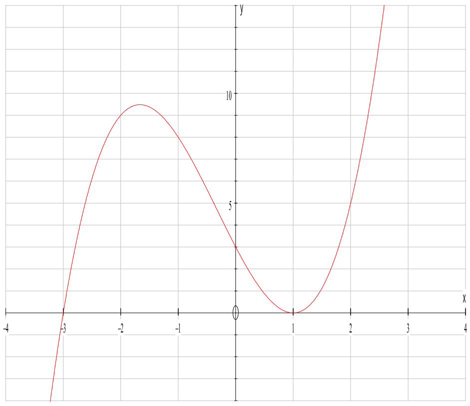
(b) Special case:
If the graph is reflected in the x-axis (instead of the y-axis), B1 B0 B0 can be scored. This requires shape and coordinates to be fully correct, i.e.
Shape:  Minimum in 4th quadrant and 2 intersections on positive x-axis,

1 and 4 labelled (in correct place) or clearly stated as coordinates,
(2, –5) labelled or clearly stated.

Question number	Scheme	Marks	
7.	(a) $1(p+1)$ or $p+1$	B1	(1)
	(b) $((a))(p+(a))$ [(a) must be a function of p]. $[(p+1)(p+p+1)]$	M1	
	$=1+3p+2p^2$ (*)	A1cso	(2)
	(c) $1+3p+2p^2=1$	M1	
	$p(2p+3)=0$ $p=...$	M1	
	$p=-\frac{3}{2}$ (ignore p = 0, if seen, even if 'chosen' as the answer)	A1	(3)
	(d) Noting that even terms are the same. This M mark can be implied by listing at least 4 terms, e.g. $1,\ -\frac{1}{2},\ 1,\ -\frac{1}{2},...$	M1	
	$x_{2008}=-\frac{1}{2}$	A1	(2)
			8
	(b) M: Valid attempt to use the given recurrence relation to find x_3. Missing brackets, e.g. $p+1(p+p+1)$ Condone for the M1, then if all terms in the expansion are correct, with working fully shown, M1 A1 is still allowed. Beware 'working back from the answer', e.g. $1+3p+2p^2=(1+p)(1+2p)$ scores no marks unless the recurrence relation is justified. (c) 2nd M: Attempt to solve a quadratic equation in p (e.g. quadratic formula or completing the square). The equation must be based on $x_3=1$. The attempt must lead to a non-zero solution, so just stating the zero solution p = 0 is M0. A: The A mark is dependent on both M marks. (d) M: Can be implied by a correct answer for their p (answer is p + 1), and can also be implied if the working is 'obscure'). Trivialising, e.g. p = 0, so every term = 1, is M0. If the additional answer $x_{2008}=1$ (from p = 0) is seen, ignore this (isw).		

Question number	Scheme	Marks
8.	(a) $x^2 + kx + (8-k)$ $(= 0)$ $8-k$ need not be bracketed	M1
	$b^2 - 4ac = k^2 - 4(8-k)$	M1
	$b^2 - 4ac < 0 \Rightarrow k^2 + 4k - 32 < 0$ (*)	A1cso (3)
	(b) $(k+8)(k-4) = 0$ $k = ...$	M1
	$k = -8$ $k = 4$	A1
	Choosing 'inside' region (between the two k values)	M1
	$-8 < k < 4$ or $4 > k > -8$	A1 (4)
		7
	(a) 1st M: Using the k from the right hand side to form 3-term quadratic in x ('= 0' can be implied), or… attempting to complete the square $\left(x+\frac{k}{2}\right)^2 - \frac{k^2}{4} + 8 - k \ (= 0)$ or equiv., using the k from the right hand side. For either approach, condone sign errors. 1st M may be implied when candidate moves straight to the discriminant. 2nd M: Dependent on the 1st M. Forming expressions in k (with no x's) by using b^2 and $4ac$. (Usually seen as the discriminant $b^2 - 4ac$, but separate expressions are fine, and also allow the use of $b^2 + 4ac$. (For 'completing the square' approach, the expression must be clearly separated from the equation in x). If b^2 and $4ac$ are used in the quadratic formula, they must be clearly separated from the formula to score this mark. For any approach, condone sign errors. If the wrong statement $\sqrt{b^2 - 4ac} < 0$ is seen, maximum score is M1 M1 A0. (b) Condone the use of x (instead of k) in part (b). 1st M: Attempt to solve a 3-term quadratic equation in k. It might be different from the given quadratic in part (a). Ignore the use of < in solving the equation. The 1st M1 A1 can be scored if –8 and 4 are achieved, even if stated as $k < -8,\ k < 4$. Allow the first M1 A1 to be scored in part (a). N.B. '$k > -8,\ k < 4$' scores 2nd M1 A0 '$k > -8$ or $k < 4$' scores 2nd M1 A0 '$k > -8$ and $k < 4$' scores 2nd M1 A1 '$k = -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3$' scores 2nd M0 A0 Use of ≤ (in the answer) loses the final mark.	

Question number	Scheme	Marks
9.	(a) $4x \to kx^2$ or $6\sqrt{x} \to kx^{3/2}$ or $\frac{8}{x^2} \to kx^{-1}$ (k a non-zero constant)	M1
	$f(x) = 2x^2,\ -4x^{3/2},\ -8x^{-1}$ (+ C) (+ C not required)	A1, A1, A1
	At $x = 4$, $y = 1$: $1 = (2\times 16) - \left(4\times 4^{3/2}\right) - \left(8\times 4^{-1}\right) + C$ <u>Must be in part (a)</u>	M1
	$C = 3$	A1 (6)
	(b) $f'(4) = 16 - (6\times 2) + \frac{8}{16} = \frac{9}{2}\ (= m)$ M: Attempt $f'(4)$ with the <u>given</u> f'. <u>Must be in part (b)</u>	M1
	Gradient of normal is $-\frac{2}{9}\left(= -\frac{1}{m}\right)$ M: Attempt perp. grad. rule. Dependent on the use of their $f'(x)$	M1
	Eqn. of normal: $y - 1 = -\frac{2}{9}(x - 4)$ (or any equiv. form, e.g. $\frac{y-1}{x-4} = -\frac{2}{9}$)	M1 A1 (4)
	Typical answers for A1: $\left(y = -\frac{2}{9}x + \frac{17}{9}\right)$ $(2x + 9y - 17 = 0)$ $(y = -0.\dot{2}x + 1.\dot{8})$	
	Final answer: gradient $-\frac{1}{\left(9/2\right)}$ or $-\frac{1}{4.5}$ is A0 (but all M marks are available).	
		10
	(a) The first 3 A marks are awarded in the order shown, and the terms must be simplified. 'Simplified' coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or – sign is allowed (e.g. + – must be replaced by –). 2nd M: Using $x = 4$ <u>and</u> $y = 1$ (<u>not</u> $y = 0$) to form an eqn in C. (No C is M0) (b) 2nd M: Dependent upon use of their $f'(x)$. 3rd M: eqn. of a straight line through (4, 1) with any gradient except 0 or ∞. <u>Alternative for 3rd M:</u> Using (4, 1) in $y = mx + c$ to <u>find a value</u> of c, but an equation (general or specific) must be seen. Having coords the <u>wrong way round</u>, e.g. $y - 4 = -\frac{2}{9}(x - 1)$, loses the 3rd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$. N.B. The A mark is scored for <u>any</u> form of the correct equation… be prepared to apply isw if necessary.	

Question number	Scheme	Marks
10.	(a) 	
	Shape  (drawn anywhere)	B1
	Minimum at (1, 0) (perhaps labelled 1 on x-axis)	B1
	$(-3, 0)$ (or -3 shown on –ve x-axis)	B1
	(0, 3) (or 3 shown on +ve y-axis)	B1 (4)
	N.B. The max. can be anywhere.	
	(b) $y = (x+3)(x^2-2x+1)$	M1
	$= x^3 + x^2 - 5x + 3$ $(k = 3)$ [Marks can be awarded if this is seen in part (a)]	A1cso (2)
	(c) $\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 + 2x - 5$	M1 A1
	$3x^2 + 2x - 5 = 3$ or $3x^2 + 2x - 8 = 0$	M1
	$(3x-4)(x+2) = 0$ $x = ...$	M1
	$x = \frac{4}{3}$ (or exact equiv.) , $x = -2$	A1, A1 (6)
		12
	(a) The individual marks are independent, <u>but</u> the 2nd, 3rd and 4th B's are dependent upon a sketch having been attempted. B marks for coordinates: Allow (0, 1), etc. (coordinates the wrong way round) <u>if</u> marked in the correct place on the sketch. (b) M: Attempt to multiply out $(x-1)^2$ and write as a product with $(x+3)$, or attempt to multiply out $(x+3)(x-1)$ and write as a product with $(x-1)$, or attempt to expand $(x+3)(x-1)(x-1)$ directly (at least 7 terms). The $(x-1)^2$ or $(x+3)(x-1)$ expansion must have 3 (or 4) terms, so should not, for example, be just x^2+1. A: It is not necessary to state explicitly 'k = 3'. Condone missing brackets if the intention seems clear and a fully correct expansion is seen. (c) 1st M: Attempt to differentiate (correct power of x in at least one term). 2nd M: Setting their derivative equal to 3. 3rd M: Attempt to solve a 3-term quadratic based on their derivative. The equation <u>could</u> come from $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$. N.B. After an incorrect k value in (b), full marks are still possible in (c).	

Question number	Scheme	Marks
11.	(a) $u_{25} = a + 24d = 30 + 24 \times (-1.5)$	M1
	$= -6$	A1 (2)
	(b) $a + (n-1)d = 30 - 1.5(r-1) = 0$	M1
	$r = 21$	A1 (2)
	(c) $S_{20} = \frac{20}{2}\{60 + 19(-1.5)\}$ or $S_{21} = \frac{21}{2}\{60 + 20(-1.5)\}$ or $S_{21} = \frac{21}{2}\{30 + 0\}$	M1 A1ft
	$= 315$	A1 (3)
		7
	(a) M: Substitution of $a = 30$ and $d = \pm 1.5$ into ($a + 24d$). Use of $a + 25d$ (or any other variations on 24) scores M0. (b) M: Attempting to use the term formula, equated to 0, to form an equation in r (with no other unknowns). Allow this to be called n instead of r. Here, being 'one off' (e.g. equivalent to $a + nd$), scores M1. (c) M: Attempting to use the correct sum formula to obtain S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r. 1st A(ft): A correct numerical expression for S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r …. but the ft is dependent on an integer value of r. Methods such as calculus to find a maximum only begin to score marks after establishing a value of r at which the maximum sum occurs. This value of r can be used for the M1 A1ft, but must be a positive integer to score A marks, so evaluation with, say, $n = 20.5$ would score M1 A0 A0. 'Listing' and other methods (a) M: Listing terms (found by a correct method), and picking the 25th term. (There may be numerical slips). (b) M: Listing terms (found by a correct method), until the zero term is seen. (There may be numerical slips). 'Trial and error' approaches (or where working is unclear or non-existent) score M1 A1 for 21, M1 A0 for 20 or 22, and M0 A0 otherwise. (c) M: Listing sums, or listing and adding terms (found by a correct method), at least as far as the 20th term. (There may be numerical slips). A2 (scored as A1 A1) for 315 (clearly selected as the answer). 'Trial and error' approaches essentially follow the main scheme, beginning to score marks when trying S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r. If no working (or no legitimate working) is seen, but the answer 315 is given, allow one mark (scored as M1 A0 A0). For reference: Sums: 30, 58.5, 85.5, 111, 135, 157.5, 178.5, 198, 216, 232.5, 247.5, 261, 273, 283.5, 292.5, 300, 306, 310.5, 313.5, 315, ……..	

Mark Scheme (Results)

Summer 2008

GCE Mathematics (6663/01)

GCE

June 2008
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks
1.	$2x + \frac{5}{3}x^3 + c$	M1A1A1
		(3)
		3

M1 for an attempt to integrate $x^n \to x^{n+1}$. Can be given if $+c$ is only correct term.

1st A1 for $\frac{5}{3}x^3$ or $2x + c$. Accept $1\frac{2}{3}$ for $\frac{5}{3}$. Do <u>not</u> accept $\frac{2x}{1}$ or $2x^1$ as final answer

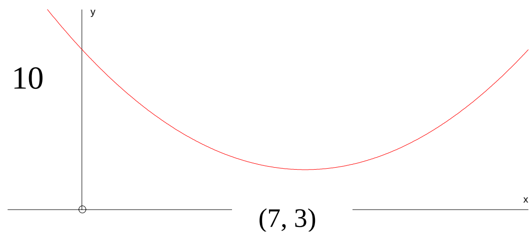
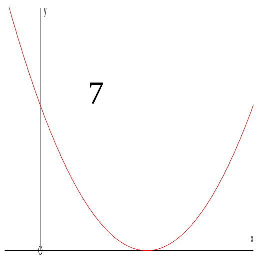
2nd A1 for as printed (no extra or omitted terms). Accept $1\frac{2}{3}$ or $1.\dot{6}$ for $\frac{5}{3}$ but not 1.6 or 1.67 etc

Give marks for the first time correct answers are seen e.g. $\frac{5}{3}$ that later becomes 1.67, the 1.67 is treated as ISW

NB M1A0A1 is not possible

Question number	Scheme	Marks
2.	$x(x^2-9)$ or $(x\pm 0)(x^2-9)$ or $(x-3)(x^2+3x)$ or $(x+3)(x^2-3x)$	B1
	$x(x-3)(x+3)$	M1A1 (3)
		3
	B1 for first factor taken out correctly as indicated in line 1 above. So $x(x^2+9)$ is B0 M1 for attempting to factorise a relevant quadratic. "Ends" correct so e.g. $(x^2-9)=(x\pm p)(x\pm q)$ where pq = 9 is OK. This mark can be scored for $\left(x^2-9\right)=\left(x+3\right)\left(x-3\right)$ seen anywhere. A1 for a fully correct expression with all 3 factors. Watch out for $-x(3-x)(x+3)$ which scores A1 Treat any working to solve the equation x^3-9x as ISW.	

s

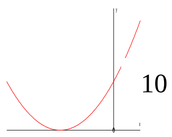
Question number	Scheme	Marks
3	(a) 	B1B1B1 (3)
	(b) 	B1B1 (2)
		5

Allow "stopping at" (0, 10) or (0, 7) instead of "cutting"

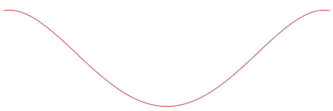
(a) 1st B1 for moving the given curve up. Must be U shaped curve, minimum in first quadrant, not touching x-axis but cutting positive y-axis. Ignore any values on axes.

2nd B1 for curve cutting y-axis at (0, 10) . Point 10(or even (10, 0) marked on positive y-axis is OK)

3rd B1 for minimum indicated at (7, 3). Must have both coordinates and in the right order.



this would score B0B1B0



If the curve flattens out to a turning point like this penalise <u>once</u> at first offence ie 1st B1 in (a) or in (b) but not in both.

The U shape mark can be awarded if the sides are fairly straight as long as the vertex is rounded.

(b) 1st B1 for U shaped curve, touching positive x-axis and crossing y-axis at (0, 7)[condone (7, 0) if marked on positive y axis] or 7 marked on y-axis

2nd B1 for minimum at (3.5, 0) or 3.5 or $\frac{7}{2}$ marked on x-axis. Do <u>not</u> condone (0, 3.5) here.

Redrawing f(x) will score B1B0 in part (b).

Points on sketch override points given in text/table.
If coordinates are given elsewhere (text or table) marks can be awarded if they are compatible with the sketch.

Question number	Scheme	Marks	
4. (a)	$[\,f'(x) = \,]\; 3 + 3x^2$	M1A1	(2)
(b)	$3 + 3x^2 = 15$ and start to try and simplify	M1	
	$x^2 = k \rightarrow x = \sqrt{k}$ (ignore $\pm$)	M1	
	$x = 2$ (ignore $x = -2$)	A1	(3)
			5

(a) M1 for attempting to differentiate $x^n \rightarrow x^{n-1}$. Just one term will do.

A poor integration attempt that gives $3x^2 + ...$ (or similar) scores M0A0

A1 for a fully correct expression. Must be 3 not $3x^0$. If there is a + c they score A0.

(b) 1st M1 for forming a correct equation and trying to rearrange their $f'(x) = 15$ e.g. collect terms.

e.g. $3x^2 = 15 - 3$ or $1 + x^2 = 5$ or even 3+3x^2 $\rightarrow$ $3x^2 = \frac{15}{3}$ or $3x^{-1} + 3x^2 = 15 \rightarrow 6x = 15$

(i.e algebra can be awful as long as they try to collect terms in their $f'(x) = 15$ equation)

2nd M1 this is dependent upon their $f'(x)$ being of the form $a + bx^2$ and

attempting to solve $a + bx^2 = 15$

For correct processing leading to $x = \ldots$

Can condone arithmetic slips but processes should be correct so

e.g. $3 + 3x^2 = 15 \rightarrow 3x^2 = \frac{15}{3} \rightarrow x = \frac{\sqrt{15}}{3}$ scores M1M0A0

$3 + 3x^2 = 15 \rightarrow 3x^2 = 12 \rightarrow x^2 = 9 \rightarrow x = 3$ scores M1M0A0

$3 + 3x^2 = 15 \rightarrow 3x^2 = 12 \rightarrow 3x = \sqrt{12} \rightarrow x = \frac{\sqrt{12}}{3}$ scores M1M0A0

Question number	Scheme	Marks
5. (a)	$[x_2 =]\, a-3$	B1 (1)
(b)	$[x_3 =]\;\; ax_2 - 3$ or $a(a-3)-3$	M1
	$= a(a-3)-3$ } both lines needed for A1	
	$= a^2-3a-3$ **(*)**	A1cso (2)
(c)	$a^2-3a-3=7$	
	$a^2-3a-10=0$ or $a^2-3a=10$	M1
	$(a-5)(a+2)=0$	dM1
	$\underline{a=5 \text{ or } -2}$	A1 (3)
		6
(a)	B1 for $a\times 1-3$ or better. Give for $a-3$ in part (a) or if it appears in (b) they must state $x_2 = a-3$ This must be seen in (a) or before the $a(a-3)-3$ step.	
(b)	M1 for clear show that. Usually for $a(a-3)-3$ but can follow through their x_2 and even allow ax_2-3 A1 for correct processing leading to printed answer. Both lines needed and no incorrect working seen.	
(c)	1st M1 for attempt to form a correct equation and start to collect terms. It must be a quadratic but need not lead to a 3TQ=0 2nd dM1 This mark is dependent upon the first M1. for attempt to factorize their 3TQ=0 or to solve their 3TQ=0. The "=0"can be implied. $(x\pm p)(x\pm q)=0$, where $pq=10$ or $(x\pm\frac{3}{2})^2 \pm \frac{9}{4} - 10 = 0$ or correct use of quadratic formula with $\underline{\pm}$ They must have a form that leads directly to 2 values for *a*. Trial and Improvement that leads to only one answer gets M0 here. A1 for both correct answers. Allow $x = \ldots$ Give 3/3 for correct answers with no working or trial and improvement that gives <u>both</u> values for *a*	

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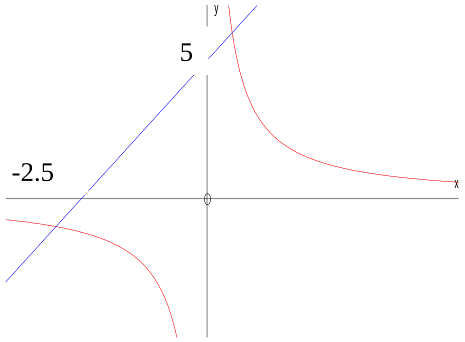
Question Number	Scheme	Marks
6. (a)		B1M1A1 (3)
(b)	$2x+5=\frac{3}{x}$	M1
	$2x^2+5x-3\,[=0]$ or $2x^2+5x=3$	A1
	$(2x-1)(x+3)\,[=0]$	M1
	$x=-3$ or $\frac{1}{2}$	A1
	$y=\frac{3}{-3}$ or $2\times(-3)+5$ or $y=\frac{3}{\frac{1}{2}}$ or $2\times\left(\frac{1}{2}\right)+5$	M1
	Points are $(-3,-1)$ and $(\frac{1}{2},6)$ (correct pairings)	A1ft
		9

(a)	B1	for curve of correct shape i.e 2 branches of curve, in correct quadrants, of roughly the correct shape and no touching or intersections with axes. Condone up to 2 inward bends but there must be some ends that are roughly asymptotic.
	M1	for a straight line <u>cutting</u> the positive *y*-axis and the negative *x*-axis. Ignore any values.
	A1	for (0,5) and (-2.5,0) or points correctly marked on axes. Do not give for values in tables. Condone mixing up (*x*, *y*) as (*y*, *x*) if one value is zero and other value correct.
(b)	1st M1	for attempt to form a suitable equation and multiply by *x* (at least one of 2*x* or +5) should be multiplied.
	1st A1	for correct 3TQ - condone missing = 0
	2nd M1	for an attempt to solve a relevant 3TQ leading to 2 values for *x* =…
	2nd A1	for both *x* = -3 and 0.5.
		T&I for *x* values <u>may</u> score 1st M1A1 otherwise no marks unless both values correct. Answer only of *x* = -3 and *x* = $\frac{1}{2}$ scores 4/4, then apply the scheme for the final M1A1ft
	3rd M1	for an attempt to find at least one *y* value by substituting their *x* in either $\frac{3}{x}$ or 2*x* + 5
	3rd A1ft	follow through both their *x* values, in either equation but the same for each, correct pairings required but can be *x* = -3, *y* = -1 etc

Question number	Scheme	Marks	
7. (a)	5, 7, 9, 11 or 5+2+2+2=11 or 5+6=11 use a = 5, d = 2, n = 4 and $t_4 = 5+3\times 2 = 11$	B1	(1)
(b)	$t_n = a+(n-1)d$ with one of a = 5 or d = 2 correct (can have a letter for the other)	M1	
	= 5 + 2(n − 1) or 2n + 3 or 1 + 2(n + 1)	A1	(2)
(c)	$S_n = \frac{n}{2}[2\times 5+2(n-1)]$ or use of $\frac{n}{2}(5+\text{"their } 2n+3\text{"})$ (may also be scored in (b))	M1A1	
	= {n(5 + n - 1)} = n(n + 4) **(*)**	A1cso	(3)
(d)	43 = 2n + 3	M1	
	[n] = 20	A1	(2)
(e)	$S_{20} = 20\times 24$, = <u>480</u> (km)	M1A1	(2)
		10	

(a)	B1	Any other sum must have a convincing argument
(b)	M1	for an attempt to use a + (n - 1)d with one of a or d correct (the other can be a letter) Allow any answer of the form 2n + p ($p \neq 5$) to score M1.
	A1	for a correct expression (needn't be simplified) [**Beware** $5+(2n-1)$ scores A0] Expression must be in n not x. Correct answers with no working scores 2/2.
(c)	M1	for an attempt to use S_n formula with a = 5 or d = 2 or a = 5 and their "2n + 3"
	1st A1	for a fully correct expression
	2nd A1	for correctly simplifying to given answer. No incorrect working seen. Must see S_n used.
		Do not give credit for part (b) if the equivalent work is given in part (d)
(d)	M1	for forming a suitable equation in n (ft their (b)) and attempting to solve leading to n =…
	A1	for 20 Correct answer only scores 2/2 . Allow 20 following a restart but check working. eg 43 = 2n + 5 that leads to 40 = 2n and n =20 should score M1A0.
(e)	M1	for using their answer for n in n(n + 4) or S_n formula, their n must be a value.
	A1	for 480 (ignore units but accept 480 000 m etc)[no matter where their 20 comes from]
		NB "attempting to solve" eg part (d) means we will allow sign slips and slips in arithmetic but not in processes. So dividing when they should subtract etc would lead to M0. Listing in parts (d) and (e) can score 2 (if correct) or 0 otherwise in each part. Poor labelling may occur (especially in (b) and (c)) . If you see work to get n(n + 4) mark as (c)

Question number	Scheme	Marks
8. (a)	[No real roots implies $b^2 - 4ac < 0$.] $b^2 - 4ac = q^2 - 4 \times 2q \times (-1)$	M1
	So $q^2 - 4 \times 2q \times (-1) < 0$ i.e. $q^2 + 8q < 0$ **(*)**	A1cso (2)
(b)	$q(q + 8) = 0$ or $(q \pm 4)^2 \pm 16 = 0$	M1
	$(q) = 0$ or -8 (2 cvs)	A1
	$-8 < q < 0$ <u>or</u> $q \in (-8, 0)$ <u>or</u> $q < 0$ and $q > -8$	A1ft (3)
		5

(a) M1 for attempting $b^2 - 4ac$ with one of *b* or *a* correct. < 0 not needed for M1

This may be inside a square root.

A1cso for simplifying to printed result with no incorrect working or statements seen.

Need an intermediate step

e.g. $q^2 - -8q < 0$ or $q^2 - 4 \times 2q \times -1 < 0$ or $q^2 - 4(2q)(-1) < 0$ or $q^2 - 8q(-1) < 0$ or $q^2 - 8q \times -1 < 0$

i.e. must have × or brackets on the 4*ac* term

< 0 must be seen at least one line before the final answer.

(b) M1 for factorizing or completing the square or attempting to solve $q^2 \pm 8q = 0$. A method that would lead to 2 values for *q*. The "= 0" may be implied by values appearing later.

1st A1 for $q = 0$ and $q = -8$

2nd A1 for $-8 < q < 0$. Can follow through their cvs but must choose "inside" region.

$q < 0, q > -8$ is A0, $q < 0$ or $q > -8$ is A0, (-8, 0) on its own is A0

BUT "$q < 0$ and $q > -8$" is A1

Do not accept a number line for final mark

Question number	Scheme	Marks
9. (a)	$\left[\frac{dy}{dx}=\right]3kx^2-2x+1$	M1A1 (2)
(b)	Gradient of line is $\frac{7}{2}$	B1
	When $x=-\frac{1}{2}$: $3k\times\left(\frac{1}{4}\right)-2\times\left(-\frac{1}{2}\right)+1,=\frac{7}{2}$	M1, M1
	$\frac{3k}{4}=\frac{3}{2}\Rightarrow k=2$	A1 (4)
(c)	$x=-\frac{1}{2}\Rightarrow y=k\times\left(-\frac{1}{8}\right)-\left(\frac{1}{4}\right)-\frac{1}{2}-5,=-6$	M1, A1 (2)
		8

(a)	M1	for attempting to differentiate $x^n\to x^{n-1}$ (or -5 going to 0 will do)
	A1	all correct. A "+ c" scores A0
(b)	B1	for $m=\frac{7}{2}$. Rearranging the line into $y=\frac{7}{2}x+c$ does not score this mark until you are sure they are using $\frac{7}{2}$ as the gradient of the line or state $m=\frac{7}{2}$
	1st M1	for substituting $x=-\frac{1}{2}$ into their $\frac{dy}{dx}$, some correct substitution seen
	2nd M1	for forming a suitable equation in k and attempting to solve leading to $k=\ldots$ Equation must use their $\frac{dy}{dx}$ and their gradient of line. Assuming the gradient is 0 or 7 scores M0 unless they have clearly stated that this is the gradient of the line.
	A1	for k = 2
(c)	M1	for attempting to substitute their k (however it was found or can still be a letter) and $x=-\frac{1}{2}$ into y (some correct substitution)
	A1	for - 6

Question number	Scheme	Marks
10. (a)	$QR=\sqrt{(7-1)^2+(0-3)^2}$	M1
	$=\sqrt{36+9}$ or $\sqrt{45}$ (condone $\pm$)	A1
	$=3\sqrt{5}$ or $a=3$ ($\pm 3\sqrt{5}$ etc is A0)	A1 (3)
(b)	Gradient of QR (or l_1) = $\frac{3-0}{1-7}$ or $\frac{3}{-6}, =-\frac{1}{2}$	M1, A1
	Gradient of l_2 is $-\frac{1}{-\frac{1}{2}}$ or 2	M1
	Equation for l_2 is: $y-3=2(x-1)$ or $\frac{y-3}{x-1}=2$ [or $y = 2x + 1$]	M1 A1ft (5)
(c)	P is (0, 1) (allow "$x = 0, y = 1$" but it must be clearly identifiable as P)	B1 (1)
(d)	$PQ=\sqrt{(1-x_P)^2+(3-y_P)^2}$	M1
	$PQ=\sqrt{1^2+2^2}=\sqrt{5}$	A1
	Area of triangle is $\frac{1}{2}QR\times PQ=\frac{1}{2}3\sqrt{5}\times\sqrt{5},=\frac{15}{2}$ or 7.5	dM1, A1 (4)
	Determinant Method e.g(0+0+7) - (1+21+0) = - 15 (o.e.) Area = $\frac{1}{2}\lvert -15\rvert$,= 7.5	
		13

Rules for quoting formula: For an M mark, if a correct formula is quoted and some correct substitutions seen then M1 can be awarded, if no values are correct then M0. If no correct formula is seen then M1 can only be scored for a fully correct expression.

(a) M1 for attempting QR or QR^2. May be implied by 6^2+3^2

1st A1 for as printed or better. Must have square root. Condone $\pm$

(b) 1st M1 for attempting gradient of QR

1st A1 for - 0.5 or $-\frac{1}{2}$, can be implied by gradient of $l_2=2$

2nd M1 for an attempt to use the perpendicular rule on their gradient of QR.

3rd M1 for attempting equation of a line using Q with their changed gradient.

2nd A1ft requires all 3 Ms but can ft their gradient of QR.

> $y = 2x + 1$ with no working. Send to review.

(d) 1st M1 for attempting PQ or PQ^2 follow through their coordinates of P

1st A1 for PQ as one of the given forms.

2nd dM1 for correct attempt at area of the triangle. Follow through their value of a and their PQ. This M mark is dependent upon the first M mark

2nd A1 for 7.5 or some exact equivalent. Depends on both Ms. Some working must be seen.

ALT Use QS where S is (1, 0)

1st M1 for attempting area of $OPQS$ and QSR and OPR. Need all 3.

1st A1 for $OPQS$ = $\frac{1}{2}(1+3)\times 1=2$, QSR = 9, OPR = $\frac{7}{2}$

2nd dM1 for $OPQS$ + QSR − OPR = …Follow through their values.

2nd A1 for 7.5

> **Determinant Method**
> M1 for attempt -at least one value in each bracket correct .
> A1 if correct ($\pm$ 15)
> M1 for correct area formula
> A1 for 7.5

MR Misreading x-axis for y-axis for P. Do NOT use MR rule as this oversimplifies the question. They can only get M marks in (d) if they use PQ and QR.

Question number	Scheme	Marks	
11. (a)	$(x^2+3)^2 = x^4+3x^2+3x^2+3^2$	M1	
	$\frac{(x^2+3)^2}{x^2} = \frac{x^4+6x^2+9}{x^2} = x^2+6+9x^{-2}$ **(*)**	A1cso	(2)
(b)	$y = \frac{x^3}{3}+6x+\frac{9}{-1}x^{-1}(+c)$	M1A1A1	
	$20 = \frac{27}{3}+6\times3-\frac{9}{3}+c$	M1	
	$c = -4$	A1	
	$[y=]\frac{x^3}{3}+6x-9x^{-1}-4$	A1ft	(6)
			8
(a)	M1 for attempting to expand $(x^2+3)^2$ and having at least 3(out of the 4) correct terms. A1 at least this should be seen and no incorrect working seen. If they never write $\frac{9}{x^2}$ as $9x^{-2}$ they score A0.		
(b)	1st M1 for some correct integration, one correct *x* term as printed or better Trying $\frac{\int u}{\int v}$ loses the first M mark but could pick up the second. 1st A1 for two correct *x* terms, un-simplified, as printed or better 2nd A1 for a fully correct expression. Terms need not be simplified and +*c* is not required. No + *c* loses the next 3 marks 2nd M1 for using $x = 3$ and $y = 20$ in their expression for f(*x*) $\left[\neq \frac{dy}{dx}\right]$ to form a linear equation for *c* 3rd A1 for $c = -4$ 4th A1ft for an expression for *y* with simplified *x* terms: $\frac{9}{x}$ for $9x^{-1}$ is OK . Condone missing "$y =$ " Follow through their numerical value of *c* only.		

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Mark Scheme (Results)

January 2009

GCE

GCE Mathematics (6663/01)

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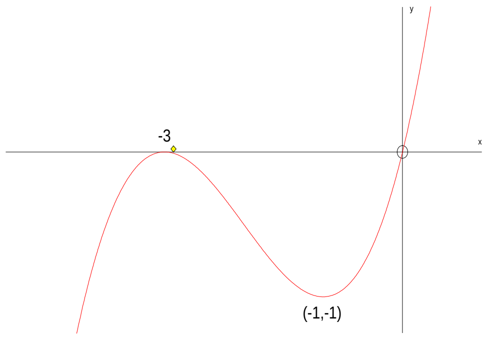
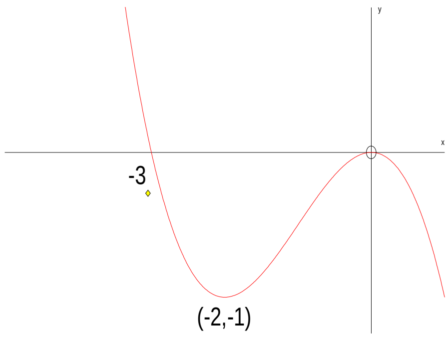
January 2009
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
1 (a)	**5** $\quad\quad$ (± 5 is B0)	B1 (1)
(b)	$\dfrac{1}{(\text{their } 5)^2}$ or $\left(\dfrac{1}{\text{their } 5}\right)^2$	M1
	$= \dfrac{1}{25}$ **or 0.04** $\quad\quad$ ($\pm\dfrac{1}{25}$ is A0)	A1 (2) **[3]**
(b)	M1 follow through their value of 5. Must have reciprocal and square. 5^{-2} is <u>not</u> sufficient to score this mark, unless $\dfrac{1}{5^2}$ follows this. A negative introduced at any stage can score the M1 but not the A1, e.g. $125^{-2/3} = \left(-\dfrac{1}{5}\right)^2 = \dfrac{1}{25}$ scores M1 A0 $125^{-2/3} = -\left(\dfrac{1}{5}\right)^2 = -\dfrac{1}{25}$ scores M1 A0. Correct answer with no working scores both marks. <u>Alternative</u>: $\dfrac{1}{\sqrt[3]{125^2}}$ or $\dfrac{1}{(125^2)^{1/3}}$ M1 (reciprocal and the correct number squared) $\left(= \dfrac{1}{\sqrt[3]{15625}}\right)$ $= \dfrac{1}{25}$ A1	

Question Number	Scheme	Marks
2	$(I=)\frac{12}{6}x^6-\frac{8}{4}x^4+3x+c$ $=2x^6-2x^4+3x+c$	M1 A1A1A1 **[4]**
	M1 for an attempt to integrate $x^n \to x^{n+1}$ (i.e. ax^6 or ax^4 or ax, where a is any non-zero constant). Also, this M mark can be scored for just the + c (seen at some stage), even if no other terms are correct. 1st A1 for $2x^6$ 2nd A1 for $-2x^4$ 3rd A1 for $3x$ + c (or $3x+k$, etc., any appropriate letter can be used as the constant) Allow $3x^1+c$, but <u>not</u> $\frac{3x^1}{1}+c$. Note that the A marks can be awarded at separate stages, e.g. $\frac{12}{6}x^6-2x^4+3x$ scores 2nd A1 $\frac{12}{6}x^6-2x^4+3x+c$ scores 3rd A1 $2x^6-2x^4+3x$ scores 1st A1 (even though the c has now been lost). Remember that all the A marks are dependent on the M mark. If applicable, isw (ignore subsequent working) after a correct answer is seen. Ignore wrong notation if the intention is clear, e.g. Answer $\int 2x^6-2x^4+3x+c\,dx$.	

Question Number	Scheme	Marks
3	$\sqrt{7}^2+2\sqrt{7}-2\sqrt{7}-2^2$, or $7-4$ or an exact equivalent such as $\sqrt{49}-2^2$ = **3**	M1 A1 **[2]**
	M1 for an expanded expression. At worst, there can be <u>one wrong term</u> and <u>one wrong sign</u>, or <u>two wrong signs</u>. e.g. $7+2\sqrt{7}-2\sqrt{7}-2$ is M1 (one wrong term -2) $7+2\sqrt{7}+2\sqrt{7}+4$ is M1 (two wrong signs $+2\sqrt{7}$ and $+4$) $7+2\sqrt{7}+2\sqrt{7}+2$ is M1 (one wrong term $+2$, one wrong sign $+2\sqrt{7}$) $\sqrt{7}+2\sqrt{7}-2\sqrt{7}+4$ is M1 (one wrong term $\sqrt{7}$, one wrong sign $+4$) $\sqrt{7}+2\sqrt{7}-2\sqrt{7}-2$ is M0 (two wrong terms $\sqrt{7}$ and -2) $7+\sqrt{14}-\sqrt{14}-4$ is M0 (two wrong terms $\sqrt{14}$ and $-\sqrt{14}$) If only 2 terms are given, they must be correct, i.e. (7 – 4) or an equivalent unsimplified version to score M1. The terms can be seen <u>separately</u> for the M1. Correct answer with <u>no working</u> scores both marks.	

Question Number	Scheme	Marks
4	$\left(\mathrm{f}(x)=\right)\frac{3x^3}{3}-\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}-7x(+c)$	M1
	$= \ x^3-2x^{\frac{3}{2}}-7x \quad (+c)$	A1A1
	f(4) = 22 $\Rightarrow$ $22=64-16-28+c$	M1
	$\boldsymbol{c}$ **= 2**	A1cso (5)
		[5]
	1st M1 for an attempt to integrate (x^3 or $x^{\frac{3}{2}}$ seen). The *x* term is insufficient for this mark and similarly the + *c* is insufficient. 1st A1 for $\frac{3}{3}x^3$ or $-\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}$ (An unsimplified or simplified correct form) 2nd A1 for all three *x* terms correct and simplified… (the simplification may be seen later). The + *c* is not required for this mark. Allow $-7x^1$, but not $-\frac{7x^1}{1}$. 2nd M1 for an attempt to use *x* = 4 and *y* = 22 in a changed function (even if differentiated) to form an equation in *c*. 3rd A1 for *c* = 2 with no earlier incorrect work (a final expression for f(*x*) is not required).	

Question Number	Scheme	Marks
5 (a)	 Shape  , touching the x-axis at its maximum. Through (0,0) & -3 marked on x-axis, or $(-3,0)$ seen. Allow $(0,-3)$ if marked on the x-axis. Marked in the correct place, but 3, is A0. Min at $(-1,-1)$	M1 A1 A1 (3)
(b)	 Correct shape  (top left - bottom right) Through -3 and max at (0, 0). Marked in the correct place, but 3, is B0. Min at $(-2,-1)$	B1 B1 B1 (3) **[6]**
(a) (b)	M1 as described above. Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min. 1st A1 for curve passing through -3 and the origin. Max at $(-3,0)$ 2nd A1 for minimum at $(-1,-1)$. Can simply be indicated on sketch. 1st B1 for the correct shape. A negative cubic passing from top left to bottom right. Shape: Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min. 2nd B1 for curve passing through $(-3,0)$ having a max at (0, 0) and no other max. 3rd B1 for minimum at $(-2,-1)$ and no other minimum. If in correct quadrant but labelled, e.g. $(-2,1)$, this is B0. In each part the (0, 0) does not need to be written to score the second mark… having the curve pass through the origin is sufficient. The last mark (for the minimum) in each part is dependent on a sketch being attempted, and the sketch must show the minimum in approximately the correct place (not, for example, $(-2,-1)$ marked in the wrong quadrant). The mark for the minimum is not given for the coordinates just marked on the axes unless these are clearly linked to the minimum by vertical and horizontal lines.	

Question Number	Scheme	Marks
6 (a)	$2x^{3/2}$ or $p=\frac{3}{2}$ (<u>Not</u> $2x\sqrt{x}$)	B1
	$-x$ or $-x^1$ or $q=1$	B1 (2)
(b)	$\left(\frac{dy}{dx}=\right)\ 20x^3+2\times\frac{3}{2}x^{1/2}-1$	M1
	$=\underline{20x^3+3x^{\frac{1}{2}}-1}$	A1A1ftA1ft (4) **[6]**
(a)	1st B1 for $p=1.5$ or exact equivalent 2nd B1 for $q=1$	
(b)	M1 for an attempt to differentiate $x^n\to x^{n-1}$ (for any of the 4 terms) 1st A1 for $20x^3$ (the -3 must 'disappear') 2nd A1ft for $3x^{\frac{1}{2}}$ or $3\sqrt{x}$. Follow through their *p* but they must be differentiating $2x^p$, where *p* is a <u>fraction</u>, and the coefficient must be simplified if necessary. 3rd A1ft for -1 (<u>not</u> the unsimplified $-x^0$), or follow through for correct differentiation of their $-x^q$ (i.e. coefficient of x^q is -1). If ft is applied, the coefficient must be simplified if necessary. 'Simplified' coefficient means $\frac{a}{b}$ where *a* and *b* are integers with no common factors. Only a single + or – sign is allowed (e.g. – – must be replaced by +). If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b). <u>Multiplying</u> by $\sqrt{x}$: (assuming this is a restart) e.g. $y=5x^4\sqrt{x}-3\sqrt{x}+2x^2-x^{3/2}$ $\left(\frac{dy}{dx}=\right)\frac{45}{2}x^{7/2}-\frac{3}{2}x^{-1/2}+4x-\frac{3}{2}x^{1/2}$ scores M1 A0 A0 (*p* not a fraction) A1ft. <u>Extra term</u> included: This invalidates the final mark. e.g. $y=5x^4-3+2x^2-x^{3/2}-x^{1/2}$ $\left(\frac{dy}{dx}=\right)20x^3+4x-\frac{3}{2}x^{1/2}-\frac{1}{2}x^{-1/2}$ scores M1 A1 A0 (*p* not a fraction) A0. <u>Numerator and denominator differentiated separately</u>: For this, neither of the last two (ft) marks should be awarded. <u>Quotient/product rule</u>: Last two terms must be correct to score the last 2 marks. (If the M mark has not already been earned, it can be given for the quotient/product rule attempt.)	

Question Number	Scheme	Marks
7 (a)	$b^2 - 4ac > 0 \Rightarrow \quad 16 - 4k(5-k) > 0$ or equiv., e.g. $16 > 4k(5-k)$	M1A1
	So $k^2 - 5k + 4 > 0$ (Allow any order of terms, e.g. $4 - 5k + k^2 > 0$) (*)	A1cso (3)
(b)	<u>Critical Values</u> $(k-4)(k-1) = 0$ $k = \ldots.$	M1
	$k = 1$ or 4	A1
	Choosing "outside" region	M1
	<u>$\boldsymbol{k < 1}$ **or** $\boldsymbol{k > 4}$</u>	A1 (4) **[7]**

For this question, ignore (a) and (b) labels and award marks wherever correct work is seen.

(a)

M1 for attempting to use the discriminant of the initial equation (> 0 not required, but substitution of a, b and c in the correct formula is required).
If the formula $b^2 - 4ac$ is seen, at least 2 of a, b and c must be correct.
If the formula $b^2 - 4ac$ is <u>not</u> seen, all 3 (a, b and c) must be correct.
This mark can still be scored if substitution in $b^2 - 4ac$ is within the quadratic formula.
This mark can also be scored by comparing b^2 and $4ac$ (with substitution).
However, use of $b^2 + 4ac$ is M0.

1st A1 for fully correct expression, possibly unsimplified, with > symbol. NB must appear before the last line, even if this is simply in a statement such as $b^2 - 4ac > 0$ or 'discriminant positive'.
Condone a bracketing slip, e.g. $16 - 4 \times k \times 5 - k$ if subsequent work is correct and convincing.

2nd A1 for a fully correct derivation with no incorrect working seen.
Condone a bracketing slip if otherwise correct and convincing.

<u>Using</u> $\sqrt{b^2 - 4ac} > 0$:
Only available mark is the first M1 (unless recovery is seen).

(b)

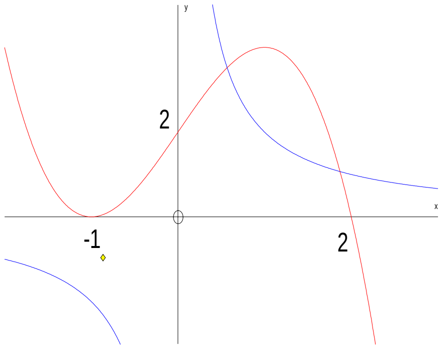
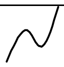
1st M1 for attempt to solve an appropriate 3TQ
1st A1 for both $k = 1$ and 4 (only the critical values are required, so accept, e.g. $k > 1$ and $k > 4$). **
2nd M1 for choosing the "outside" region. A diagram or table alone is not sufficient.
Follow through their values of k.
The set of values must be 'narrowed down' to score this M mark… listing everything $k < 1$, $1 < k < 4$, $k > 4$ is M0.
2nd A1 for correct answer only, condone "$k < 1$, $k > 4$" and even "$k < 1$ and $k > 4$",
but "$1 > k > 4$" is A0.

** Often the statement $k > 1$ and $k > 4$ is followed by the correct final answer. Allow full marks.

<u>Seeing 1 and 4 used as critical values</u> gives the first M1 A1 by implication.

In part (b), condone working with x's except for the final mark, where the set of values must be a set of values of k (i.e. 3 marks out of 4).

Use of ≤ (or ≥) in the final answer loses the final mark.

Question Number	Scheme	Marks
8 (a)	$(a =)\ \ (1+1)^2(2-1) = \underline{\mathbf{4}}$ (1, 4) or $y = 4$ is also acceptable	B1 (1)
(b)	 (i) Shape  or  anywhere	B1
	Min at $(-1, 0)$ … can be -1 on x-axis. Allow $(0, -1)$ if marked on the x-axis. Marked in the correct place, but 1, is B0.	B1
	(2, 0) and (0, 2) can be 2 on axes	B1
	(ii) Top branch in 1^{st} quadrant with 2 intersections	B1
	Bottom branch in 3^{rd} quadrant (ignore any intersections)	B1 (5)
(c)	(2 intersections therefore) $\underline{\mathbf{2}}$ (roots)	B1ft (1) **[7]**
(b)	1^{st} B1 for shape  or  Can be anywhere, but there must be one max. and one min. and no further max. and min. turning points. Shape: Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min. 2^{nd} B1 for minimum at $(-1, 0)$ (even if there is an additional minimum point shown) 3^{rd} B1 for the sketch meeting axes at (2, 0) and (0, 2). They can simply mark 2 on the axes. The marks for minimum and intersections are dependent upon having a sketch. Answers on the diagram for min. and intersections take precedence over answers seen elsewhere. 4^{th} B1 for the branch fully within 1^{st} quadrant having 2 intersections with (not just 'touching') the other curve. The curve can 'touch' the axes. A curve of (roughly) the correct shape is required, but be very generous, even when the arc appears to turn 'inwards' rather than approaching the axes, and when the curve looks like two straight lines with a small curve at the join. Allow, for example, shapes like these: 5^{th} B1 for a branch fully in the 3^{rd} quadrant (ignore any intersections with the other curve for this branch). The curve can 'touch' the axes. A curve of (roughly) the correct shape is required, but be very generous, even when the arc appears to turn 'inwards' rather than approaching the axes.	
(c)	B1ft for a statement about the number of roots - compatible with their sketch. No sketch is B0. The answer 2 <u>incompatible with the sketch</u> is B0 (ignore any algebra seen). If the sketch shows the 2 correct intersections <u>and</u>, for example, one other intersection, the answer here should be 3, not 2, to score the mark.	

Question Number	Scheme	Marks
9 (a)	$a+17d=25$ or equiv. (for 1st B1), $a+20d=32.5$ or equiv. (for 2nd B1),	B1, B1 (2)
(b)	Solving (Subtract) $3d=7.5$ so $\boldsymbol{d}$ **= 2.5**	M1
	$a=32.5-20\times2.5$ so $\boldsymbol{a}$ **= -17.5** (*)	A1cso (2)
(c)	$2750=\frac{n}{2}\left[-35+\frac{5}{2}(n-1)\right]$	M1A1ft
	$\{\ 4\times2750=n(5n-75)\ \}$	
	$4\times550=n(n-15)$	M1
	$n^2-15n=55\times40$ (*)	A1cso (4)
(d)	$n^2-15n-55\times40=0$ or $n^2-15n-2200=0$	M1
	$(n-55)(n+40)=0$ $n=\ldots$	M1
	$\boldsymbol{n}$ **= 55** (ignore - 40)	A1 (3) **[11]**

Mark parts (a) and (b) as 'one part', ignoring labelling.

(a) Alternative:

1st B1: $d=2.5$ or equiv. or $d=\frac{32.5-25}{3}$. No method required, but $a=-17.5$ must not be assumed.

2nd B1: Either $a+17d=25$ or $a+20d=32.5$ seen, or used with a value of $d\ldots$ or for 'listing terms' or similar methods, 'counting back' 17 (or 20) terms.

(b) M1: In main scheme: for a full method (allow numerical or sign slips) leading to solution for d or a without assuming $a=-17.5$

In alternative scheme: for using a d value to find a value for a.

A1: Finding correct values for both a and d (allowing equiv. fractions such as $d=\frac{15}{6}$), with no incorrect working seen.

In the main scheme, if the given a is used to find d from one of the equations, then allow M1A1 if both values are checked in the 2nd equation.

(c) 1st M1 for attempt to form equation with correct S_n formula and 2750, with values of a and d.

1st A1ft for a correct equation following through their d.

2nd M1 for expanding and simplifying to a 3 term quadratic.

2nd A1 for correct working leading to printed result (no incorrect working seen).

(d) 1st M1 forming the correct 3TQ = 0 . Can condone missing "= 0" but all terms must be on one side.

First M1 can be implied (perhaps seen in (c), but there must be an attempt at (d) for it to be scored).

2nd M1 for attempt to solve 3TQ, by factorisation, formula or completing the square (see general marking principles at end of scheme). If this mark is earned for the 'completing the square' method or if the factors are written down directly, the 1st M1 is given by implication.

A1 for $n=55$ dependent on both Ms. Ignore – 40 if seen.

No working or 'trial and improvement' methods in (d) score all 3 marks for the answer 55, otherwise no marks.

Question Number	Scheme	Marks
10 (a)	$y-5=-\frac{1}{2}(x-2)$ or equivalent, e.g. $\frac{y-5}{x-2}=-\frac{1}{2}$, $y=-\frac{1}{2}x+6$	M1A1, A1cao (3)
(b)	$x=-2 \Rightarrow y=-\frac{1}{2}(-2)+6 = 7$ (therefore B lies on the line) (or equivalent verification methods)	B1 (1)
(c)	$(AB^2 =)\ (2--2)^2+(7-5)^2$, $= 16 + 4 = 20$, $AB=\sqrt{20}=2\sqrt{5}$	M1, A1, A1 (3)
(d)	C is $(p, -\frac{1}{2}p+6)$, so $AC^2=(p-2)^2+\left(-\frac{1}{2}p+6-5\right)^2$	M1
	Therefore $25=p^2-4p+4+\frac{1}{4}p^2-p+1$	M1
	$25=1.25p^2-5p+5$ or $100=5p^2-20p+20$ (or better, RHS simplified to 3 terms)	A1
	Leading to: $0=p^2-4p-16$ (*)	A1cso (4) **[11]**
(a)	M1 A1 The version in the scheme above can be written down directly (for 2 marks), and M1 A0 can be allowed if there is just one slip (sign or number). If the 5 and 2 are the wrong way round the M mark can still be given if a correct formula (e.g. $y-y_1=m(x-x_1)$) is seen, otherwise M0. If (2, 5) is substituted into $y=mx+c$ to find c, the M mark is for attempting this and the 1st A mark is for c = 6. Correct answer without working or from a sketch scores full marks.	
(b)	A conclusion/comment is not required, except when the method used is to establish that the line through $(-2,7)$ with gradient $-\frac{1}{2}$ has the same eqn. as found in part (a), or to establish that the line through $(-2,7)$ and $(2,5)$ has gradient $-\frac{1}{2}$. In these cases a comment 'same equation' or 'same gradient' or 'therefore on same line' is sufficient.	
(c)	M1 for attempting AB^2 or AB. Allow one slip (sign or number) <u>inside</u> a bracket, i.e. do <u>not</u> allow $(2--2)^2-(7-5)^2$. 1st A1 for 20 (condone bracketing slips such as $-2^2=4$) 2nd A1 for $2\sqrt{5}$ or k = 2 (Ignore ± here).	
(d)	1st M1 for $(p-2)^2+(\text{linear function of } p)^2$. The linear function may be unsimplified but must be equivalent to $ap+b,\ a\neq 0,\ b\neq 0$. 2nd M1 (dependent on 1st M) for forming an equation in p (using 25 or 5) and attempting (perhaps not very well) to multiply out both brackets. 1st A1 for collecting like p terms and having a correct expression. 2nd A1 for correct work leading to printed answer. <u>Alternative, using the result</u>: Solve the quadratic $(p=2\pm 2\sqrt{5})$ and use one or both of the two solutions to find the length of AC^2 or $C_1C_2{}^2$: e.g. $AC^2=(2+2\sqrt{5}-2)^2+(5-\sqrt{5}-5)^2$ scores 1st M1, and 1st A1 if fully correct. Finding the length of AC or AC^2 for both values of p, or finding C_1C_2 with some evidence of halving (or intending to halve) scores the 2nd M1. Getting AC = 5 for both values of p, or showing $\frac{1}{2}C_1C_2=5$ scores the 2nd A1 (cso).	

Question Number	Scheme	Marks
11 (a)	$\left(\frac{dy}{dx}=\right)-4+8x^{-2}$ (4 or $8x^{-2}$ for M1… sign can be wrong)	M1A1
	$x=2\Rightarrow$ $m=-4+2=-2$	M1
	$y=9-8-\frac{8}{2}=-3$ The first 4 marks could be earned in part (b)	B1
	Equation of tangent is: $y+3=-2(x-2)\to$ $y=1-2x$ (*)	M1 A1cso (6)
(b)	Gradient of normal = $\frac{1}{2}$	B1ft
	Equation is: $\frac{y+3}{x-2}=\frac{1}{2}$ or better equivalent, e.g. $y=\frac{1}{2}x-4$	M1A1 (3)
(c)	$(A:)\ \frac{1}{2}$, $(B:)\ 8$	B1, B1
	Area of triangle is: $\frac{1}{2}(x_B\pm x_A)\times y_P$ with values for all of x_B, x_A and y_P	M1
	$\frac{1}{2}\left(8-\frac{1}{2}\right)\times 3=$ $\frac{45}{4}$ or 11.25	A1 (4) **[13]**

(a)
1st M1 for 4 or $8x^{-2}$ (ignore the signs).
1st A1 for both terms correct (including signs).
2nd M1 for substituting x = 2 into their $\frac{dy}{dx}$ (must be different from their y)
B1 for $y_P=-3$, but not if clearly found from the given equation of the tangent.
3rd M1 for attempt to find the equation of tangent at P, follow through their m and y_P.
Apply general principles for straight line equations (see end of scheme).
NO DIFFERENTIATION ATTEMPTED: Just assuming $m=-2$ at this stage is M0
2nd A1cso for correct work leading to printed answer (allow equivalents with $2x$, y, and 1 terms… such as $2x+y-1=0$).

(b)
B1ft for correct use of the perpendicular gradient rule. Follow through their m, but if $m\neq-2$ there must be clear evidence that the m is thought to be the gradient of the tangent.
M1 for an attempt to find normal at P using their changed gradient and their y_P.
Apply general principles for straight line equations (see end of scheme).
A1 for any correct form as specified above (correct answer only).

(c)
1st B1 for $\frac{1}{2}$ and 2nd B1 for 8.
M1 for a full method for the area of triangle ABP. Follow through their x_A, x_B and their y_P, but the mark is to be awarded 'generously', condoning sign errors..
The final answer must be positive for A1, with negatives in the working condoned.

Determinant: Area = $\frac{1}{2}\begin{vmatrix}x_1 & y_1 & 1\\ x_2 & y_2 & 1\\ x_3 & y_3 & 1\end{vmatrix}=\frac{1}{2}\begin{vmatrix}2 & -3 & 1\\ 0.5 & 0 & 1\\ 8 & 0 & 1\end{vmatrix}=\ldots$ (Attempt to multiply out required for M1)

Alternative: $AP=\sqrt{(2-0.5)^2+(-3)^2}$, $BP=\sqrt{(2-8)^2+(-3)^2}$, Area = $\frac{1}{2}AP\times BP=\ldots$ M1

Intersections with y-axis instead of x-axis: Only the M mark is available B0 B0 M1 A0.

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Mark Scheme (Results)

Summer 2009

GCE

GCE Mathematics (6663/01)

A PEARSON COMPANY

June 2009
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)	$(3\sqrt{7})^2 = 63$	B1 (1)
(b)	$(8+\sqrt{5})(2-\sqrt{5}) = 16-5+2\sqrt{5}-8\sqrt{5}$	M1
	$= 11,\ -6\sqrt{5}$	A1, A1
		(3)
		[4]
(a)	B1 for 63 only	
(b)	M1 for an attempt to expand <u>their</u> brackets with $\geq$ 3 terms correct. They may collect the $\sqrt{5}$ terms to get $16-5-6\sqrt{5}$ Allow $-\sqrt{5}\times\sqrt{5}$ or $-(\sqrt{5})^2$ or $-\sqrt{25}$ instead of the -5 These 4 values may appear in a list or table but they should have minus signs included **The next two marks should be awarded for the final answer but check that correct values follow from correct working. Do not use ISW rule** 1st A1 for 11 from 16 – 5 <u>or</u> $-6\sqrt{5}$ from $-8\sqrt{5}+2\sqrt{5}$ 2nd A1 for <u>both</u> 11 and $-6\sqrt{5}$. <u>S.C - Double sign error in expansion</u> For $16-5-2\sqrt{5}+8\sqrt{5}$ leading to 11 + … allow <u>one</u> mark	

Question Number	Scheme	Marks
Q2	$32 = 2^5$ or $2048 = 2^{11}$, $\sqrt{2} = 2^{1/2}$ or $\sqrt{2048} = (2048)^{\frac{1}{2}}$ $a = \frac{11}{2}$ $\left(\text{or } 5\frac{1}{2} \text{ or } 5.5\right)$	B1, B1 B1 **[3]**
	1st B1 for $32 = 2^5$ or $2048 = 2^{11}$ This should be explicitly seen: $32\sqrt{2} = 2^a$ followed by $2^5\sqrt{2} = 2^a$ is OK Even writing $32 \times 2 = 2^5 \times 2\left(= 2^6\right)$ is OK but simply writing $32 \times 2 = 2^6$ is NOT 2nd B1 for $2^{\frac{1}{2}}$ or $(2048)^{\frac{1}{2}}$ seen. This mark may be implied 3rd B1 for answer as written. **Need *a* =** … so $2^{\frac{11}{2}}$ is B0 $a = \frac{11}{2}$ $\left(\text{or } 5\frac{1}{2} \text{ or } 5.5\right)$ with no working scores full marks. If $a = 5.5$ seen then award 3/3 unless it is clear that the value follows from totally incorrect work. Part solutions: e.g. $2^5\sqrt{2}$ scores the first B1. <u>Special case</u>: If $\sqrt{2} = 2^{1/2}$ is not explicitly seen, but the final answer includes $\frac{1}{2}$, e.g. $a = 2\frac{1}{2}$, $a = 4\frac{1}{2}$, the second B1 is given by implication.	

Question Number	Scheme	Marks
Q3 (a)	$\dfrac{dy}{dx} = 6x^2 - 6x^{-3}$	M1 A1 A1 (3)
(b)	$\dfrac{2x^4}{4} + \dfrac{3x^{-1}}{-1}(+C)$	M1 A1
	$\dfrac{x^4}{2} - 3x^{-1} + C$	A1 (3) **[6]**
(a) (b)	M1 for an attempt to differentiate $x^n \to x^{n-1}$ 1st A1 for $6x^2$ 2nd A1 for $-6x^{-3}$ or $-\dfrac{6}{x^3}$ Condone + $-6x^{-3}$ here. Inclusion of +*c* scores A0 here. M1 for some attempt to integrate an *x* term of the given *y*. $x^n \to x^{n+1}$ 1st A1 for **both** *x* terms correct but unsimplified- as printed or better. Ignore +*c* here 2nd A1 for both *x* terms correct and simplified and +*c*. Accept $-\dfrac{3}{x}$ but <u>NOT</u> $+-3x^{-1}$ Condone the +*c* appearing on the first (unsimplified) line but missing on the final (simplified) line Apply ISW if a correct answer is seen If part (b) is attempted first and this is clearly labelled then apply the scheme and allow the marks. Otherwise assume the first solution is for part (a).	

Question Number	Scheme	Marks
Q4 (a)	$5x > 10$, $x > 2$ [Condone $x > \frac{10}{2} = 2$ for M1A1]	M1, A1 (2)
(b)	$(2x+3)(x-4) = 0$, 'Critical values' are $-\frac{3}{2}$ and 4	M1, A1
	$-\frac{3}{2} < x < 4$	M1 A1ft (4)
(c)	$2 < x < 4$	B1ft (1) **[7]**
(a)	M1 for attempt to collect like terms on each side leading to $ax > b$, or $ax < b$, or $ax = b$ Must have a or b correct so eg $3x > 4$ scores M0	
(b)	1st M1 for an attempt to factorize or solve to find critical values. Method must potentially give 2 critical values 1st A1 for $-\frac{3}{2}$ and 4 seen. They may write $x < -\frac{3}{2}$, $x < 4$ and still get this A1 2nd M1 for choosing the "inside region" for their critical values 2nd A1ft follow through their 2 distinct critical values Allow $x > -\frac{3}{2}$ with "or" "," "$\cup$" " " $x < 4$ to score M1A0 but "and" or "$\cap$" score M1A1 $x \in (-\frac{3}{2}, 4)$ is M1A1 but $x \in [-\frac{3}{2}, 4]$ is M1A0. Score M0A0 for a number line or graph only	
(c)	B1ft Allow if **a correct answer is seen** or follow through their answer to (a) and their answer to (b) but their answers to (a) and (b) must be regions. Do not follow through single values. If their follow through answer is the empty set accept $\varnothing$ or {} or equivalent in words If (a) or (b) are not given then score this mark for cao NB You may see x<4 (with anything or nothing in-between) $x < -1.5$ in (b) and empty set in (c) for B1ft **Do not award marks for part (b) if only seen in part (c)** Use of ≤ instead of < (or ≥ instead of >) loses one accuracy mark only, at first occurrence.	

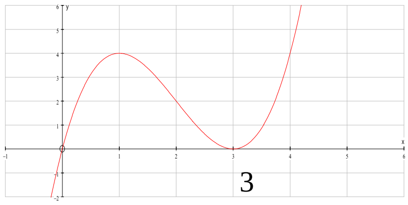
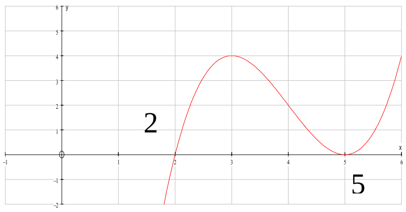
Question Number	Scheme	Marks
Q5 (a)	$a+9d=2400 \qquad a+39d=600$	M1
	$d=\frac{-1800}{30} \qquad d=-60 \qquad$ (accept $\pm$ 60 for A1)	M1 A1 (3)
(b)	$a-540=2400 \qquad a=2940$	M1 A1 (2)
(c)	Total = $\frac{1}{2}n\{2a+(n-1)d\}=\frac{1}{2}\times 40\times(5880+39\times -60)$ (ft values of a and d)	M1 A1ft
	= <u>70 800</u>	A1cao (3) **[8]**
	<u>Note</u>: If the sequence is considered 'backwards', an equivalent solution may be given using d = 60 with a = 600 and l = 2940 for part (b). This can still score full marks. **Ignore labelling of (a) and (b)**	
(a)	1st M1 for an attempt to use 2400 and 600 in $a+(n-1)d$ formula. Must use both values i.e. need $a + pd = 2400$ <u>and</u> $a + qd = 600$ where p = 8 or 9 and q = 38 or 39 (any combination) 2nd M1 for an attempt to solve <u>their</u> 2 linear equations in a and d as far as d =… A1 for $d = \pm 60$. Condone correct equations leading to d = 60 or $a + 8d = 2400$ and $a + 38d = 600$ leading to d = - 60. They should get penalised in (b) and (c). **NB This is a "one off" ruling for A1. Usually an A mark must follow from their work.** ALT 1st M1 for $(30d) = \pm(2400 - 600)$ 2nd M1 for $(d=)\pm\frac{(2400-600)}{30}$ A1 for $d = \pm 60$ $a + 9d = 600$, $a + 39d = 2400$ **only** scores M0 BUT if they solve to find $d = \pm 60$ then use ALT scheme above.	
(b)	M1 for use of <u>their</u> d in a **correct** linear equation to find a leading to a = … A1 their a must be compatible with their d so d = 60 must have a = 600 and d = -60, a = 2940 So for example they can have 2400 = a + 9(60) leading to a = … for M1 but it scores A0 Any approach using a list scores M1A1 for a correct a but M0A0 otherwise	
(c)	M1 for use of a correct S_n formula with n = 40 and at least one of a, d or l correct or correct ft. 1st A1ft for use of a correct S_{40} formula and both a, d or a, l correct or correct follow through ALT Total = $\frac{1}{2}n\{a+l\}=\frac{1}{2}\times 40\times(2940+600)$ (ft value of a) M1 A1ft 2nd A1 for 70800 only	

Question Number	Scheme	Marks
Q6	b^2-4ac attempted, in terms of p.	M1
	$(3p)^2-4p=0$ o.e.	A1
	Attempt to solve for p e.g. $p(9p-4)=0$ Must potentially lead to $p=k,\ k\neq 0$	M1
	$p=\frac{4}{9}$ (Ignore p = 0, if seen)	A1cso
		[4]
	1st M1 for an attempt to substitute into b^2-4ac or $b^2=4ac$ with b or c correct Condone x's in one term only. This can be inside a square root as part of the quadratic formula for example. **Use of inequalities can score the M marks only** 1st A1 for any correct equation: $(3p)^2-4\times1\times p=0$ or better 2nd M1 for an attempt to factorize or solve their quadratic expression in p. Method must be sufficient to lead to their $p=\frac{4}{9}$. Accept factors or use of quadratic formula or $\left(p\pm\frac{2}{9}\right)^2=k^2$ (o.e. eg) $\left(3p\pm\frac{2}{3}\right)^2=k^2$ or equivalent work on <u>their</u> eqn. $9p^2=4p\Rightarrow\frac{9p^{\cancel{2}}}{\cancel{p}}=4$ which would lead to $9p=4$ is OK for this 2nd M1 ALT <u>Comparing coefficients</u> M1 for $(x+\alpha)^2=x^2+\alpha^2+2\alpha x$ and A1 for a correct equation eg $3p=2\sqrt{p}$ M1 for forming solving leading to $\sqrt{p}=\frac{2}{3}$ or better <u>Use of quadratic/discriminant formula (or any formula) Rule for awarding M mark</u> If the formula is quoted accept some correct substitution leading to a partially correct expression. If the formula is not quoted only award for a fully correct expression using their values.	

Question Number	Scheme	Marks
Q7 (a)	$(a_2 =)2k-7$	B1 (1)
(b)	$(a_3 =)2(2k-7)-7$ or $4k-14-7, = 4k-21$ (*)	M1, A1cso (2)
(c)	$(a_4 =)2(4k-21)-7 \quad (=8k-49)$	M1
	$\sum_{r=1}^{4} a_r = k + "(2k-7)" + (4k-21) + "(8k-49)"$	M1
	$k+(2k-7)+(4k-21)+(8k-49) = 15k-77 = 43 \qquad k = 8$	M1 A1 (4) **[7]**
(b) (c)	M1 must see 2(their a_2) - 7 or $2(2k-7)-7$ or $4k-14-7$. Their a_2 must be a function of *k*. A1cso must see the $2(2k-7)-7$ or $4k - 14 - 7$ expression and the $4k$ - 21 with no incorrect working 1st M1 for an attempt to find a_4 using the given rule. Can be awarded for $8k$ - 49 seen. **Use of formulae for the sum of an arithmetic series scores M0M0A0 for the next 3 marks.** 2nd M1 for attempting the sum of the 1st 4 terms. Must have "+" not just , or clear attempt to sum. Follow through their a_2 and a_4 provided they are linear functions of *k*. Must lead to linear expression in *k*. Condone use of their linear $a_3 \neq 4k-21$ here too. 3rd M1 for forming a linear equation in *k* using their sum and the 43 and attempt to solve for *k* as far as $pk = q$ A1 for *k* = 8 only so $k = \frac{120}{15}$ is A0 Answer Only (e.g. trial improvement) Accept *k* = 8 only if 8 + 9 + 11 + 15 = 43 is seen as well Sum $a_2 + a_3 + a_4 + a_5$ or $a_2 + a_3 + a_4$ Allow: M1 if $8k$ - 49 is seen, M0 for the sum (since they are not adding the 1st 4 terms) then M1 if they use their sum along with the 43 to form a linear equation and attempt to solve but A0	

Question Number	Scheme	Marks
Q8 (a)	AB: $m = \frac{2-7}{8-6}$, $\left(= -\frac{5}{2}\right)$	B1
	Using $m_1 m_2 = -1$: $m_2 = \frac{2}{5}$	M1
	$y - 7 = \frac{2}{5}(x-6)$, $2x - 5y + 23 = 0$ (o.e. with integer coefficients)	M1, A1 (4)
(b)	Using $x = 0$ in the answer to (a), $y = \frac{23}{5}$ or 4.6	M1, A1ft (2)
(c)	Area of triangle = $\frac{1}{2} \times 8 \times \frac{23}{5} = \frac{92}{5}$ (o.e) e.g. $\left(18\frac{2}{5},\ 18.4,\ \frac{184}{10}\right)$	M1 A1 (2)
		[8]
(a)	B1 for an expression for the gradient of AB. Does not need the = -2.5 1st M1 for use of the perpendicular gradient rule. Follow through their m 2nd M1 for the use of (6, 7) and their changed gradient to form an equation for l. Can be awarded for $\frac{y-7}{x-6} = \frac{2}{5}$ o.e. Alternative is to use (6, 7) in $y = mx + c$ to find a value for c. Score when $c = \ldots$ is reached. A1 for a correct equation in the required form and must have "= 0" and integer coefficients	
(b)	M1 for using $x = 0$ in their answer to part (a) e.g. $-5y + 23 = 0$ A1ft for $y = \frac{23}{5}$ provided that $x = 0$ clearly seen or C (0, 4.6). Follow through their equation in (a) If $x = 0$, $y = 4.6$ are clearly seen but C is given as (4.6,0) apply ISW and award the mark. This A mark requires a simplified fraction or an exact decimal Accept their 4.6 marked on diagram next to C for M1A1ft	
(c)	M1 for $\frac{1}{2} \times 8 \times y_C$ so can follow through their y coordinate of C. A1 for 18.4 (o.e.) but their y coordinate of C must be positive Use of 2 triangles or trapezium and triangle Award M1 when an expression for area of OCB only is seen Determinant approach Award M1 when an expression containing $\frac{1}{2} \times 8 \times y_C$ is seen	

Question Number	Scheme	Marks
Q9 (a)	$\left[(3-4\sqrt{x})^2 =\right] 9-12\sqrt{x}-12\sqrt{x}+(-4)^2 x$	M1
	$9x^{-\frac{1}{2}}+16x^{\frac{1}{2}}-24$	A1, A1 (3)
(b)	$f'(x)=-\frac{9}{2}x^{-\frac{3}{2}},\ +\frac{16}{2}x^{-\frac{1}{2}}$	M1 A1, A1ft
		(3)
(c)	$f'(9)=-\frac{9}{2}\times\frac{1}{27}+\frac{16}{2}\times\frac{1}{3}=-\frac{1}{6}+\frac{16}{6}=\frac{5}{2}$	M1 A1 (2)
		[8]
(a)	M1 for an attempt to expand $(3-4\sqrt{x})^2$ with at least 3 terms correct- as printed or better Or $9-k\sqrt{x}+16x$ $(k\neq 0)$. See also the MR rule below 1st A1 for their coefficient of $\sqrt{x}$ = 16. Condone writing $(\pm)9x^{(\pm)\frac{1}{2}}$ instead of $9x^{-\frac{1}{2}}$ 2nd A1 for *B* = - 24 or their constant term = - 24	
(b)	M1 for an attempt to differentiate an *x* term $x^n \to x^{n-1}$ 1st A1 for $-\frac{9}{2}x^{-\frac{3}{2}}$ <u>and</u> their constant *B* differentiated to zero. NB $-\frac{1}{2}\times 9x^{-\frac{3}{2}}$ is A0 2nd A1ft follow through their $Ax^{\frac{1}{2}}$ but can be scored without a value for *A*, i.e. for $\frac{A}{2}x^{-\frac{1}{2}}$	
(c)	M1 for some correct substitution of *x* = 9 in <u>their</u> expression for $f'(x)$ including an attempt at $(9)^{\pm\frac{k}{2}}$ (*k* odd) somewhere that leads to some appropriate multiples of $\frac{1}{3}$ or 3 A1 accept $\frac{15}{6}$ or any exact equivalent of 2.5 e.g. $\frac{45}{18},\frac{135}{54}$ or even $\frac{67.5}{27}$ <u>Misread (MR)</u> Only allow MR of the form $\frac{(3-k\sqrt{x})^2}{\sqrt{x}}$ N.B. Leads to answer in (c) of $\frac{k^2-1}{6}$ Score as M1A0A0, M1A1A1ft, M1A1ft	

Question Number	Scheme	Marks
Q10 (a)	$x(x^2-6x+9)$	B1
	$= x(x-3)(x-3)$	M1 A1 (3)
(b)	 Shape 	B1
	<u>Through</u> origin (<u>not</u> touching)	B1
	Touching x-axis only once	B1
	Touching at (3, 0), or 3 on x-axis [Must be on graph not in a table]	B1ft (4)
(c)	 Moved horizontally (either way)	M1
	(2, 0) and (5, 0), or 2 and 5 on x-axis	A1 (2)
		[9]

(a) B1 for correctly taking out a factor of x

M1 for an attempt to factorize their 3TQ e.g. $(x+p)(x+q)$ where $|pq| = 9$.

So $(x-3)(x+3)$ will score M1 but A0

A1 for a fully correct factorized expression - accept $x(x-3)^2$

If they "solve" use ISW

S.C. If the only correct linear factor is $(x - 3)$, perhaps from factor theorem, award B0M1A0

Do not award marks for factorising in part (b)

<u>For the graphs</u>

"Sharp points" will lose the 1st B1 in (b) but otherwise be generous on shape

Condone (0, 3) in (b) and (0, 2), (0,5) in (c) if the points are marked in the correct places.

(b) 2nd B1 for a curve that starts or terminates at (0, 0) score B0

4th B1ft for a curve that touches (not crossing or terminating) at $(a, 0)$ where their $y = x(x-a)^2$

(c) M1 for their graph moved horizontally (only) <u>or</u> a fully correct graph

Condone a partial stretch if ignoring their values looks like a simple translation

A1 for their graph translated 2 to the right <u>and</u> crossing or touching the axis at 2 and 5 only

Allow a fully correct graph (as shown above) to score M1A1 whatever they have in (b)

Question Number	Scheme	Marks
Q11 (a)	$x=2$: $y=8-8-2+9=7$ (*)	B1 (1)
(b)	$\frac{dy}{dx}=3x^2-4x-1$	M1 A1
	$x=2$: $\frac{dy}{dx}=12-8-1(=3)$	A1ft
	$y-7=3(x-2)$, $\underline{y=3x+1}$	M1, <u>A1</u> (5)
(c)	$m=-\frac{1}{3}$ (for $-\frac{1}{m}$ with their m)	B1ft
	$3x^2-4x-1=-\frac{1}{3}$, $9x^2-12x-2=0$ or $x^2-\frac{4}{3}x-\frac{2}{9}=0$ (o.e.)	M1, A1
	$\left(x=\frac{12+\sqrt{144+72}}{18}\right)\left(\sqrt{216}=\sqrt{36}\sqrt{6}=6\sqrt{6}\right)$ or $(3x-2)^2=6\rightarrow 3x=2\pm\sqrt{6}$	M1
	$x=\frac{1}{3}\left(2+\sqrt{6}\right)$ (*)	A1cso (5)
		[11]
(a)	B1 there must be a clear attempt to substitute $x=2$ leading to 7 e.g. $2^3-2\times 2^2-2+9=7$	
(b)	1st M1 for an attempt to differentiate with at least one of the given terms fully correct. 1st A1 for a fully correct expression 2nd A1ft for sub. x= 2 in <u>their</u> $\frac{dy}{dx}(\neq y)$ accept for a correct expression e.g. $3\times(2)^2-4\times 2-1$ 2nd M1 for use of their "3" (provided it comes from their $\frac{dy}{dx}(\neq y)$ and x=2) to find equation of tangent. Alternative is to use (2, 7) in $y=mx+c$ to <u>find a value</u> for c. Award when c = … is seen. **No attempted use of $\frac{dy}{dx}$ in (b) scores 0/5**	
(c)	1st M1 for forming an equation from their $\frac{dy}{dx}(\neq y)$ and their $-\frac{1}{m}$ (must be changed from m) 1st A1 for a correct 3TQ all terms on LHS (condone missing =0) 2nd M1 for proceeding to x =… or $3x$ = … by formula or completing the square for a 3TQ. Not factorising. Condone <u>+</u> 2nd A1 for proceeding to given answer with no incorrect working seen. Can still have <u>+</u>.	
ALT	<u>Verify (for M1A1M1A1)</u> 1st M1 for attempting to square need $\geq$ 3 correct values in $\frac{4+6+4\sqrt{6}}{9}$, 1st A1 for $\frac{10+4\sqrt{6}}{9}$ 2nd M1 Dependent on 1st M1 in this case for substituting in all terms of their $\frac{dy}{dx}$ 2nd A1cso for cso <u>with a full comment</u> e.g. "the x co-ord of Q is ..."	

Mark Scheme (Results)
January 2010

GCE

Core Mathematics C1 (6663)

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Core Mathematics C1 6663
Mark Scheme

Question number	Scheme	Marks
Q1	$x^4 \to kx^3$ or $x^{\frac{1}{3}} \to kx^{-\frac{2}{3}}$ or $3 \to 0$ (k a non-zero constant)	M1
	$\left(\frac{dy}{dx}=\right)$ $4x^3$.......... , with '3' differentiated to zero (or 'vanishing')	A1
	$\left(\frac{dy}{dx}=\right)$ .... $+\frac{1}{3}x^{-\frac{2}{3}}$ or equivalent, e.g. $\frac{1}{3\sqrt[3]{x^2}}$ or $\frac{1}{3\left(\sqrt[3]{x}\right)^2}$	A1 **[3]**
	1st A1 requires $4x^3$, <u>and</u> 3 differentiated to zero. Having '$+C$' loses the 1st A mark. Terms not added, but otherwise correct, e.g. $4x^3$, $\frac{1}{3}x^{-\frac{2}{3}}$ loses the 2nd A mark.	

Question number	Scheme	Marks
Q2	(a) $(7+\sqrt{5})(3-\sqrt{5}) = 21-5+3\sqrt{5}-7\sqrt{5}$ Expand to get 3 or 4 terms $= 16,\ -4\sqrt{5}$ (1st A for 16, 2nd A for $-4\sqrt{5}$) (i.s.w. if necessary, e.g. $16-4\sqrt{5} \to 4-\sqrt{5}$)	M1 A1, A1 (3)
	(b) $\frac{7+\sqrt{5}}{3+\sqrt{5}} \times \frac{3-\sqrt{5}}{3-\sqrt{5}}$ (This is sufficient for the M mark) Correct denominator without surds, i.e. $9-5$ or 4 $4-\sqrt{5}$ or $4-1\sqrt{5}$	M1 A1 A1 (3) **[6]**
	(a) M1: Allowed for an attempt giving 3 or 4 terms, with at least 2 correct (even if unsimplified). e.g. $21-\sqrt{5}^2+\sqrt{15}$ scores M1. Answer only: $16-4\sqrt{5}$ scores full marks One term correct scores the M mark by implication, e.g. $26-4\sqrt{5}$ scores M1 A0 A1 (b) Answer only: $4-\sqrt{5}$ scores full marks One term correct scores the M mark by implication, e.g. $4+\sqrt{5}$ scores M1 A0 A0 $16-\sqrt{5}$ scores M1 A0 A0 Ignore subsequent working, e.g. $4-\sqrt{5}$ so $a=4,\ b=1$ Note that, as always, A marks are dependent upon the preceding M mark, so that, for example, $\frac{7+\sqrt{5}}{3+\sqrt{5}} \times \frac{3+\sqrt{5}}{3-\sqrt{5}} = \frac{........}{4}$ is M0 A0. <u>Alternative</u> $(a+b\sqrt{5})(3+\sqrt{5}) = 7+\sqrt{5}$, then form simultaneous equations in a and b. M1 Correct equations: $3a+5b=7$ and $3b+a=1$ A1 $a=4$ and $b=-1$ A1	

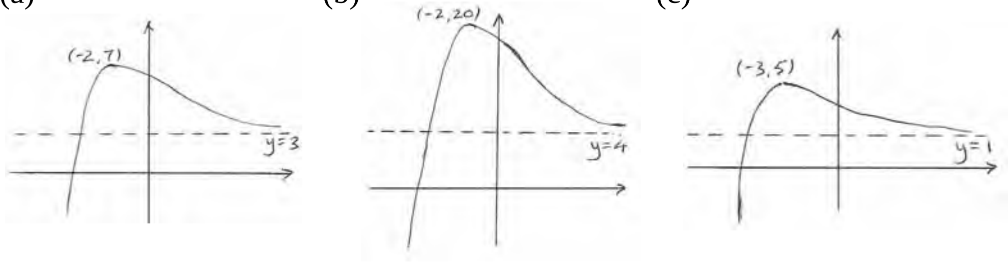
Question number	Scheme	Marks
Q3	(a) Putting the equation in the form $y = mx\ (+c)$ <u>and</u> attempting to extract the m or mx (<u>not</u> the c), or finding 2 points on the line and using the correct gradient formula.	M1
	Gradient $= -\frac{3}{5}$ (or equivalent)	A1 (2)
	(b) Gradient of perp. line $= \frac{-1}{\text{"}\left(-\frac{3}{5}\right)\text{"}}$ (Using $-\frac{1}{m}$ with the m from part (a))	M1
	$y - 1 = \text{"}\left(\frac{5}{3}\right)\text{"}(x-3)$	M1
	$y = \frac{5}{3}x - 4$ (Must be in this form... allow $y = \frac{5}{3}x - \frac{12}{3}$ but not $y = \frac{5x-12}{3}$) This A mark is dependent upon <u>both</u> M marks.	A1 (3) **[5]**
	(a) Condone sign errors and ignore the c for the M mark, so... both marks can be scored even if c is wrong (e.g. $c = -\frac{2}{5}$) or omitted. <u>Answer only</u>: $-\frac{3}{5}$ scores M1 A1. Any other <u>answer only</u> scores M0 A0. $y = -\frac{3}{5}x + \frac{2}{5}$ with no further progress scores M0 A0 (m or mx not extracted). (b) 2nd M: For the equation, in any form, of a straight line through (3, 1) with <u>any</u> numerical gradient (except 0 or ∞). (Alternative is to use (3, 1) in $y = mx + c$ to <u>find a value</u> for c, in which case $y = \frac{5}{3}x + c$ leading to $c = -4$ is sufficient for the A1). (See general principles for straight line equations at the end of the scheme).	

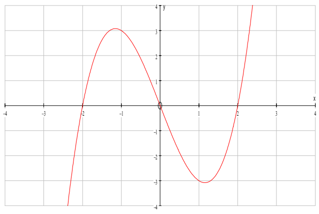
Question number	Scheme	Marks
Q4	$x\sqrt{x} = x^{\frac{3}{2}}$ (Seen, or implied by correct integration)	B1
	$x^{-\frac{1}{2}} \to kx^{\frac{1}{2}}$ or $x^{\frac{3}{2}} \to kx^{\frac{5}{2}}$ (k a non-zero constant)	M1
	$(y =)\ \dfrac{5x^{\frac{1}{2}}}{\frac{1}{2}} ... + \dfrac{x^{\frac{5}{2}}}{\frac{5}{2}}$ $(+C)$ ("$y =$" and " $+C$" are not required for these marks)	A1... A1
	$35 = \dfrac{5 \times 4^{\frac{1}{2}}}{\frac{1}{2}} + \dfrac{4^{\frac{5}{2}}}{\frac{5}{2}} + C$ An equation in C is required (see conditions below). (With their terms simplified or unsimplified).	M1
	$C = \dfrac{11}{5}$ or equivalent $2\dfrac{1}{5}$, 2.2	A1
	$y = 10x^{\frac{1}{2}} + \dfrac{2x^{\frac{5}{2}}}{5} + \dfrac{11}{5}$ (Or equivalent <u>simplified</u>)	A1 ft
	I.s.w. if necessary, e.g. $y = 10x^{\frac{1}{2}} + \dfrac{2x^{\frac{5}{2}}}{5} + \dfrac{11}{5} = 50x^{\frac{1}{2}} + 2x^{\frac{5}{2}} + 11$	
	The final A mark requires an <u>equation</u> "$y = ...$" with correct x terms (see below).	**[7]**
	B mark: $x^{\frac{3}{2}}$ often appears from integration of $\sqrt{x}$, which is B0. 1st A: Any unsimplified or simplified correct form, e.g. $\dfrac{5\sqrt{x}}{0.5}$. 2nd A: Any unsimplified or simplified correct form, e.g. $\dfrac{x^2\sqrt{x}}{2.5}$, $\dfrac{2(\sqrt{x})^5}{5}$. 2nd M: Attempting to use $x = 4$ <u>and</u> $y = 35$ in a changed function (even if differentiated) to form an equation in C. 3rd A: Obtaining $C = \dfrac{11}{5}$ with no earlier incorrect work. 4th A: Follow-through <u>only</u> the value of C (i.e. the other terms must be correct). Accept equivalent <u>simplified</u> terms such as $10\sqrt{x} + 0.4x^2\sqrt{x}$ ...	

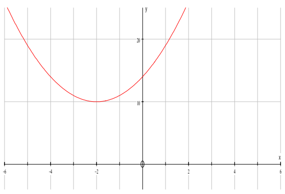
Question number	Scheme	Marks
Q5	$y=3x-2 \qquad (3x-2)^2-x-6x^2(=0)$	M1
	$9x^2-12x+4-x-6x^2=0$	
	$3x^2-13x+4=0$ (or equiv., e.g. $3x^2=13x-4$)	M1 A1cso
	$(3x-1)(x-4)=0 \qquad x=\dots \qquad x=\frac{1}{3}$ (or <u>exact</u> equivalent) $\quad x=4$	M1 A1
	$y=-1 \quad y=10$ (Solutions need not be "paired")	M1 A1
		[7]
	1st M: Obtaining an equation in x only (or y only). Condone missing "= 0" Condone sign slips, e.g. $(3x+2)^2-x-6x^2=0$, but <u>not</u> other algebraic mistakes (such as squaring individual terms... see bottom of page). 2nd M: Multiplying out their $(3x-2)^2$, which must lead to a 3 term quadratic, i.e. ax^2+bx+c, where $a\neq 0,\ b\neq 0,\ c\neq 0$, <u>and</u> collecting terms. 3rd M: Solving a 3-term quadratic (see general principles at end of scheme). 2nd A: Both values. 4th M: Using an x value, found algebraically, to attempt at least one y value (or using a y value, found algebraically, to attempt at least one x value)… allow b.o.d. for this mark in cases where the value is wrong but working is not shown. 3rd A: Both values. If y solutions are given as x values, or vice-versa, penalise at the end, so that it is possible to score M1 M1A1 M1 A1 M0 A0. <u>"Non-algebraic" solutions:</u> No working, and only one correct solution pair found (e.g. $x=4$, $y=10$): M0 M0 A0 M0 A0 M1 A0 No working, and both correct solution pairs found, but not demonstrated: M0 M0 A0 M1 A1 M1 A1 Both correct solution pairs found, and demonstrated: Full marks <u>Alternative</u>: $x=\frac{y+2}{3} \qquad y^2-\frac{y+2}{3}-6\left(\frac{y+2}{3}\right)^2=0$ — M1 $y^2-\frac{y+2}{3}-6\left(\frac{y^2+4y+4}{9}\right)=0 \qquad y^2-9y-10=0$ — M1 A1 $(y+1)(y-10)=0 \qquad y=\dots \qquad y=-1 \quad y=10$ — M1 A1 $x=\frac{1}{3} \quad x=4$ — M1 A1 <u>Squaring each term in the first equation</u>, e.g. $y^2-9x^2+4=0$, and using this to obtain an equation in x only could score at most 2 marks: M0 M0 A0 M1 A0 M1 A0.	

Question number	Scheme	Marks
Q6	(a) $y=\frac{x^2-5x-24}{x}=x-5-24x^{-1}$ (or equiv., e.g. $x+3-8-\frac{24}{x}$)	M1 A1
	$\frac{dy}{dx}=1+24x^{-2}$ or $\frac{dy}{dx}=1+\frac{24}{x^2}$	M1 A1
		(4)
	(b) $x=2$: $y=-15$ Allow if seen in part (a).	B1
	$\left(\frac{dy}{dx}=\right)$ $1+\frac{24}{4}=7$ Follow-through from candidate's <u>non-constant</u> $\frac{dy}{dx}$. This must be simplified to a "single value".	B1ft
	$y+15=7(x-2)$ (or equiv., e.g. $y=7x-29$) Allow $\frac{y+15}{x-2}=7$	M1 A1
		(4) **[8]**
	(a) 1st M: Mult. out to get x^2+bx+c, $b\neq 0$, $c\neq 0$ <u>and</u> dividing by x (<u>not</u> x^2). Obtaining one correct term, e.g. x…….. is sufficient evidence of a division attempt. 2nd M: <u>Dependent on the 1st M</u>: Evidence of $x^n\to kx^{n-1}$ for one x term (i.e. not just the constant term) is sufficient). Note that mark is <u>not</u> given if, for example, the numerator and denominator are differentiated separately. A mistake in the 'middle term', e.g. $x+5-24x^{-1}$, does not invalidate the 2nd A mark, so M1 A0 M1 A1 is possible. (b) B1ft: For evaluation, using $x=2$, of their $\frac{dy}{dx}$, even if unlabelled or called y. M: For the equation, in any form, of a straight line through (2, '–15') with candidate's $\frac{dy}{dx}$ value as gradient. Alternative is to use (2, '–15') in $y=mx+c$ to <u>find a value</u> for c, in which case $y=7x+c$ leading to $c=-29$ is sufficient for the A1). . (See general principles for straight line equations at the end of the scheme). Final A: 'Unsimplified' forms are acceptable, but… $y-(-15)=7(x-2)$ is A0 (unresolved 'minus minus').	

Question number	Scheme	Marks
Q7	(a) $a+9d=150+9\times10=240$	M1 A1 (2)
	(b) $\frac{1}{2}n\{2a+(n-1)d\}=\frac{20}{2}\{2\times150+19\times10\}$, $=4900$	M1 A1, A1 (3)
	(c) Kevin: $\frac{1}{2}n\{2a+(n-1)d\}=\frac{20}{2}\{2A+19\times30\}$ Kevin's total = $2\times$"4900" (or "4900" = $2\times$ Kevin's total) $\frac{20}{2}\{2A+19\times30\}=2\times$"4900" $A=205$	B1 M1 A1ft A1 (4) **[9]**
	(a) M: Using $a+9d$ with at least one of a = 150 and d = 10. Being 'one off' (e.g. equivalent to a + 10d), scores M0. Correct answer with no working scores both marks. (b) M: Attempting to use the correct sum formula to obtain S_{20}, with at least one of a = 150 and d = 10. If the wrong value of n or a or d is used, the M mark is only scored if the correct sum formula has been quoted. 1st A: Any fully correct numerical version. (c) B: A correct expression, in terms of A, for Kevin's total. M: Equating Kevin's total to twice Jill's total, or Jill's total to twice Kevin's. For this M mark, the expression for Kevin's total need not be correct, but must be a linear function of A (or a). 1st A: (Kevin's total, correct, possibly unsimplified) = 2(Jill's total), ft Jill's total from part (b). 'Listing' and other methods (a) M: Listing terms (found by a correct method with at least one of a = 150 and d = 10), and picking the 10th term. (There may be numerical slips). (b) M: Listing sums, or listing and adding terms (found by a correct method with at least one of a = 150 and d = 10), far enough to establish the required sum. (There may be numerical slips). Note: 20th term is 340. A2 (scored as A1 A1) for 4900 (clearly selected as the answer). If no working (or no legitimate working) is seen, but the answer 4900 is given, allow one mark (scored as M1 A0 A0). (c) By trial and improvement: Obtaining a value of A for which Kevin's total is twice Jill's total, or Jill's total is twice Kevin's (using Jill's total from (b)): M1 Obtaining a value of A for which Kevin's total is twice Jill's total (using Jill's total from (b)): A1ft Fully correct solutions then score the B1 and final A1. The answer 205 with no working (or no legitimate working) scores no marks.	

Question number	Scheme	Marks
Q8	(a) (b) (c)  	
	(a) $(-2, 7)$, $y = 3$ (Marks are dependent upon a sketch being attempted) See conditions below.	B1, B1 (2)
	(b) $(-2, 20)$, $y = 4$ (Marks are dependent upon a sketch being attempted) See conditions below.	B1, B1 (2)
	(c) Sketch: Horizontal translation (either way)… (There must be evidence that $y = 5$ at the max and that the asymptote is still $y = 1$) $(-3, 5)$, $y = 1$	B1 B1, B1 (3) **[7]**
	<u>Parts (a) and (b)</u>: (i) If <u>only one</u> of the B marks is scored, there is <u>no penalty</u> for a wrong sketch. (ii) If both the maximum and the equation of the asymptote are correct, the sketch must be "correct" to score B1 B1. If the sketch is "wrong", award B1 B0. The (generous) conditions for a "correct" sketch are that the maximum must be in the 2nd quadrant and that the curve must not cross the positive *x*-axis... ignore other "errors" such as "curve appearing to cross its asymptote" and "curve appearing to have a minimum in the 1st quadrant". <u>Special case</u>: (b) Stretch $\frac{1}{4}$ instead of 4: Correct shape, with $\left(-2, \frac{5}{4}\right)$, $y = \frac{1}{4}$: B1 B0. <u>Coordinates of maximum</u>: If the coordinates are the wrong way round (e.g. $(7, -2)$ in part (a)), or the coordinates are just shown as values on the *x* and *y* axes, penalise <u>only once in the whole question</u>, at first occurrence. <u>Asymptote marks</u>: If the <u>equation</u> of the asymptote is not given, e.g. in part (a), 3 is marked on the *y*-axis but $y = 3$ is not seen, penalise <u>only once in the whole question</u>, at first occurrence. <u>Ignore</u> extra asymptotes stated (such as $x = 0$).	

Question number	Scheme	Marks
Q9	(a) $x(x^2-4)$ Factor x seen in a <u>correct</u> factorised form of the expression. $= x(x-2)(x+2)$ M: Attempt to factorise quadratic (general principles). Accept $(x-0)$ or $(x+0)$ instead of x at any stage. Factorisation must be seen in part (a) to score marks.	B1 M1 A1 (3)
	(b)  Shape  (2 turning points required) Through (or touching) origin Crossing x-axis or "stopping at x-axis" (<u>not</u> a turning point) at (–2, 0) and (2, 0). Allow –2 and 2 on x-axis. Also allow (0, –2) and (0, 2) if marked on x-axis. Ignore extra intersections with x-axis.	B1 B1 B1 (3)
	(c) <u>Either</u> $y = 3$ (at $x = -1$) <u>or</u> $y = 15$ (at $x = 3$) Allow if seen elsewhere. Gradient $= \frac{"15-3"}{3-(-1)}$ $(=3)$ Attempt correct grad. formula with their y values. For gradient M mark, if correct formula not seen, allow one slip, e.g. $\frac{"15-3"}{3-1}$ $y-"15"=m(x-3)$ or $y-"3"=m(x-(-1))$, with any value for m. $y-15=3(x-3)$ or the <u>correct</u> equation in <u>any</u> form, e.g. $y-3=\frac{15-3}{3-(-1)}(x-(-1))$, $\frac{y-3}{x+1}=\frac{15-3}{3+1}$ $y = 3x+6$	B1 M1 M1 A1 A1 (5)
	(d) $AB = \sqrt{("15-3")^2 + (3-(-1))^2}$ (With their <u>non-zero</u> y values)... Square root is required. $= \sqrt{160}$ $\left(= \sqrt{16}\sqrt{10}\right) = 4\sqrt{10}$ (Ignore ± if seen) ($\sqrt{16}\sqrt{10}$ need not be seen).	M1 A1 (2) **[13]**
	(a) $x^3-4x \to x(x^2-4) \to (x-2)(x+2)$ scores B1 M1 A0. $x^3-4x \to x^2-4 \to (x-2)(x+2)$ scores B0 M1 A0 (dividing by x). $x^3-4x \to x(x^2-4x) \to x^2(x-4)$ scores B0 M1 A0. $x^3-4x \to x(x^2-4) \to x(x-2)^2$ scores B1 M1 A0 Special cases: $x^3-4x \to (x-2)(x^2+2x)$ scores B0 M1 A0. $x^3-4x \to x(x-2)^2$ (with no intermediate step seen) scores B0 M1 A0 (b) The 2nd and 3rd B marks are not dependent upon the 1st B mark, but <u>are</u> dependent upon a sketch having been attempted. (c) 1st M: May be implicit in the equation of the line, e.g. $\frac{y-"15"}{3-"15"} = \frac{x-"3"}{-1-"3"}$ 2nd M: An equation of a line through (3, "15") or (–1, "3") <u>in any form</u>, with any gradient (except 0 or ∞). 2nd M: Alternative is to use one of the points in $y = mx + c$ to <u>find a value</u> for c, in which case $y = 3x + c$ leading to $c = 6$ is sufficient for both A marks. 1st A1: <u>Correct</u> equation in <u>any</u> form.	

Question number	Scheme	Marks
Q10	(a) $(x+2k)^2$ or $\left(x+\frac{4k}{2}\right)^2$	M1
	$(x \pm F)^2 \pm G \pm 3 \pm 11k$ (where F and G are <u>any</u> functions of k, not involving x)	M1
	$(x+2k)^2 - 4k^2 + (3+11k)$ Accept unsimplified equivalents such as $\left(x+\frac{4k}{2}\right)^2 - \left(\frac{4k}{2}\right)^2 + 3 + 11k$, <u>and i.s.w. if necessary</u>.	A1 (3)
	(b) Accept part (b) solutions seen in part (a).	
	$"4k^2 - 11k - 3" = 0$ $(4k+1)(k-3) = 0$ $k = \ldots,$ [Or, 'starting again', $b^2 - 4ac = (4k)^2 - 4(3+11k)$ and proceed to $k = \ldots$]	M1
	$-\frac{1}{4}$ and 3 (Ignore any inequalities for the first 2 marks in (b)).	A1
	Using $b^2 - 4ac < 0$ for no real roots, i.e. $"4k^2 - 11k - 3" < 0$, to establish inequalities involving their <u>two</u> critical values m and n (<u>even if the inequalities are wrong</u>, e.g. $k < m$, $k < n$).	M1
	$-\frac{1}{4} < k < 3$ (See conditions below) Follow through their critical values. The final A1ft is still scored if the answer $m < k < n$ follows $k < m$, $k < n$. <u>Using x instead of k in the final answer</u> loses only the 2nd A mark, (condone use of x in earlier working).	A1ft (4)
	(c) Shape  (seen in (c))	B1
	 Minimum in correct quadrant, <u>not</u> touching the x-axis, <u>not</u> on the y-axis, and there must be no other minimum or maximum.	B1
	(0, 14) or 14 on y-axis. Allow (14, 0) marked on y-axis.	B1 (3)
	n.b. Minimum is at $(-2, 10)$, (but there is no mark for this).	**[10]**
	(b) 1st M: Forming and solving a 3-term quadratic in k (usual rules.. see general principles at end of scheme). The quadratic must come from $"b^2 - 4ac"$, or from the $"q"$ in part (a). Using <u>wrong discriminant</u>, e.g. $"b^2 + 4ac"$ will score <u>no marks</u> in part (b). 2nd M: As defined in main scheme above. 2nd A1ft: $m < k < n$, where $m < n$, for their critical values m and n. Other possible forms of the answer (in each case $m < n$): (i) $n > k > m$ (ii) $k > m$ <u>and</u> $k < n$ In this case the word "and" must be seen (implying intersection). (iii) $k \in (m, n)$ (iv) $\{k : k > m\} \cap \{k : k < n\}$ <u>Not</u> just a number line. <u>Not</u> just $k > m$, $k < n$ (without the word "and"). (c) Final B1 is dependent upon a sketch having been attempted in part (c).	

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SOME GENERAL PRINCIPLES FOR C1 MARKING
(But the particular mark scheme always takes precedence)

Method marks

Usually we would overlook simple arithmetic errors or sign slips but the correct **processes** should be used. So dividing by a number instead of subtracting would be M0 but adding a number instead of subtracting would be treated as the correct process but a sign error.

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2+bx+c)=(x+p)(x+q),$ where $|pq|=|c|$, leading to $x = \ldots$

$(ax^2+bx+c)=(mx+p)(nx+q),$ where $|pq|=|c|$ and $|mn|=|a|$, leading to $x = \ldots$

2. Formula

Attempt to use correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2+bx+c=0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c = 0,\ \ q \neq 0$, leading to $x = \ldots$

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values (but refer to the mark scheme first… the application of this principle may vary).
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

Equation of a straight line

Apply the following conditions to the M mark for the equation of a line through (a,b):
If the a and b are the wrong way round the M mark can still be given if a correct formula is seen, (e.g. $y - y_1 = m(x - x_1)$) otherwise M0.
If (a, b) is substituted into $y = mx + c$ to find c, the M mark is for attempting this and scored when c =… is reached.

Answers without working

The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

Misreads

A misread must be consistent for the whole question to be interpreted as such.
These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).
Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.
If in doubt, send the response to Review.

June 2010
Core Mathematics C1 6663
Mark Scheme

Question Number	Scheme	Marks
1.	$\left(\sqrt{75}-\sqrt{27}\right)=5\sqrt{3}-3\sqrt{3}$	M1
	$= 2\sqrt{3}$	A1 **2**
	Notes	
	M1 for $5\sqrt{3}$ from $\sqrt{75}$ or $3\sqrt{3}$ from $\sqrt{27}$ seen anywhere A1 for $2\sqrt{3}$; allow $\sqrt{12}$ or $k=2, x=3$ or allow $k=1, x=12$ Some Common errors $\sqrt{75}-\sqrt{27}=\sqrt{48}$ leading to $4\sqrt{3}$ is M0A0 $25\sqrt{3}-9\sqrt{3}=16\sqrt{3}$ is M0A0	

Question Number	Scheme	Marks
2.	$\dfrac{8x^4}{4}+\dfrac{6x^{\frac{3}{2}}}{\frac{3}{2}}-5x+c$	M1 A1
	$= 2x^4+4x^{\frac{3}{2}},-5x+c$	A1 A1
		4
	Notes	

M1 for some attempt to integrate a term in x: $x^n \to x^{n+1}$

1st A1 for correct, possibly un-simplified x^4 or $x^{\frac{3}{2}}$ term. e.g. $\dfrac{8x^4}{4}$ or $\dfrac{6x^{\frac{3}{2}}}{\frac{3}{2}}$

2nd A1 for <u>both</u> $2x^4$ and $4x^{\frac{3}{2}}$ terms correct and simplified on the same line

N.B. some candidates write $4\sqrt{x^3}$ or $4x^{1\frac{1}{2}}$ which are, of course, fine for A1

3rd A1 for $-5x+c$. Accept $-5x^1+c$.

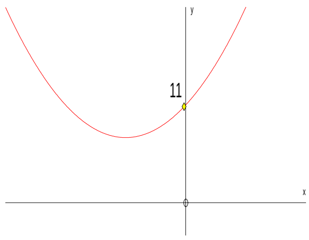
The $+c$ must appear on the same line as the $-5x$

N.B. We do not need to see one line with a fully correct integral

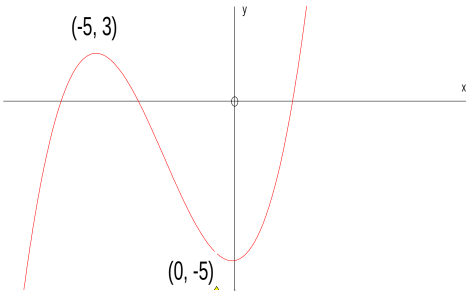
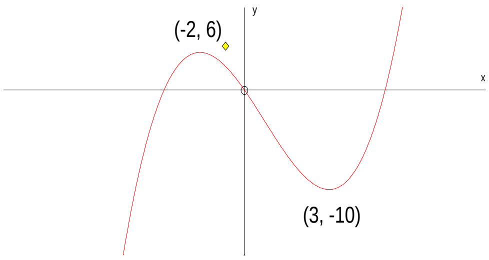
Ignore ISW (ignore incorrect subsequent working) if a correct answer is followed by an incorrect version.

Condone poor use of notation e.g. $\int 2x^4+4x^{\frac{3}{2}}-5x+c$ will score full marks.

Question Number	Scheme	Marks
3. **(a)**	$3x-6<8-2x \rightarrow \; 5x<14$ (Accept $5x-14<0$ (o.e.))	M1
	$x<2.8$ or $\frac{14}{5}$ or $2\frac{4}{5}$ (condone $\leq$)	A1 (2)
(b)	Critical values are $x=\frac{7}{2}$ and -1	B1
	Choosing "inside" $-1<x<\frac{7}{2}$	M1 A1 (3)
(c)	$-1<x<2.8$	B1ft (1)
	Accept any exact equivalents to -1, 2.8, 3.5	**6**
	<u>**Notes**</u>	
(a)	M1 for attempt to rearrange to $kx<m$ (o.e.) Either $k = 5$ or $m = 14$ should be correct Allow $5x = 14$ or even $5x > 14$	
(b)	B1 for both correct critical values. (May be implied by a correct inequality) M1 ft their values and choose the "inside" region A1 for fully correct inequality (Must be in part (b): do not give marks if only seen in (c)) Condone seeing $x < -1$ in working provided $-1 < x$ is in the final answer. e.g. $x>-1,\; x<\frac{7}{2}$ <u>or</u> $x>-1$ "or" $x<\frac{7}{2}$ <u>or</u> $x>-1$ "blank space" $x<\frac{7}{2}$ score M1A0 BUT allow $x>-1$ and $x<\frac{7}{2}$ to score M1A1 (the "and" must be seen) Also $\left(-1,\frac{7}{2}\right)$ will score M1A1 NB $x<-1, x<\frac{7}{2}$ is of course M0A0 and a number line even with "open" ends is M0A0 Allow 3.5 instead of $\frac{7}{2}$	
(c)	B1ft for $-1<x<2.8$ (ignoring their previous answers) <u>or</u> ft their answers to part (a) and part (b) provided both answers were regions and not single values. Allow use of "and" between inequalities as in part (b) If their set is empty allow a suitable description in words or the symbol $\varnothing$. <u>Common error:</u> If (a) is correct and in (b) they simply leave their answer as $x<-1$, $x < 3.5$ then in (c) $x < -1$ would get B1ft as this is a correct follow through of these 3 inequalities. Penalise use of $\leq$ only on the A1 in part (b). [i.e. condone in part (a)]	

Question Number	Scheme	Marks
4. **(a)**	$(x+3)^2+2$ or $p=3$ or $\frac{6}{2}$	B1
	$q=2$	B1 (2)
(b)	 U shape with min in 2nd quad (Must be above *x*-axis and not on *y*=axis)	B1
	U shape crossing *y*-axis at (0, 11) only (Condone (11,0) marked on *y*-axis)	B1 (2)
(c)	$b^2-4ac=6^2-4\times11$	M1
	$= \underline{-8}$	A1 (2)
		6
	Notes	
(a)	Ignore an "= 0" so $(x+3)^2+2=0$ can score both marks	
(b)	The U shape can be interpreted fairly generously. Penalise an obvious V on 1st B1 only. The U needn't have equal "arms" as long as there is a clear min that "holds water" 1st B1 for U shape with minimum in 2nd quad. Curve need not cross the *y*-axis but minimum should NOT touch *x*-axis and should be left of (not on) *y*-axis 2nd B1 for U shaped curve crossing at (0, 11). Just 11 marked on *y*-axis is fine. The point must be marked on the sketch (do not allow from a table of values) Condone stopping at (0, 11)	
(c)	M1 for some correct substitution into b^2-4ac. This may be as part of the quadratic formula but must be in part (c) and must be only numbers (no *x* terms present). Substitution into $b^2<4ac$ or $b^2=4ac$ or $b^2>4ac$ is M0 A1 for -8 only. If they write $-8<0$ treat the <0 as ISW and award A1 If they write $-8\geq0$ then score A0 A substitution in the quadratic formula leading to -8 inside the square root is A0. So substituting into $b^2-4ac<0$ leading to $-8<0$ can score M1A1. Only award marks for use of the discriminant in part (c)	

Question Number	Scheme	Marks
5.		
(a)	$a_2 = \left(\sqrt{4+3}\right) = \sqrt{7}$	B1
	$a_3 = \sqrt{\text{"their 7"}+3} = \sqrt{10}$	B1ft (2)
(b)	$a_4 = \sqrt{10+3}\left(=\sqrt{13}\right)$	M1
	$a_5 = \sqrt{13+3} = 4$ *	A1 cso (2)
		4
	Notes	
(a)	1st B1 for $\sqrt{7}$ only 2nd B1ft follow through their "7" in correct formula provided they have $\sqrt{n}$,where n is an integer.	
(b)	M1 for an attempt to find a_4. Should see $\sqrt{\text{"their"}(a_3)^2 + 3}$. Must see evidence for M1. $a_4 = \sqrt{13}$ provided this follows from their a_3 working or answer is sufficient A1cso for a correct solution (M1 explicit) must include the = 4. Ending at $\sqrt{16}$ only is A0 and ending with $\pm$ 4 is A0. Ignore any incorrect statements that are not used e.g. common difference = $\sqrt{3}$ Listing: A full list: 2 $\left(=\sqrt{4}\right)$, $\sqrt{7}$, $\sqrt{10}$, $\sqrt{13}$, $\sqrt{16} = 4$ is fine for M1A1	
ALT	Formula: Some may state (or use) $a_n = \sqrt{3n+1}$ leading to $a_5 = \sqrt{3\times 5+1} = 4$. This will get marks in (a) [if correct values are seen] and can score the M1 in (b) if $a_n = \sqrt{3n+1}$ or $a_4 = \sqrt{13}$ are seen.	
$\pm\sqrt{\ }$	If $\pm\sqrt{\ }$ appear any where ignore in part (a) and withhold the final A mark only	

Question Number	Scheme		Marks	
6.				
(a)		Horizontal translation of ± 3	M1	
		$(-5, 3)$ marked on sketch **or in text**	B1	
		$(0, -5)$ and min intentionally on y-axis Condone $(-5, 0)$ if correctly placed on negative y-axis	A1	(3)
(b)		Correct shape and intentionally through (0,0) between the max and min	B1	
		$(-2, 6)$ marked on graph **or in text**	B1	
		$(3, -10)$ marked on graph **or in text**	B1	(3)
(c)	$(a =)$ <u>5</u>		B1	(1)

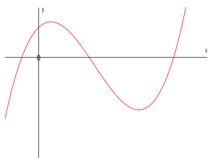
<u>Notes</u>

Turning points (not on axes) should have both co-ordinates given in form(x,y) .
Do not accept points marked on axes e.g. -5on x-axis and 3 on y-axis is not sufficient.
For repeated offenders apply this penalty **once only** at first offence and condone elsewhere.

In (a) and (b) no graphs means no marks.

In (a) and (b) the ends of the graphs do not need to cross the axes provided max and min are clear

(a)

M1 for a horizontal translation of ± 3 so accept  i.e max in 1st quad <u>and</u> coordinates of (1, 3) <u>or</u> (6, -5) seen.
[Horizontal translation to the left should have a min <u>on</u> the y-axis]
If curve passes through (0,0) then M0 (and A0) but they could score the B1 mark.

A1 for minimum clearly on negative y-axis and at least -5 marked on y-axis.
Allow this mark if the minimum is very close and the point $(0, -5)$ clearly indicated

(b)

1st B1 Ignore coordinates for this mark
Coordinates or points on sketch override coordinates given in the text.
Condone (y, x) confusion for points on axes only. So $(-5,0)$ for $(0, -5)$ is OK if the point is marked correctly but (3,10) is B0 even if in 4th quadrant.

(c)

This may be at the bottom of a page or in the question...make sure you scroll up and down!

Question Number	Scheme		Marks
7.	$\frac{3x^2+2}{x}=3x+2x^{-1}$ $(y'=)\,24x^2, -2x^{-\frac{1}{2}}, +3-2x^{-2}$ $\left[24x^2-2x^{-\frac{1}{2}}+3-2x^{-2}\right]$		M1 A1 M1 A1 A1A1 **6**
	Notes		
	1st M1 for attempting to divide(one term correct) 1st A1 for both terms correct on the same line, accept $3x^1$ for $3x$ or $\frac{2}{x}$ for $2x^{-1}$ These first two marks may be implied by a correct differentiation at the end. 2nd M1 for an attempt to differentiate $x^n \to x^{n-1}$ for at least one term of their expression "Differentiating" $\frac{3x^2+2}{x}$ and getting $\frac{6x}{1}$ is M0 2nd A1 for $24x^2$ only 3rd A1 for $-2x^{-\frac{1}{2}}$ allow $\frac{-2}{\sqrt{x}}$. Must be simplified to this, not e.g. $\frac{-4}{2}x^{-\frac{1}{2}}$ 4th A1 for $3-2x^{-2}$ allow $\frac{-2}{x^2}$. Both terms needed. Condone $3+(-2)x^{-2}$ If "+c" is included then they lose this final mark They do not need one line with all terms correct for full marks. Award marks when first seen in this question and apply ISW. Condone a mixed line of some differentiation and some division e.g. $24x^2-4x^{\frac{1}{2}}+3x+2x^{-1}$ can score 1st M1A1 and 2nd M1A1		
Quotient /Product Rule	$\frac{x(6x)-(3x^2+2)\times 1}{x^2}$ or $6x(x^{-1})+(3x^2+2)(-x^{-2})$ $\frac{3x^2-2}{x^2}$ or $3-\frac{2}{x^2}$ (o.e.)	1st M1 for an attempt: $\frac{P-Q}{x^2}$ or $R+(-S)$ with one of P,Q or R,S correct. 1st A1 for a correct expression 4th A1 same rules as above	

Question Number	Scheme	Marks	
8.			
(a)	$m_{AB} = \frac{4-0}{7-2}$ $\left(=\frac{4}{5}\right)$	M1	
	Equation of *AB* is: $y - 0 = \frac{4}{5}(x-2)$ or $y - 4 = \frac{4}{5}(x-7)$ (o.e.)	M1	
	$\underline{4x - 5y - 8 = 0}$ (o.e.)	A1	(3)
(b)	$(AB =)\sqrt{(7-2)^2 + (4-0)^2}$	M1	
	$= \sqrt{41}$	A1	(2)
(c)	Using isos triangle with *AB* = *AC* then $t = 2 \times y_A = 2 \times 4 = 8$	B1	(1)
(d)	Area of triangle = $\frac{1}{2}t \times (7-2)$	M1	
	$= \underline{20}$	A1	(2)
			8

Notes

(a)

Apply the usual rules for quoting formulae here.
For a correctly quoted formula with some correct substitution award M1
If no formula is quoted then a fully correct expression is needed for the M mark

1st M1 for attempt at gradient of *AB*. Some correct substitution in correct formula.

2nd M1 for an attempt at equation of *AB*. Follow through their gradient, not e.g. $-\frac{1}{m}$

Using $y = mx + c$ scores this mark when c is found.

Use of $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$ scores 1st M1 for denominator, 2nd M1 for use of a correct point

A1 requires integer form but allow $5y + 8 = 4x$ etc. Must have an "=" or A0

(b) M1 for an expression for *AB* or AB^2. Ignore what is "left" of the equals sign

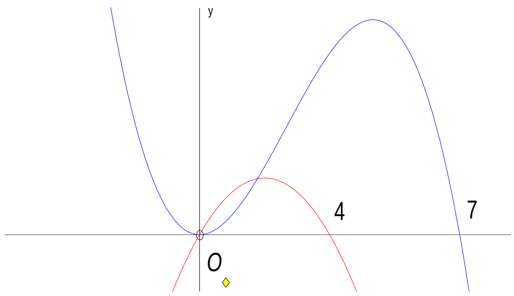
(c) B1 for $t = 8$. May be implied by correct coordinates (2, 8) or the value appearing in (d)

(d) M1 for an expression for the area of the triangle, follow through their t ($\neq 0$) but must have the $(7-2)$ or 5 and the $\frac{1}{2}$.

DET e.g. $\begin{matrix} 2 & 7 & 2 & 2 \\ 0 & 4 & t & 0 \end{matrix}$ Area $= \frac{1}{2}\left[8 + 7t + 0 - (0 + 8 + 2t)\right]$ Must have the $\frac{1}{2}$ for M1

Question Number	Scheme	Marks
9. **(a)**	$a + 29d = 40.75$ or $a = 40.75 - 29d$ or $29d = 40.75 - a$	M1 A1 (2)
(b)	$(S_{30}) = \frac{30}{2}(a+l)$ or $\frac{30}{2}(a+40.75)$ or $\frac{30}{2}(2a+(30-1)d)$ or $15(2a+29d)$	M1
	So $1005 = 15[a + 40.75]$ *	A1 cso (2)
(c)	$67 = a + 40.75$ so <u>a = (£) 26.25 or 2625p or $26\frac{1}{4}$</u> NOT $\frac{105}{4}$	M1 A1
	$29d = 40.75 - 26.25$	M1
	$= 14.5$ so <u>d = (£)0.50 or 0.5 or 50p</u> or $\frac{1}{2}$	A1 (4)
		8
	Notes	

(a)	M1 for attempt to use $a + (n - 1)d$ with n =30 to form an equation . So $a + (30 - 1)d$ = any number is OK A1 as written. Must see $29d$ not just $(30 - 1)d$. Ignore any floating £ signs e.g. $a + 29d =$ £40.75 is OK for M1A1 These two marks must be scored in (a). Some may omit (a) but get correct equation in (c) [or (b)] but we do not give the marks retrospectively.
	Parts (b) and (c) may run together
(b)	M1 for an attempt to use an S_n formula with n =30 . **Must see one of the printed forms.** ($S_{30} =$ is not required) A1cso for forming an equation with 1005 and S_n and simplifying to printed answer. Condone £ signs e.g. 15[a+ £40.75]=1005 is OK for A1
(c)	1st M1 for an attempt to simplify the given linear equation for a. Correct processes. Must get to ka = … or $k = a + m$ i.e. one step (division or subtraction) from a = … Commonly: $15a = 1005 - 611.25$ (= 393.75) 1st A1 For a = 26.25 or 2625p or $26\frac{1}{4}$ NOT $\frac{105}{4}$ or any other fraction 2nd M1 for correct attempt at a linear equation for d, follow through their a or equation in (a) Equation just has to be linear in d, they don't have to simplify to d =… 2nd A1 depends upon 2nd M1 and use of correct a. Do not penalise a second time if there were minor arithmetic errors in finding a provided a = 26.25 (o.e.) is used. Do not accept other fractions other than $\frac{1}{2}$ **If answer is in pence a "p" must be seen.**
Sim Equ	Use this scheme: 1st M1A1 for a and 2nd M1A1 for d. Typically solving: $1005=30a + 435d$ and $40.75 = a + 29d$. If they find d first then follow through use of their d when finding a.

Question Number	Scheme	Marks
10. (a)	 (i) ∩ shape (anywhere on diagram)	B1
	Passing through or stopping at (0, 0) and (4,0) only(Needn't be ∩ shape)	B1
	(ii) correct shape (-ve cubic) with a max and min drawn anywhere	B1
	Minimum or maximum at (0,0)	B1
	Passes through or stops at (7,0) but <u>NOT</u> touching.	B1 (5)
	(7, 0) should be to right of (4,0) or B0	
	Condone (0,4) or (0, 7) marked correctly on *x*-axis. Don't penalise poor overlap near origin.	
	Points must be marked on the sketch...not in the text	
(b)	$x(4-x)=x^2(7-x)$ $(0=)x[7x-x^2-(4-x)]$	M1
	$(0=)x[7x-x^2-(4-x)]$ (o.e.)	B1ft
	$0=x\left(x^2-8x+4\right)$ *	A1 cso (3)
(c)	$\left(0=x^2-8x+4\Rightarrow\right)x=\dfrac{8\pm\sqrt{64-16}}{2}$ or $(x\pm4)^2-4^2+4(=0)$	M1
	$(x-4)^2=12$	A1
	$=\dfrac{8\pm4\sqrt{3}}{2}$ or $(x-4)=\pm2\sqrt{3}$	B1
	$x=4\pm2\sqrt{3}$	A1
	From sketch *A* is $x=4-2\sqrt{3}$	M1
	So $y=\left(4-2\sqrt{3}\right)\left(4-[4-2\sqrt{3}]\right)$ (dependent on 1st M1)	M1
	$\underline{=-12+8\sqrt{3}}$	A1 (7)
		15
	Notes	
(b)	M1 for forming a suitable equation B1 for a common factor of *x* taken out legitimately. Can treat this as an M mark. Can ft their cubic = 0 found from an attempt at solving their equations e.g. $x^3-8x^2-4x=x(\ldots$ A1cso no incorrect working seen. The "= 0" is required but condone missing from some lines of working. Cancelling the *x* scores B0A0.	
(c)	1st M1 for some use of the correct formula or attempt to complete the square 1st A1 for a fully correct expression: condone + instead of $\pm$ **or** for $(x-4)^2=12$ B1 for simplifying $\sqrt{48}=4\sqrt{3}$ or $\sqrt{12}=2\sqrt{3}$ .Can be scored independently of this expression 2nd A1 for correct solution of the form $p+q\sqrt{3}$: can be $\pm$ or + or − 2nd M1 for selecting their answer in the interval (0,4). If they have no value in (0,4) score M0 3rd M1 for attempting *y* =…using their *x* in correct equation. An expression needed for M1A0 3rd A1 for correct answer. If 2 answers are given A0.	

Question Number	Scheme	Marks
11. **(a)**	$(y=)\dfrac{3x^2}{2}-\dfrac{5x^{\frac{1}{2}}}{\frac{1}{2}}-2x \quad (+c)$	M1A1A1
	$\mathrm{f}(4)=5 \quad \Rightarrow 5=\frac{3}{2}\times16-10\times2-8+c$	M1
	$\underline{c=9}$	A1 (5)
	$\left[\mathrm{f}(x)=\frac{3}{2}x^2-10x^{\frac{1}{2}}-2x+9\right]$	
(b)	$m=3\times4-\dfrac{5}{2}-2 \quad \left(=7.5 \text{ or } \dfrac{15}{2}\right)$	M1
	Equation is: $y-5=\dfrac{15}{2}(x-4)$	M1A1
	$\underline{2y-15x+50=0}$ o.e.	A1 (4) **(9marks)**

(a)

1st M1 for an attempt to integrate $x^n \to x^{n+1}$
1st A1 for at least 2 correct terms in *x* (unsimplified)
2nd A1 for all 3 terms in *x* correct (condone missing +*c* at this point). Needn't be simplified
2nd M1 for using the point (4, 5) to form a linear equation for *c*. Must use *x* = 4 and *y* = 5 and have no *x* term and the function must have "changed".
3rd A1 for *c* = 9. The final expression is not required.

(b)

1st M1 for an attempt to evaluate $\mathrm{f}'(4)$. Some correct use of *x* = 4 in $\mathrm{f}'(x)$ but condone slips. They must therefore have at least 3×4 or $-\frac{5}{2}$ and clearly be using $\mathrm{f}'(x)$ with *x* = 4. Award this mark wherever it is seen.

2nd M1 for using their value of *m* [or their $-\dfrac{1}{m}$] (provided it clearly comes from using *x* = 4 in f'(*x*)) to form an equation of the line through (4,5)).

Allow this mark for an attempt at a normal or tangent. Their *m* must be numerical. Use of *y* = *mx* +*c* scores this mark when *c* is found.
1st A1 for any correct expression for the equation of the line
2nd A1 for any correct equation with integer coefficients. An "=" is required. e.g. 2*y* = 15*x* − 50 etc as long as the equation is correct and has integer coefficients.

Normal

Attempt at normal can score both M marks in (b) but A0A0

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Mark Scheme (Results)

January 2011

GCE

GCE Core Mathematics C1 (6663) Paper 1

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General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper
   - $\sqsubset$ The second mark is dependent on gaining the first mark

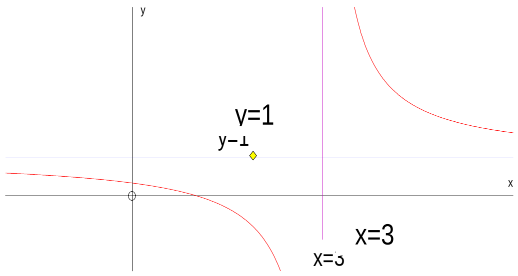
January 2011
Core Mathematics C1 6663
Mark Scheme

Question Number	Scheme	Marks
1.		
(a)	$16^{\frac{1}{4}} = 2$ or $\dfrac{1}{16^{\frac{1}{4}}}$ or better	M1
	$\left(16^{-\frac{1}{4}} =\right) \dfrac{1}{2}$ or 0.5 (ignore $\pm$)	A1
		(2)
(b)	$\left(2x^{-\frac{1}{4}}\right)^4 = 2^4 x^{-\frac{4}{4}}$ or $\dfrac{2^4}{x^{\frac{4}{4}}}$ or equivalent	M1
	$x\left(2x^{-\frac{1}{4}}\right)^4 = 2^4$ or 16	A1 cao
		(2) **4**
	<u>Notes</u>	
(a)	M1 for a correct statement dealing with the $\frac{1}{4}$ or the $-$ power This may be awarded if 2 is seen or for reciprocal of their $16^{\frac{1}{4}}$ s.c ¼ is M1 A0 , also 2^{-1} is M1 A0 $\pm\frac{1}{2}$ is not penalised so M1 A1	
(b)	M1 for **correct** use of the power 4 on both the 2 and the *x* terms A1 for cancelling the *x* and simplifying to one of these two forms. Correct answers with no working get full marks	

Question Number	Scheme	Marks
2.	$\left(\int =\right)\dfrac{12x^6}{6}, -\dfrac{3x^3}{3}, +\dfrac{4x^{\frac{4}{3}}}{\frac{4}{3}}, (+c)$	M1A1,A1,A1
	$= \underline{2x^6 - x^3 + 3x^{\frac{4}{3}} + c}$	A1
		5
	Notes	
	M1 for some attempt to integrate: $x^n \to x^{n+1}$ i.e ax^6 or ax^3 or $ax^{\frac{4}{3}}$ or $ax^{1\frac{1}{3}}$, where a is a non zero constant 1st A1 for $\dfrac{12x^6}{6}$ or better 2nd A1 for $-\dfrac{3x^3}{3}$ or better 3rd A1 for $\dfrac{4x^{\frac{4}{3}}}{\frac{4}{3}}$ or better 4th A1 for each term correct and simplified and the $+c$ occurring in the final answer	

Question Number	Scheme	Marks
3.	$\frac{5-2\sqrt{3}}{\sqrt{3}-1}\times\frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$	M1
	$=\frac{\dots}{2}$ denominator of 2	A1
	Numerator = $5\sqrt{3}+5-2\sqrt{3}\sqrt{3}-2\sqrt{3}$	M1
	So $\frac{5-2\sqrt{3}}{\sqrt{3}-1}=-\frac{1}{2}+\frac{3}{2}\sqrt{3}$	A1
		4
	Alternative: $\left(p+q\sqrt{3}\right)(\sqrt{3}-1)=5-2\sqrt{3}$, and form simultaneous equations in p and q	M1
	$-p + 3q = 5$ and $p - q = -2$	A1
	Solve simultaneous equations to give $p = -\frac{1}{2}$ and $q=\frac{3}{2}$.	M1 A1
	<u>Notes</u>	
	1st M1 for multiplying numerator and denominator by same correct expression 1st A1 for a correct denominator as a single number (NB depends on M mark) 2nd M1 for an attempt to multiply the numerator by $\left(\sqrt{3}\pm1\right)$ and get 4 terms with at least 2 correct. 2nd A1 for the answer as written or $p = -\frac{1}{2}$ and $q=\frac{3}{2}$. Allow -0.5 and 1.5. (Apply isw if correct answer seen, then slip writing p =, q =)	
	Answer only (very unlikely) is full marks if correct – no part marks	

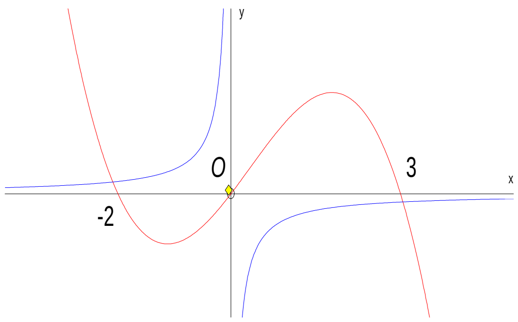
Question Number	Scheme	Marks
4 (a)	$(a_2 =)\ 6 - c$	B1 (1)
(b)	$a_3 = 3(\text{their } a_2) - c$ (= 18 - 4*c*) $a_1 + a_2 + a_3 = 2 + "(6-c)" + "(18-4c)"$ "$26 - 5c$" = 0 So $c = 5.2$	M1 M1 A1ft A1 o.a.e (4) **5**
	Notes	
(b)	1st M1 for attempting a_3. Can follow through their answer to (a) but it must be an expression in *c*. 2nd M1 for an attempt to find the sum $a_1 + a_2 + a_3$ must see evidence of sum 1st A1ft for their sum put equal to 0. Follow through their values but answer must be in the form $p + qc = 0$ A1 – accept any correct equivalent answer	

Question Number	Scheme	Marks
5. **(a)**	 Correct shape with a single crossing of each axis y = 1 labelled or stated x = 3 labelled or stated	B1 B1 B1 (3)
(b)	Horizontal translation so crosses the x-axis at (1, 0) New equation is $(y=)\dfrac{x\pm1}{(x\pm1)-2}$ When $x = 0$ $y =$ $=\dfrac{1}{3}$	B1 M1 M1 A1 (4) **7**
	Notes	
(b)	B1 for point (1,0) identified - this may be marked on the sketch as 1 on x axis. Accept x = 1. 1st M1 for attempt at new equation and either numerator or denominator correct 2nd M1 for setting x = 0 in their new equation and solving as far as y =… A1 for $\frac{1}{3}$ or exact equivalent. Must see $y = \frac{1}{3}$ or (0, $\frac{1}{3}$) or point marked on y-axis. **Alternative** $f(-1)=\dfrac{-1}{-1-2}=\dfrac{1}{3}$ scores M1M1A0 unless x =0 is seen or they write the point as (0, $\frac{1}{3}$) or give y = 1/3 Answers only: x = 1, y = 1/3 is full marks as is (1,0) (0, 1/3) Just 1 and 1/3 is B0 M1 M1 A0 Special case : Translates 1 unit to left (a) B0, B1, B0 (b) Mark (b) as before May score B0 M1 M1 A0 so 3/7 or may ignore sketch and start again scoring full marks for this part.	

Question Number	Scheme	Marks
6.		
(a)	$S_{10}=\frac{10}{2}\left[2a+9d\right]$ or	M1
	$S_{10}=a+a+d+a+2d+a+3d+a+4d+a+5da+6d+a+7d+a+8d+a+9d$	
	$162 = 10a + 45d$ *	A1cso
		(2)
(b)	$\left(u_n=a+(n-1)d \;\Rightarrow\;\right)17=a+5d$	B1
		(1)
	$10\times(b)$ gives $10a+50d=170$	M1
	(a) is $10a + 45d = 162$	
	Subtract $5d = 8$ so d = <u>1.6</u> o.e.	A1
	Solving for a $a = 17 - 5d$	M1
	so a = <u>9</u>	A1
		(4)
		7
	<u>Notes</u>	
(a)	M1 for use of S_n with $n = 10$	
(b)	1st M1 for an attempt to eliminate a or d from their two linear equations 2nd M1 for using their value of a or d to find the other value.	

Question Number	Scheme	Marks
7.	$\left(\mathrm{f}(x)=\right)\dfrac{12x^3}{3}-\dfrac{8x^2}{2}+x\left(+c\right)$	M1 A1 A1
	$\left(\mathrm{f}(-1)=0\Rightarrow\right)\ 0=4\times(-1)-4\times1-1+c$	M1
	$c=\underline{9}$	A1
	$\left[\mathrm{f}(x)=4x^3-4x^2+x+9\right]$	**5**
	<u>Notes</u>	
	1st M1 for an attempt to integrate $x^n\rightarrow x^{n+1}$ 1st A1 for at least 2 terms in *x* correct - needn't be simplified, ignore +*c* 2nd A1 for all the terms in *x* correct but they need not be simplified. No need for +*c* 2nd M1 for using *x* = -1 and *y* =0 to form a linear equation in *c*. No +*c* gets M0A0 3rd A1 for *c* = 9. Final form of f(*x*) is not required.	
8 . **(a)**	$b^2-4ac=\left(k-3\right)^2-4\left(3-2k\right)$	M1
	$k^2-6k+9-4\left(3-2k\right)>0$ or $\left(k-3\right)^2-12+8k>0$ or better	M1
	$\underline{k^2+2k-3>0}$ *	A1cso (3)
(b)	$\left(k+3\right)\left(k-1\right)\left[=0\right]$	M1
	Critical values are *k* = 1 or -3	A1
	(choosing "outside" region)	M1
	$\underline{k>1 \text{ or } k<-3}$	A1 cao (4) **7**
	<u>Notes</u>	
(a)	1st M1 for attempt to find b^2-4ac with one of *b* or *c* correct 2nd M1 for a correct inequality symbol and an attempt to expand. A1cso no incorrect working seen	
(b)	1st M1 for an attempt to factorize **or** solve leading to *k* = (2 values) 2nd M1 for a method that leads them to choose the "outside" region. Can follow through their critical values. 2nd A1 Allow "," instead of "or" $\geq$ loses the final A1 1 < *k* < -3 scores M1A0 unless a correct version is seen before or after this one.	

Question Number	Scheme	Marks
9. **(a)**	$(8-3-k=0)$ so $\underline{k=5}$	B1 (1)
(b)	$2y=3x+k$ $y=\frac{3}{2}x+...$ and so $m=\frac{3}{2}$ o.e.	M1 A1 (2)
(c)	Perpendicular gradient = $-\frac{2}{3}$ Equation of line is: $y-4=-\frac{2}{3}(x-1)$ $\underline{3y+2x-14=0}$ o.e.	B1ft M1A1ft A1 (4)
(d)	$y=0, \Rightarrow B(7,0)$ or $\underline{x=7}$ $x=7$ or $-\frac{c}{a}$	M1A1ft (2)
(e)	$AB^2=(7-1)^2+(4-0)^2$ $AB=\sqrt{52}$ or $2\sqrt{13}$	M1 A1 (2) **11**
	Notes	
(b)	M1 for an attempt to rearrange to $y = \ldots$ A1 for clear statement that gradient is 1.5, can be m =1.5 o.e.	
(c)	B1ft for using the perpendicular gradient rule correctly on their "1.5" M1 for an attempt at finding the equation of the line through A using their gradient. Allow a sign slip 1st A1ft for a correct equation of the line follow through their changed gradient 2nd A1 as printed or equivalent with integer coefficients – allow $\underline{3y+2x=14}$ or $\underline{3y=14-2x}$	
(d)	M1 for use of y = 0 to find x =…in their equation A1ft for $x=7$ or $-\frac{c}{a}$	
(e)	M1 for an attempt to find AB or AB^2 A1 for any correct surd form- need not be simplified	

Question Number	Scheme	Marks
10. **(a)**	 (i) correct shape (-ve cubic) Crossing at (-2, 0) Through the origin Crossing at (3,0) (ii) 2 branches in correct quadrants not crossing axes One intersection with cubic on each branch	B1 B1 B1 B1 B1 B1 (6)
(b)	"2" solutions Since only "2" intersections	B1ft dB1ft (2) **8**
	Notes	
(b)	B1ft for a value that is compatible with their sketch dB1ft This mark is dependent on the value being compatible with their sketch. For a comment relating the number of solutions to the number of intersections. [Only allow 0, 2 or 4]	
11. **(a)**	$\left(\frac{dy}{dx}=\right)\frac{3}{2}x^2-\frac{27}{2}x^{\frac{1}{2}}-8x^{-2}$	M1A1A1A1 (4)
(b)	$x=4 \Rightarrow y=\frac{1}{2}\times 64-9\times 2^3+\frac{8}{4}+30$ $= 32 - 72 + 2 + 30 \qquad = \underline{-8}$ *	M1 A1cso (2)
(c)	$x=4 \Rightarrow y'=\frac{3}{2}\times 4^2-\frac{27}{2}\times 2-\frac{8}{16}$ $= 24-27-\frac{1}{2}= \qquad -\frac{7}{2}$ Gradient of the normal = $-1\div "\frac{7}{2}"$ Equation of normal: $y--8=\frac{2}{7}(x-4)$ $\underline{7y-2x+64=0}$	M1 A1 M1 M1A1ft A1 (6) **12**

Question Number	Scheme	Marks
	Notes	
(a)	1st M1 for an attempt to differentiate $x^n \to x^{n-1}$ 1st A1 for one correct term in x 2nd A1 for 2 terms in x correct 3rd A1 for all correct x terms. No 30 term and no $+c$.	
(b)	M1 for substituting $x = 4$ into $y =$ and attempting $4^{\frac{3}{2}}$ A1 note this is a printed answer	
(c)	1st M1 Substitute x = 4 into y' (allow slips) A1 Obtains –3.5 or equivalent 2nd M1 for correct use of the perpendicular gradient rule using their gradient. (May be slip doing the division) Their gradient must have come from y' 3rd M1 for an attempt at equation of tangent or normal at P 2nd A1ft for correct use of their changed gradient to find **normal** at P. Depends on 1st, 2nd and 3rd Ms 3rd A1 for any equivalent form with integer coefficients	

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Mark Scheme (Results)

June 2011

GCE Core Mathematics C1 (6663) Paper 1

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol √ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - ∗ The answer is printed on the paper
   - ⎿ The second mark is dependent on gaining the first mark

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June 2011
Core Mathematics C1 6663
Mark Scheme

Question Number	Scheme	Marks
1. **(a)**	5 (or ± 5)	B1 (1)
(b)	$25^{-\frac{3}{2}} = \frac{1}{25^{\frac{3}{2}}}$ **or** $25^{\frac{3}{2}} = 125$ or better	M1
	$\frac{1}{125}$ or 0.008 (or $\pm\frac{1}{125}$)	A1
		(2) **3**
	Notes (a) Give B1 for 5 or ± 5 Anything else is B0 (including just –5) (b) M: Requires reciprocal OR $25^{\frac{3}{2}} = 125$ Accept $\frac{1}{5^3}$, $\frac{1}{\sqrt{15625}}$, $\frac{1}{25\times 5}$, $\frac{1}{25\sqrt{25}}$, $\frac{1}{\sqrt{25}^3}$ for M1 Correct answer with no working (or notation errors in working) scores both marks i.e. M1 A1 M1A0 for - $\frac{1}{125}$ without $+\frac{1}{125}$	

Question Number	Scheme	Marks
2. (a)	$\dfrac{dy}{dx} = 10x^4 - 3x^{-4}$ or $10x^4 - \dfrac{3}{x^4}$	M1 A1 A1 (3)
(b)	$\left(\int =\right) \dfrac{2x^6}{6} + 7x + \dfrac{x^{-2}}{-2} = \dfrac{x^6}{3} + 7x - \dfrac{x^{-2}}{2}$ $+ C$	M1 A1 A1 B1 (4) **7**
	Notes (a) M1: Attempt to differentiate $x^n \to x^{n-1}$ (for any of the 3 terms) i.e. ax^4 or ax^{-4}, where a is any non-zero constant or the 7 differentiated to give 0 is sufficient evidence for M1 1st A1: One correct (non-zero) term, possibly unsimplified. 2nd A1: Fully correct **simplified** answer. (b) M1: Attempt to integrate $x^n \to x^{n+1}$ (i.e. ax^6 or ax or ax^{-2}, where a is any non-zero constant). 1st A1: Two correct terms, possibly unsimplified. 2nd A1: All three terms correct and **simplified**. Allow correct equivalents to printed answer , e.g. $\dfrac{x^6}{3} + 7x - \dfrac{1}{2x^2}$ or $\dfrac{1}{3}x^6 + 7x - \dfrac{1}{2}x^{-2}$ Allow $\dfrac{1x^6}{3}$ or $7x^1$ B1: + C appearing at any stage in part (b) (independent of previous work)	

Question Number	Scheme	Marks
3.	Mid-point of PQ is (4, 3)	B1
	PQ: $m = \frac{0-6}{9-(-1)}, \left(= -\frac{3}{5}\right)$	B1
	Gradient perpendicular to PQ $= -\frac{1}{m}$ $\left(= \frac{5}{3}\right)$	M1
	$y - 3 = \frac{5}{3}(x-4)$	M1
	$5x - 3y - 11 = 0$ or $3y - 5x + 11 = 0$ or multiples e.g. $10x - 6y - 22 = 0$	A1 (5) **5**
	Notes B1: correct midpoint. B1: correct numerical expression for gradient – need not be simplified 1st M: Negative reciprocal of their numerical value for m 2nd M: Equation of a line through **their** (4, 3) with any gradient except 0 or ∞. If the 4 and 3 are the wrong way round the 2nd M mark can still be given if a correct formula (e.g. $y - y_1 = m(x - x_1)$) is seen, otherwise M0. If (4, 3) is substituted into $y = mx + c$ to find c, the 2nd M mark is for attempting this. A1: Requires integer form with an = zero (see examples above)	

Question Number	Scheme	Marks
4.	Either: $y^2 = 4 - 4x + x^2$ Or: $x^2 = 4 - 4y + y^2$	M1
	Either: $4(4-4x+x^2) - x^2 = 11$ or $4(2-x)^2 - x^2 = 11$ Or: $4y^2 - (4-4y+y^2) = 11$ or $4y^2 - (2-y)^2 = 11$	M1
	Either: $3x^2 - 16x + 5 = 0$ Or: $3y^2 + 4y - 15 = 0$ Correct 3 terms	A1
	Either: $(3x-1)(x-5) = 0, \quad x = ...$ Or: $(3y-5)(y+3) = 0, \quad y = ...$	M1
	Either: $x = \frac{1}{3} \quad x = 5$ Or: $y = \frac{5}{3} \quad y = -3$	A1
	Either: $y = \frac{5}{3} \quad y = -3$ Or: $x = \frac{1}{3} \quad x = 5$	M1 A1
		(7) **7**

Notes

1st M: Squaring to give 3 or 4 terms (need a middle term)

2nd M: Substitute to give quadratic in one variable (may have just two terms)

3rd M: Attempt to solve a **3 term** quadratic.

4th M: Attempt to find at least one *y* value (or *x* value). (The second variable)

This will be by substitution or by starting again.

If *y* solutions are given as *x* values, or vice-versa, penalise accuracy, so that it is possible to score M1 M1A1 M1 A0 M1 A0.

<u>"Non-algebraic" solutions:</u>

No working, and only one correct solution pair found (e.g. $x = 5$, $y = -3$):
M0 M0 A0 M1 A0 M1 A0

No working, and both correct solution pairs found, but not demonstrated:
M0 M0 A0 M1 A1 M1 A1

Both correct solution pairs found, and demonstrated: Full marks are possible (send to review)

Question Number	Scheme	Marks
5.		
(a)	$(a_2 =)\ 5k+3$	B1 (1)
(b)	$(a_3 =)\ 5(5k+3)+3$	M1
	$= 25k+18$ (*)	A1 cso (2)
(c) **(i)**	$a_4 = 5(25k+18)+3 \quad (=125k+93)$	M1
	$\sum_{r=1}^{4} a_r = k+(5k+3)+(25k+18)+(125k+93)$	M[illegible]
	$= 156k+114$	A[illegible] ao
(ii)	$= 6(26k+19)$ (or explain each term is divisible by 6)	A[illegible] (4) **7**
	<u>Notes</u> (a) $5k + 3$ must be seen in (a) to gain the mark (b) 1st M: Substitutes their a_2 into $5a_2+3$ - note the answer is given so working must be seen. (c) 1st M1: Substitutes their a_3 into $5a_3+3$ or uses $125k+93$ 2nd M1: for **their** sum $k+a_2+a_3+a_4$ - must see evidence of **four terms with plus signs and must not be sum of AP** 1st A1: All correct so far 2nd A1ft: Limited ft – previous answer must be divisible by 6 (eg $156k + 42$) . This is dependent on second M mark in (c) Allow $\frac{156k+114}{6} = 26k+19$ without explanation. No conclusion is needed.	

Question Number	Scheme	Marks
6.		
(a)	$p=\frac{1}{2},\ q=2$ or $6x^{\frac{1}{2}},\ 3x^2$	B1, B1
		(2)
(b)	$\frac{6x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}+\frac{3x^3}{3}$ $\left(=4x^{\frac{3}{2}}+x^3\right)$	M1 A1ft
	$x=4,\ y=90$: $32+64+C=90 \Rightarrow C=-6$	M1 A1
	$y=4x^{\frac{3}{2}}+x^3+\text{"}their-6\text{"}$	A1
		(5)
		7
	Notes	
	(a) Accept any equivalent answers, e.g. p = 0.5, q = 4/2 (b) 1st M: Attempt to integrate $x^n \to x^{n+1}$ (for either term) 1st A: ft their p and q, but terms need not be simplified (+C not required for this mark) 2nd M: Using x = 4 and y = 90 to form an equation in C. 2nd A: cao 3rd A: answer as shown with simplified correct coefficients and powers – but follow through their value for C If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b). Numerator and denominator integrated separately: First M mark **cannot** be awarded so only mark available is second M mark. So 1 out of 5 marks.	

Question Number	Scheme	Marks
7. **(a)**	Discriminant: $b^2-4ac=(k+3)^2-4k$ or equivalent	M1 A1 (2)
(b)	$(k+3)^2-4k=k^2+2k+9=(k+1)^2+8$	M1 A1 (2)
(c)	For real roots, $b^2-4ac\geq 0$ or $b^2-4ac>0$ or $(k+1)^2+8>0$ $(k+1)^2\geq 0$ for all *k*, so $b^2-4ac>0$**,** so roots are real for all *k* (or equiv.)	M1 A1 cso (2) **6**

Notes

(a) M1: attempt to find discriminant – substitution is required

If formula b^2-4ac is seen at least 2 of *a*, *b* and *c* must be correct

If formula b^2-4ac is **not** seen all 3 of *a*, *b* and *c* must be correct

Use of b^2+4ac is M0

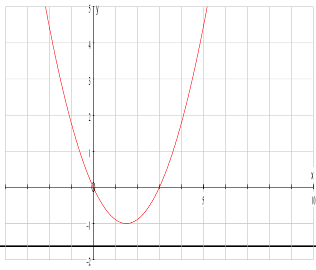
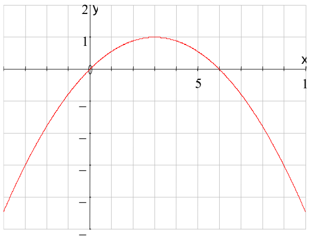
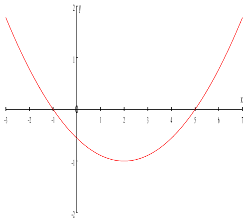
A1: correct unsimplified

(b) M1: Attempt at completion of square (see earlier notes)

A1: both correct (no ft for this mark)

(c) M1: States condition as on scheme **or** attempts to explain that their $(k+1)^2+8$ is greater than 0

A1: The final mark (A1cso) requires $(k+1)^2\geq 0$ and conclusion. We will allow $(k+1)^2>0$ (or word positive) also allow $b^2-4ac\geq 0$ and conclusion.

Question Number	Scheme		Marks
8. **(a)**		Shape  through (0, 0)	B1
		(3, 0)	B1
		(1.5, –1)	B1 (3)
(b)		Shape 	B1
		(0, 0) and (6, 0)	B1
		(3, 1)	B1 (3)
(c)		Shape  , <u>not</u> through (0, 0)	M1
		Minimum in 4^{th} quadrant	A1
		$(-p, 0)$ and $(6-p, 0)$	B1
		$(3-p, -1)$	B1 (4) **10**

<u>Notes</u>

(a) B1: U shaped parabola through origin
B1: (3,0) stated or 3 labelled on x axis
B1: (1.5, -1) or equivalent e.g. (3/2, -1)

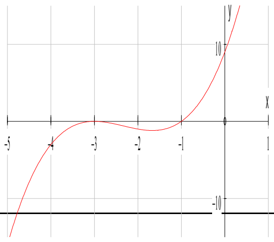
(b) B1: Cap shaped parabola in any position

B1: through origin (may not be labelled) and (6,0) stated or 6 labelled on x - axis
B1: (3,1) shown

(c) M1: U shaped parabola not through origin
A1: Minimum in 4^{th} quadrant (depends on M mark having been given)
B1: Coordinates stated or shown on x axis
B1: Coordinates stated

Note: If values are taken for p, then it is possible to give M1A1B0B0 even if there are several attempts. (In this case all minima should be in fourth quadrant)

Question Number	Scheme	Marks
9. **(a)**	Series has 50 terms	B1
	$S=\frac{1}{2}(50)(2+100)=2550$ or $S=\frac{1}{2}(50)(4+49\times 2)=2550$	M1 A1
		(3)
(b) **(i)**	$\frac{100}{k}$	B1
(ii)	Sum: $\frac{1}{2}\left(\frac{100}{k}\right)(k+100)$ or $\frac{1}{2}\left(\frac{100}{k}\right)\left(2k+\left(\frac{100}{k}-1\right)k\right)$	M1 A1
	$=50+\frac{5000}{k}$ (*)	A1 cso
		(4)
(c)	50^{th} term = $a+(n-1)d$	
	$=(2k+1)+49\text{"}(2k+3)\text{"}$ | Or $2k + 49(2k) + 1 + 49(3)$	M1
	$=100k+148$ | $=100k+148$	A1
		(2)
		9
	Notes	
	(a) B for seeing attempt to use n = 50 or n = 50 stated M for attempt to use $\frac{1}{2}n(a+l)$ or $\frac{1}{2}n(2a+(n-1)d)$ with a = 2 and values for other variables (Using n = 100 may earn B0 M1A0) (b) M for use of $a = k$ and $d = k$ or l = 100 with their value for n , could be numerical or even letter n in correct formula for sum. A1: Correct formula with $n = 100/k$ A1: NB Answer is printed – so no slips should have appeared in working (c) M for use of formula $a+49d$ with $a = 2k$ +1 and with d obtained from difference of terms A1: Requires this simplified answer	

Question Number	Scheme	Marks
10. (a)	 Shape (cubic in this orientation) **Touching** x-axis at **–3** **Crossing** at **–1** on x-axis Intersection at **9** on y-axis	B1 B1 B1 B1 (4)
(b)	$y=(x+1)(x^2+6x+9)=x^3+7x^2+15x+9$ or equiv. (possibly unsimplified) Differentiates their polynomial correctly – may be unsimplified $\frac{dy}{dx}=3x^2+14x+15$ **(*)**	B1 M1 A1 cso (3)
(c)	At $x=-5$: $\frac{dy}{dx}=75-70+15=20$ At $x=-5$: $y=-16$ $y-("-16")="20"(x-(-5))$ or y = "20x" + c with (-5, -"16") used to find c $y=20x+84$	B1 B1 M1 A1 (4)
(d)	Parallel: $3x^2+14x+15="20"$ $(3x-1)(x+5)=0$ $x=\ldots$ $x=\frac{1}{3}$	M1 M1 A1 (3) **14**
	Notes (a) Crossing at –3 is B0. Touching at –1 is B0 (b) M: This needs to be correct differentiation here A1: Fully correct simplified answer. (c) M: If the –5 and "-16" are the wrong way round or – omitted the M mark can still be given if a correct formula is seen, (e.g. $y-y_1=m(x-x_1)$) otherwise M0. m should be numerical and not 0 or infinity and should not have involved negative reciprocal. (d) 1st M: Putting the derivative expression equal to their value for gradient 2nd M: Attempt to solve quadratic (see notes) This may be implied by correct answer.	

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Mark Scheme (Results)

January 2012

GCE Core Mathematics C1 (6663) Paper 1

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January 2012
Publications Code US030304

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⎾ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

General Principals for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$$(x^2 + bx + c) = (x + p)(x + q), \text{ where } |pq| = |c|$$, leading to x = ...

$$(ax^2 + bx + c) = (mx + p)(nx + q), \text{ where } |pq| = |c| \text{ and } |mn| = |a|$$, leading to x = …

2. Formula

Attempt to use correct formula (with values for a, b and c), leading to x = …

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c, \quad q \neq 0$, leading to x = …

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

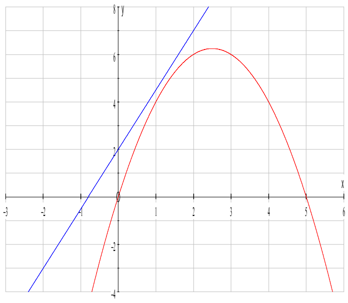
January 2012
C1 6663
Mark Scheme

Question	Scheme	Marks
1. **(a)**	$4x^3 + 3x^{-\frac{1}{2}}$	M1A1A1 (3)
(b)	$\frac{x^5}{5} + 4x^{\frac{3}{2}} + C$	M1A1A1 (3) **6 marks**
	Notes	
(a)	M1 for $x^n \to x^{n-1}$ i.e. x^3 or $x^{-\frac{1}{2}}$ seen 1st A1 for $4x^3$ <u>or</u> $6\times\frac{1}{2}\times x^{-\frac{1}{2}}$ (o.e.) (ignore any + c for this mark) 2nd A1 for simplified terms i.e. <u>both</u> $4x^3$ <u>and</u> $3x^{-\frac{1}{2}}$ or $\frac{3}{\sqrt{x}}$ and no +c $\left[\frac{3}{1}x^{-\frac{1}{2}} \text{ is A0}\right]$ Apply ISW here and award marks when first seen	
(b)	M1 for $x^n \to x^{n+1}$ applied to y only so x^5 or $x^{\frac{3}{2}}$ seen. Do not award for integrating their answer to part (a) 1st A1 for $\frac{x^5}{5}$ or $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ (or better). Allow $1/5x^5$ here but not for 2nd A1 2nd A1 for fully correct and simplified answer with +C. Allow $(1/5)x^5$ If + C appears earlier but not on a line where 2nd A1 could be scored then A0	

Question	Scheme	Marks
2. (a)	$\sqrt{32} = 4\sqrt{2}$ or $\sqrt{18} = 3\sqrt{2}$	B1
	$\left(\sqrt{32}+\sqrt{18}=\right)$ $\underline{7\sqrt{2}}$	B1 (2)
(b)	$\times\dfrac{3-\sqrt{2}}{3-\sqrt{2}}$ <u>or</u> $\times\dfrac{-3+\sqrt{2}}{-3+\sqrt{2}}$ seen	M1
	$\left[\dfrac{\sqrt{32}+\sqrt{18}}{3+\sqrt{2}}\times\dfrac{3-\sqrt{2}}{3-\sqrt{2}}=\right]$ $\dfrac{a\sqrt{2}\left(3-\sqrt{2}\right)}{[9-2]}$ $\rightarrow$ $\dfrac{3a\sqrt{2}-2a}{[9-2]}$ (or better)	dM1
	$= \underline{3\sqrt{2}, -2}$	A1, A1 (4)
ALT	$(b\sqrt{2}+c)(3+\sqrt{2}) = 7\sqrt{2}$ leading to: $3b+c=7$, $3c+2b=0$	M1
	e.g. $3(7-3b)+2b=0$ (o.e.)	dM1
		6 marks
	Notes	
(a)	1st B1 for either surd simplified 2nd B1 for $7\sqrt{2}$ or accept $a = 7$. Answer only scores B1B1 NB Common error is $\sqrt{32}+\sqrt{18}=\sqrt{50}=5\sqrt{2}$ this scores B0B0 but can use their "5" in (b) to get M1M1	
(b)	1st M1 for an attempt to multiply by $\dfrac{3-\sqrt{2}}{3-\sqrt{2}}$ (o.e.) Allow poor use of brackets 2nd dM1 for using $a\sqrt{2}$ to correctly obtain a numerator of the form $p + q\sqrt{2}$ where p and q are non-zero integers. Allow arithmetic slips e.g. $21\sqrt{2}-28$ or $3\sqrt{2}\times\sqrt{2}=3$ Follow through their $a = 7$ or a new value found in (b). Ignore denominator. Allow use of letter a. Dependent on 1st M1 So $3\sqrt{32}-\sqrt{64}+3\sqrt{8}-\sqrt{36}$ is M0 until they reduce $p + q\sqrt{2}$ 1st A1 for $3\sqrt{2}$ or accept $b = 3$ from correct working 2nd A1 for -2 or accept $c = -2$ from correct working	
ALT	**Simultaneous Equations** 1st M1 for $(b\sqrt{2}+c)(3+\sqrt{2}) = 7\sqrt{2}$ and forming 2 simultaneous equations. Ft their $a = 7$ 2nd dM1 for solving their simultaneous equations: reducing to a linear equation in one variable	

Question	Scheme	Marks
3. (a)	$5x > 20$	M1
	$\underline{\mathbf{x > 4}}$	A1 (2)
(b)	$x^2 - 4x - 12 = 0$	
	$(x+2)(x-6)$ [= 0]	M1
	$x = 6,\ -2$	A1
	$x < -2\ ,\ x > 6$	M1, A1ft
		(4)
		6 marks
	Notes	
(a)	M1 for reducing to the form $px > q$ with one of p or q correct Using $px = q$ is M0 unless > appears later on A1 $x > 4$ only	
(b)	1st M1 for multiplying out and attempting to solve a 3TQ with at least $\pm 4x$ or ± 12 See **General Principles** for definitions of "attempt to solve" 1st A1 for 6 and -2 seen. Allow $x > 6$, $x > -2$ etc to score this mark. Values may be on a sketch. 2nd M1 for choosing the "outside region" for their critical values. Do not award simply for a diagram or table – they must have chosen their "outside" regions 2nd A1ft follow through their 2 distinct critical values. Allow "," "or" or a "blank" between answers. Use of "and" is M1A0 i.e. loses the final A1 $-2 > x > 6$ scores M1A0 i.e. loses the final A1 but apply ISW if $x > 6$, $x < -2$ has been seen Accept $(-\infty, -2) \cup (6, \infty)$ (o.e) Use of ≤ instead of < (or ≥ instead of >) loses the final A mark in (b) unless A mark was lost in (a) for $x \geq 4$ in which case allow it here.	

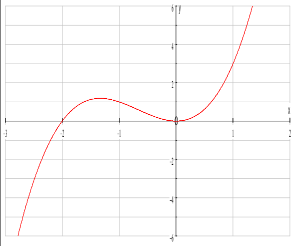
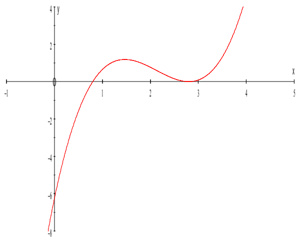
Question	Scheme	Marks
4. (a)	$(x_2 =)\ a + 5$	B1 (1)
(b)	$(x_3) = a"(a+5)"+5$	M1
	$= a^2 + 5a + 5$ **(*)**	A1cso (2)
(c)	$41 = a^2 + 5a + 5 \Rightarrow a^2 + 5a - 36 (= 0)$ or $36 = a^2 + 5a$	M1
	$(a + 9)(a - 4) = 0$	M1
	$a = 4$ or -9	A1 (3)
		6 marks
	Notes	
(a)	B1 accept $a1 + 5$ or $1 \times a + 5$ (etc)	
(b)	M1 must see a(their x_2) + 5 A1cso must have seen $a(a[1] + 5) + 5$ (etc or better) Must have both brackets (....) and no incorrect working seen	
(c)	1st M1 for forming a suitable equation using x_3 and 41 and an attempt to collect like terms and reduce to 3TQ (o.e). Allow one error in sign. Accept for example $a^2 + 5a + 46 (= 0)$ If completing the square should get to $\left(a \pm \frac{5}{2}\right)^2 = 36 + \frac{25}{4}$ 2nd M1 Attempting to solve their relevant 3TQ (**see General Principles**) A1 for both 4 and -9 seen. If $a = 4$ and -9 is followed by $-9 < a < 4$ apply ISW. No working or trial and improvement leading to <u>both</u> answers scores 3/3 but no marks for only one answer. Allow use of other letters instead of a	

Question	Scheme	Marks
5. (a)	$x(5-x)=\frac{1}{2}(5x+4)$ (o.e.)	M1
	$2x^2-5x+4(=0)$ (o.e.) e.g. $x^2-2.5x+2(=0)$	A1
	$b^2-4ac=(-5)^2-4\times2\times4$	M1
	$=25-32$ <0, so no roots <u>or</u> no intersections <u>or</u> no solutions	A1 (4)
(b)		
	Curve: $\cap$ shape and passing through (0, 0)	B1
	$\cap$ shape and passing through (5, 0)	B1
	Line : +ve gradient and no intersections with *C*. If no *C* drawn score B0	B1
	Line passing through (0, 2) and (−0.8, 0) marked on axes	B1 (4)
		8 marks

	Notes
(a)	1st M1 for forming a suitable equation in one variable
	1st A1 for a correct 3TQ equation. Allow missing "= 0" Accept $2x^2+4=5x$ etc
	2nd M1 for an attempt to evaluate discriminant for their 3TQ. Allow for $b^2>4ac$ or $b^2<4ac$
	Allow if it is part of a solution using the formula e.g. $(x=)\frac{5\pm\sqrt{25-32}}{4}$
	Correct formula quoted and some correct substitution or a correct expression
	False factorising is M0
	2nd A1 for correct evaluation of discriminant for a correct 3TQ e.g. 25 – 32 (or better) <u>and</u> a comment indicating no roots or equivalent. For <u>contradictory</u> statements score A0
ALT	2nd M1 for attempt at completing the square $a\left[\left(x\pm\frac{b}{2a}\right)^2-q\right]+c$
	2nd A1 for $\left(x-\frac{5}{4}\right)^2=-\frac{7}{16}$ and a suitable comment
(b)	**Coordinates must be seen <u>on</u> the diagram. Do not award if only in the body of the script.**
	"Passing through" means <u>not</u> stopping at and <u>not</u> touching.
	Allow (0, *x*) and (*y*, 0) if marked on the correct places on the correct axis.
	1st B1 for correct shape and passing through origin. Can be assumed if it passes through the intersection of axes
	2nd B1 for correct shape and 5 marked on *x*-axis
SC	for $\cap$ shape stopping at <u>both</u> (5, 0) <u>and</u> (0, 0) award B0B1
	3rd B1 for a line of positive gradient that (if extended) has no intersection with their *C* (possibly extended). Must have both graphs on same axes for this mark. If no *C* given score B0
	4th B1 for straight line passing through -0.8 on *x*-axis and 2 on *y*-axis
	Accept exact fraction equivalents to –0.8 or 2(e.g. $\frac{4}{2}$)

Question	Scheme	Marks
6. (a)	$(m=)\frac{2}{3}$ (or exact equivalent)	B1 (1)
(b)	B: (0, 4) [award when first seen – may be in (c)]	B1
	Gradient: $\frac{-1}{m}=-\frac{3}{2}$	M1
	$y-4=-\frac{3x}{2}$ or equiv. e.g. $\left(y=-\frac{3x}{2}+4,\quad 3x+2y-8=0\right)$	A1 (3)
(c)	A: $(-6,0)$ [award when first seen – may be in (b)]	B1
	C: $\frac{3x}{2}=4 \Rightarrow x=\frac{8}{3}$ [award when first seen – may be in (b)]	B1ft
	Area: Using $\frac{1}{2}(x_C-x_A)y_B$	M1
	$=\frac{1}{2}\left(\frac{8}{3}+6\right)4=\frac{52}{3}\ \left(=17\frac{1}{3}\right)$	A1 cso (4)
ALT	$BC=\frac{4}{6}\sqrt{52}$ (from similar triangles) (or possibly using C)	2nd B1ft
	Area: Using $\frac{1}{2}(AB\times BC)$ N.B. $AB=\sqrt{6^2+4^2}=\sqrt{52}$	M1
	$=\frac{1}{2}\times\sqrt{52}\times\left(\frac{2}{3}\sqrt{52}\right)=\frac{52}{3}\ \left(=17\frac{1}{3}\right)$	A1
		8 marks
	Notes	
(a)	B1 for $\frac{2}{3}$ seen. Do not award for $\frac{2}{3}x$ and must be in part (a)	
(b)	B1 for coordinates of B. Accept 4 marked on y-axis (clearly labelled) M1 for use of perpendicular gradient rule. Follow through their value for m A1 for a correct equation (any form, need not be simplified). Answer only 3/3	
(c)	1st B1 for the coordinates of A (clearly labelled). Accept – 6 marked on x-axis 2nd B1ft for the coordinates of C (clearly labelled) or $AC=\frac{26}{3}$. Accept $x=\frac{8}{3}$ marked on x-axis. Follow through from l_2 if >0 M1 for an expression for the area of the triangle (all lengths > 0). Ft their 4, - 6 and $\frac{8}{3}$ A1 cso for $\frac{52}{3}$ or exact equivalent seen but must be a single fraction or $17\frac{1}{3}$ or $17\frac{2}{6}$ etc $17\frac{1}{3}$ on its own can only score full marks if A, B and C are all correct.	
ALT	2nd B1ft If they use this approach award this mark for C (if seen) or BC	
Use of Det	2nd M1 must get as far as: $\frac{1}{2}\lvert x_A\times y_B-x_C\times y_B\rvert$	

Question	Scheme	Marks
7.	$\left[\text{f}(x)=\right]\dfrac{3x^3}{3}-\dfrac{3x^2}{2}+5x\left[+c\right]$ <u>or</u> $\left\{x^3-\dfrac{3}{2}x^2+5x(+c)\right\}$	M1A1
	$10 = 8 - 6 + 10 + c$	M1
	$c = -2$	A1
	$\text{f}(1) = 1-\dfrac{3}{2}+5 \quad "-2" = \dfrac{5}{2}$ (o.e.)	A1ft (5)
		5 marks
	Notes	
	1st M1 for attempt to integrate $x^n \to x^{n+1}$ 1st A1 all correct, possibly unsimplified. Ignore $+c$ here. 2nd M1 for using $x = 2$ <u>and</u> f(2) = 10 to form a linear equation in c. Allow sign errors. They should be substituting into a <u>changed</u> expression 2nd A1 for $c = -2$ 3rd A1ft for $\dfrac{9}{2}+c$ Follow through their <u>numerical</u> c ($\neq 0$) This mark is dependent on 1st M1 and 1st A1 only.	

Question	Scheme	Marks
8. (a)	$[\, y = x^3 + 2x^2 \,]$ so $\frac{dy}{dx} = 3x^2 + 4x$	M1A1 (2)
(b)		
	Shape 	B1
	Touching x-axis at origin	B1
	Through and not touching or stopping at -2 on x –axis. Ignore extra intersections.	B1 (3)
(c)	At $x = -2$: $\frac{dy}{dx} = 3(-2)^2 + 4(-2) = 4$	M1
	At $x = 0$: $\frac{dy}{dx} = 0$ (Both values correct)	A1 (2)
(d)		
	Horizontal translation (touches x-axis still)	M1
	$k-2$ and k marked on positive x-axis	B1
	$k^2(2-k)$ (o.e) marked on negative y-axis	B1 (3)
		10 marks

	Notes	
(a)	M1 for attempt to multiply out and then some attempt to differentiate $x^n \to x^{n-1}$ Do not award for $2x(\, x + 2)$ or $2x\,(1 + 2)$ etc	
Prod Rule	Award M1 for a correct attempt: 2 products with a + and at least one product correct A1 for both terms correct. (If $+c$ or extra term is included score A0)	
(b)	1st B1 for correct shape (anywhere). Must have 2 clear turning points. 2nd B1 for graph touching at origin (not crossing or ending) 3rd B1 for graph passing through (not stopping or touching at) -2 on x axis and -2 marked on axis	
SC	B0B0B1 for $y = x^3$ <u>or</u> cubic with straight line between $(-2, 0)$ and $(0, 0)$	
(c)	M1 for attempt at $y'(0)$ or $y'(-2)$. Follow through their 0 or – 2 and their $y'(x)$ <u>or</u> for a <u>correct</u> statement of zero gradient for an identified point on their curve that touches x-axis A1 for both correct answers	
(d)	For the M1 in part (d) ignore any coordinates marked – just mark the shape. M1 for a horizontal translation of their (b). Should still touch x – axis if it did in (b) <u>Or</u> for a graph of correct shape with min. and intersection in correct order on +ve x-axis 1st B1 for k and k – 2 on the positive x-axis. Curve must pass through k – 2 and touch at k 2nd B1 for a correct intercept on negative y-axis in terms of k. Allow $(0, 2k^2 - k^3)$ (o.e.) seen in script if curve passes through –ve y-axis	

Question	Scheme	Marks
9. (a)	$S_{10}=\frac{10}{2}\left[2P+9\times 2T\right]$ <u>or</u> $\frac{10}{2}\left(P+[P+18T]\right)$	M1
	e.g. $5[2P+18T]$ = (£) (10P + 90T) <u>or</u> (£) 10P + 90T **(*)**	A1cso (2)
(b)	Scheme 2: $S_{10}=\frac{10}{2}\left[2(P+1800)+9T\right]=\{10P+18000+45T\}$	M1A1
	10P + 90T = 10P + 18000 + 45T	M1
	90T = 18000 + 45T	
	T = 400 (only)	A1 (4)
(c)	Scheme 2, Year 10 salary: $\left[a+(n-1)d=\right](P+1800)+9T$	B1ft
	P + 1800 + "3600" = 29850	M1
	P = (£) <u>24450</u>	A1 (3)
		9 marks

	Notes
(a)	M1 for identifying $a = P$ or $d = 2T$ and attempt at S_{10}. Using n = 10 and one of a or d correct. Must see evidence for M mark, at least one line before the answer.
	A1cso for simplifying to given answer. No incorrect working seen. Do not penalise missing end bracket in working eg 5(2P + 18T
List	M1A1 for a full list seen (with + signs or written in columns) and no incorrect working seen. Any missing terms is M0A0
(b)	1st M1 for attempting S_{10} for scheme 2 (allow missing (…) brackets e.g. 2P + 1800 + 9T) Using n = 10 and at least one of a or d correct.
	1st A1 for a correct expression for S_{10} using scheme 2 (needn't be multiplied out)
List	Allow M1A1 if they reach 10P + 18000 + 45T with no incorrect working seen. 10P + 18000 + 45T with no working is M1A1
	2nd M1 for forming an equation using the two sums that would enable P to be eliminated. Follow through their expressions provided P would disappear.
	2nd A1 for T = 400 Answer only (4/4)
(c)	B1 for using u_{10} for scheme 2 . Can be 9T or follow through their <u>value</u> of T
	M1 for forming an equation based on u_{10} for scheme 2 and using 29850 and their <u>value</u> of T
	A1 for 24450 seen Answer only (3/3)
MR	If they misread scheme 2 as scheme 1 in part (c) apply MR rule and award B0M1A0 max for an equation based on u_{10} for scheme 1 and using 29850 and their <u>value</u> of T

Question	Scheme	Marks
10. (a)	$\left(\frac{1}{2}, 0\right)$	B1 (1)
(b)	$\frac{dy}{dx} = x^{-2}$	M1A1
	At $x = \frac{1}{2}$, $\frac{dy}{dx} = \left(\frac{1}{2}\right)^{-2} = 4$ $(= m)$	A1
	Gradient of normal $= -\frac{1}{m}$ $\left(= -\frac{1}{4}\right)$	M1
	Equation of normal: $y - 0 = -\frac{1}{4}\left(x - \frac{1}{2}\right)$	M1
	$2x + 8y - 1 = 0$ **(*)**	A1cso (6)
(c)	$2 - \frac{1}{x} = -\frac{1}{4}x + \frac{1}{8}$	M1
	$[= 2x^2 + 15x - 8 = 0]$ <u>or</u> $[8y^2 - 17y = 0]$	
	$(2x-1)(x+8) = 0$ leading to $x = \ldots$	M1
	$x = \left[\frac{1}{2}\right]$ or -8	A1
	$y = \frac{17}{8}$ (or exact equivalent)	A1ft (4)
		11 marks
	Notes	

(a)	B1 accept $x = \frac{1}{2}$ if evidence that $y = 0$ has been used. Can be written on graph. Use ISW
(b)	1st M1 for kx^{-2} even if the '2' is not differentiated to zero. If no evidence of $\frac{dy}{dx}$ seen then 0/6 1st A1 for x^{-2} (o.e.) only 2nd A1 for using $x = 0.5$ to get $m = 4$ (correctly) (or $m = 1/0.25$) To score final A1cso must see at least one intermediate equation for the line after $m = 4$ 2nd M1 for using the perpendicular gradient rule on their m coming from their $\frac{dy}{dx}$ Their m must be a value not a letter. 3rd M1 for using a changed gradient (based on y') and their A to find equation of line 3rd A1cso for reaching printed answer with no incorrect working seen. Accept $2x + 8y = 1$ or equivalent equations with $\pm 2x$ and $\pm 8y$ Trial and improvement requires sight of first equation.
(c)	1st M1 for attempt to form a suitable equation in one variable. Do not penalise poor use of brackets etc. 2nd M1 for simplifying their equation to a 3TQ and attempting to solve. May be $\Rightarrow$ by $x = -8$ 1st A1 for $x = -8$ (ignore a second value). If found y first allow ft for x if $x < 0$ 2nd A1ft for $y = \frac{17}{8}$ Follow through their x value in line or curve provided answer is > 0 This second A1 is dependent on <u>both</u> M marks

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Rewarding Learning

Mark Scheme (Results)

Summer 2012

GCE Core Mathematics C1
(6663) Paper 1

ALWAYS LEARNING

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Summer 2012
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Summer 2012
6663 Core Mathematics
C1 Mark Scheme

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- □ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x = ...

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*), leading to x = ...

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c, \quad q \neq 0$, leading to x = ...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required.

Summer 2012
6663 Core Mathematics C1
Mark Scheme

Question Number	Scheme	Marks
1.	$\left\{\int\left(6x^2+\frac{2}{x^2}+5\right)\mathrm{d}x\right\} = \frac{6x^3}{3}+\frac{2x^{-1}}{-1}+5x\,(+c)$ $= 2x^3-2x^{-1}\ ;+5x+c$	M1 A1 A1; A1 **4**
	Notes	
	M1: for some attempt to integrate a term in x: $x^n \to x^{n+1}$ So seeing either $6x^2 \to \pm\lambda x^3$ or $\frac{2}{x^2} \to \pm\mu x^{-1}$ or $5 \to 5x$ is M1. **1st A1**: for a correct un-simplified x^3 or x^{-1} $\left(\text{or } \frac{1}{x}\right)$ term. **2nd A1:** for both x^3 and x^{-1} terms correct and simplified on the same line. Ie. $2x^3-2x^{-1}$ or $2x^3-\frac{2}{x}$. **3rd A1:** for $+5x+c$. Also allow $+5x^1+c$. This needs to be written on the same line. **Ignore the incorrect use of the integral sign in candidates' responses.** **Note:** If a candidate scores M1A1A1A1 and their answer is NOT ON THE SAME LINE then withhold the final accuracy mark.	

Question Number	Scheme	Marks
2. (a)	$\left\{(32)^{\frac{3}{5}}\right\} = \left(\sqrt[5]{32}\right)^3$ or $\sqrt[5]{(32)^3}$ or 2^3 or $\sqrt[5]{32768}$	M1
	$= 8$	A1
		[2]
(b)	$\left\{\left(\frac{25x^4}{4}\right)^{-\frac{1}{2}}\right\} = \left(\frac{4}{25x^4}\right)^{\frac{1}{2}}$ or $\left(\frac{5x^2}{2}\right)^{-1}$ or $\frac{1}{\left(\frac{25x^4}{4}\right)^{\frac{1}{2}}}$ ***See notes below***	M1
	$= \frac{2}{5x^2}$ or $\frac{2}{5}x^{-2}$ ***See notes for other alternatives***	A1
		[2]
		4
	Notes	
(a)	**M1**: for a full correct interpretation of the fractional power. **Note:** $5\times(32)^3$ is M0. **A1:** for 8 only. **Note:** Award M1A1 for writing down 8.	
(b)	**M1:** For use of $\frac{1}{2}$ OR use of -1 **Use of $\frac{1}{2}$:** Candidate needs to demonstrate the they have rooted all three elements in their bracket. **Use of -1:** Either Candidate has $\frac{1}{\text{Bracket}}$ or $\left(\frac{Ax^C}{B}\right)$ becomes $\left(\frac{B}{Ax^C}\right)$. Allow M1 for... • $\left(\frac{4}{25x^4}\right)^{\frac{1}{2}}$ or $\left(\frac{5x^2}{2}\right)^{-1}$ or $\frac{1}{\left(\frac{25x^4}{4}\right)^{\frac{1}{2}}}$ or $\sqrt{\left(\frac{4}{25x^4}\right)}$ or $\frac{1}{\sqrt{\left(\frac{25x^4}{4}\right)}}$ or $\left(\frac{\frac{1}{25x^4}}{\frac{1}{4}}\right)^{\frac{1}{2}}$ or $\frac{\frac{1}{5x^2}}{\frac{1}{2}}$ or $\frac{\frac{1}{5}x^{-2}}{\frac{1}{2}}$ or $-\left(\frac{5x^2}{2}\right)$ or $\left(\frac{-5x^{-2}}{-2}\right)$ or $-\left(\frac{5x^{-2}}{2}\right)$ or $\frac{5x^{-2}}{2}$ • $\left(\frac{4}{25x^4}\right)^K$ or $\left(\frac{5x^2}{2}\right)^C$ where K, C are any powers including 1. **A1:** for either $\frac{2}{5x^2}$ or $\frac{2}{5}x^{-2}$ or $0.4x^{-2}$ or $\frac{0.4}{x^2}$. **Note:** $\left(\sqrt{\left(\frac{25x^4}{4}\right)}\right)^{-1}$ is not enough work by itself for the method mark. **Note:** A final answer of $\frac{1}{\frac{5}{2}x^2}$ or $\frac{1}{2\frac{1}{2}x^2}$ or $\frac{1}{2.5x^2}$ is A0. **Note**: Also allow $\pm\frac{2}{5x^2}$ or $\pm\frac{2}{5}x^{-2}$ or $\pm 0.4x^{-2}$ or $\pm\frac{0.4}{x^2}$ for A1.	

Question Number	Scheme		Marks
3.	$\left\{\dfrac{2}{\sqrt{12}-\sqrt{8}}\right\} = \dfrac{2}{(\sqrt{12}-\sqrt{8})} \times \dfrac{(\sqrt{12}+\sqrt{8})}{(\sqrt{12}+\sqrt{8})}$	Writing this is sufficient for M1.	M1
	$= \dfrac{\{2(\sqrt{12}+\sqrt{8})\}}{12-8}$	For $12-8$. This mark can be implied.	A1
	$= \dfrac{2(2\sqrt{3}+2\sqrt{2})}{12-8}$		B1 B1
	$= \sqrt{3}+\sqrt{2}$		A1 **cso**
			5
	Notes		

M1: for a correct method to rationalise the denominator.

1st A1: $(\sqrt{12}-\sqrt{8})(\sqrt{12}+\sqrt{8}) \to 12-8$ or $(\sqrt{3}+\sqrt{2})(\sqrt{3}-\sqrt{2}) \to 3-2$

1st B1: for $\sqrt{12} = 2\sqrt{3}$ or $\sqrt{48} = 4\sqrt{3}$ seen or implied in candidate's working.

2nd B1: for $\sqrt{8} = 2\sqrt{2}$ or $\sqrt{32} = 4\sqrt{2}$ seen or implied in candidate's working.

2nd A1: for $\sqrt{3}+\sqrt{2}$. Note: $\dfrac{\sqrt{3}+\sqrt{2}}{1}$ as a final answer is A0.

Note: The first accuracy mark is dependent on the first method mark being awarded.

Note: $\frac{1}{2}\sqrt{12}+\frac{1}{2}\sqrt{8} = \sqrt{3}+\sqrt{2}$ with no intermediate working implies the B1B1 marks.

Note: $\sqrt{12} = \sqrt{4}\sqrt{3}$ or $\sqrt{8} = \sqrt{4}\sqrt{2}$ are not sufficient for the B1 marks.

Note: A candidate who writes down (by misread) $\sqrt{18}$ for $\sqrt{8}$ can potentially obtain M1A0B1B1A0, where the 2nd B1 will be awarded for $\sqrt{18} = 3\sqrt{2}$ or $\sqrt{72} = 6\sqrt{2}$

Note: The final accuracy mark is for a correct solution only.

<u>Alternative 1 solution</u>

$\left\{\dfrac{2}{\sqrt{12}-\sqrt{8}}\right\} = \dfrac{2}{(2\sqrt{3}-2\sqrt{2})}$ B1 B1

$= \dfrac{1}{(\sqrt{3}-\sqrt{2})} \times \dfrac{(\sqrt{3}+\sqrt{2})}{(\sqrt{3}+\sqrt{2})}$ M1

$= \dfrac{\{(\sqrt{3}+\sqrt{2})\}}{3-2}$ A1 for $3-2$

$= \sqrt{3}+\sqrt{2}$ A1

Please record the marks in the relevant places on the mark grid.

<u>Alternative 2 solution</u>

$\left\{\dfrac{2}{\sqrt{12}-\sqrt{8}}\right\} = \dfrac{2}{(2\sqrt{3}-2\sqrt{2})} = \dfrac{1}{(\sqrt{3}-\sqrt{2})} = \sqrt{3}+\sqrt{2}$, or $\dfrac{2}{(2\sqrt{3}-2\sqrt{2})} = \sqrt{3}+\sqrt{2}$

with no incorrect working seen is awarded M1A1B1B1A1.

Question Number	Scheme	Marks
	$y = 5x^3 - 6x^{\frac{4}{3}} + 2x - 3$	
4. (a)	$\left\{\frac{dy}{dx} =\right\}\ 5(3)x^2 - 6\left(\frac{4}{3}\right)x^{\frac{1}{3}} + 2$	M1
	$= 15x^2 - 8x^{\frac{1}{3}} + 2$	A1 A1 A1
		[4]
(b)	$\left\{\frac{d^2y}{dx^2} =\right\}\ 30x - \frac{8}{3}x^{-\frac{2}{3}}$	M1 A1
		[2]
		6
	Notes	
(a)	**M1**: for an attempt to differentiate $x^n \to x^{n-1}$ to one of the first three terms of $y = 5x^3 - 6x^{\frac{4}{3}} + 2x - 3$. So seeing either $5x^3 \to \pm\lambda x^2$ or $-6x^{\frac{4}{3}} \to \pm\mu x^{\frac{1}{3}}$ or $2x \to 2$ is M1. **1st A1**: for $15x^2$ only. **2nd A1:** for $-8x^{\frac{1}{3}}$ or $-8\sqrt[3]{x}$ only. **3rd A1:** for $+2$ ($+c$ included in part (a) loses this mark). **Note:** $2x^0$ is A0 unless simplified to 2.	
(b)	**M1:** For differentiating $\frac{dy}{dx}$ again to give **either** • a correct follow through differentiation of their x^2 term • **or** for $\pm\alpha x^{\frac{1}{3}} \to \pm\beta x^{-\frac{2}{3}}$. **A1:** for any ***correct*** expression ***on the same line*** (accept un-simplified coefficients). For powers: $30x^{2-1} - \frac{8}{3}x^{\frac{1}{3}-1}$ is A0, but writing powers as one term eg: $(15\times 2x) - \frac{8}{3}x^{-\frac{4}{6}}$ is ok for A1. **Note:** Candidates leaving their answers as $\left\{\frac{dy}{dx} =\right\} 15x^2 - \frac{24}{3}x^{\frac{1}{3}} + 2$ and $\left(\frac{d^2y}{dx^2} =\right)\ 30x - \frac{24}{9}x^{-\frac{2}{3}}$ are awarded M1A1A0A1 in part (a) and M1A1 in part (b). **Be careful:** $30x - \frac{8}{3}x^{-\frac{1}{3}}$ will be A0. **Note:** For an extra term appearing in part (b) on the same line, ie $30x - \frac{8}{3}x^{-\frac{2}{3}} + 2$ is M1A0 **Note:** If a candidate writes in part (a) $15x^2 - 8x^{\frac{1}{3}} + 2 + c$ and in part (b) $30x - \frac{8}{3}x^{-\frac{2}{3}} + c$ then award (a) M1A1A1A0 (b) M1A1	

Question Number	Scheme	Marks
	$a_1 = 3,\ a_{n+1} = 2a_n - c\ ,\ \ n \geq 1\ ,\ c$ is a constant	
5. (a)	$\{a_2 =\}\ \ 2\times 3 - c$ or $2(3) - c$ or $6 - c$	B1
		[1]
(b)	$\{a_3 =\}\ \ 2\times(\text{"}6 - c\text{"}) - c$	M1
	$= 12 - 3c$ **(*)**	A1 cso
		[2]
(c)	$a_4 = 2\times(\text{"}12 - 3c\text{"}) - c \qquad \{= 24 - 7c\}$	M1
	$\left\{\sum_{i=1}^{4} a_i =\right\}\ \ 3 + (6 - c) + (12 - 3c) + (24 - 7c)$	M1
	$\text{"}45 - 11c\text{"} \geq 23$ or $\text{"}45 - 11c\text{"} = 23$	M1
	$c \leq 2$ or $2 \geq c$	A1 cso
		[4]
		7
	Notes	
(a)	The answer to part (a) cannot be recovered from candidate's working in part (b) or part (c). Once the candidate has achieved the correct result you can ignore subsequent working in this part.	
(b)	**M1:** For a correct substitution of ***their*** a_2 ***which must include term(s) in c*** into $2a_2 - c$ giving a result for a_3 in terms of only c. Candidates must use correct bracketing for this mark. **A1:** for correct solution only. No incorrect working/statements seen. (**Note**: the answer is given!)	
(c)	**1st M1:** For a correct substitution of a_3 ***which must include term(s) in c*** into $2a_3 - c$ giving a result for a_4 in terms of only c. Candidates must use correct bracketing (can be implied) for this mark. **2nd M1:** for an attempt to sum their a_1, a_2, a_3 and a_4 only. **3rd M1:** for their sum (of 3 or 4 or 5 consecutive terms) $=$ or $\geq$ or $>$ 23 to form a linear inequality or equation in c. **A1:** for $c \leq 2$ or $2 \geq c$ from a correct solution only. **Beware:** $-11c \geq -22 \Rightarrow c \geq 2$ is A0. **Note:** $45 - 11c \geq 23 \Rightarrow -11c \leq -22 \Rightarrow c \leq 2$ would be A0 cso. **Note:** Applying either $S_n = \frac{n}{2}(2a + (n-1)d)$ or $S_n = \frac{n}{2}(a + l)$ is 2nd M0, 3rd M0. **Note:** If a candidate gives a numerical answer in part (a); they will then get M0A0 in part (b); but if they use the printed result of $a_3 = 12 - 3c$ they could potentially get M0M1M1A0 in part (c) **Note:** If a candidate only adds numerical values (not in terms of c) in part (c) then they could potentially get only M0M0M1A0. **Note:** For the 3rd M1 candidates will usually sum a_1, a_2, a_3 and a_4 or a_2, a_3 and a_4 or a_2, a_3, a_4 and a_5 or a_1, a_2, a_3, a_4 and a_5	

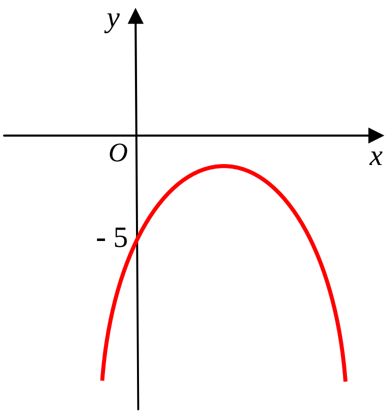
Question Number	Scheme	Marks
	Boy's Sequence: $10, 15, 20, 25, \ldots$	
6. (a)	$\{a = 10,\ d = 5 \Rightarrow T_{15} =\}\ a + 14d = 10 + 14(5); = 80$ or $0.1 + 14(0.05); = £0.80$	M1; A1
		[2]
(b)	$\{S_{60} =\}\ \frac{60}{2}\left[2(10) + 59(5)\right]$	M1 A1
	$= 30(315) = 9450$ or $£94.50$	A1
		[3]
	Boy's Sister's Sequence: $10, 20, 30, 40, \ldots$	
(c)	$\{a = 10,\ d = 10 \Rightarrow S_m =\}\ \frac{m}{2}\left(2(10) + (m-1)(10)\right)$ $\left(\text{or } \frac{m}{2} \times 10(m+1) \text{ or } 5m(m+1)\right)$	M1 A1
	63 or $6300 = \frac{m}{2}\left(2(10) + (m-1)(10)\right)$	dM1
	$6300 = \frac{m}{2}(10)(m+1)$ or $12600 = 10m(m+1)$	
	$1260 = m(m+1)$	
	$35 \times 36 = m(m+1)$ **(*)**	A1 **cso**
		[4]
(d)	$\{m =\}\ 35$	B1
		[1]
		10
	Notes	
(a)	**M1:** for using the formula $a + 14d$ with either a or d correct. **A1:** for 80 or 80p or £0.80 or £0.80p and apply ISW. Otherwise, £80 or 0.80 or 0.80p would be A0. Award M0 if candidate applies $a + 59d$. Listing the first 15 terms and highlighting that the 15th term is 80 or listing 15 terms with the final 15th term aligned with 80 will then be awarded all two marks of M1A1. Writing down 80 with no working is M1A1.	
(b)	**M1**: for use of correct $\frac{60}{2}\left[2(10) + 59(5)\right]$ or $\frac{15}{2}\left(2(10) + 14(5)\right)$ with $a = 10,\ d = 5$ and $n = 60$ or $a = 10,\ d = 5$ and $n = 15$. If a candidate uses $\frac{n}{2}(a + l)$ with $n = 60$ or 15, there must be a full method of finding or stating l as either $a + 59d\ (= 305)$ or $a + 14d\ (= 80)$, respectively. **1st A1:** for a correct expression for S_{60}. ie. $\frac{60}{2}\left[2(10) + 59(5)\right]$ or $\frac{60}{2}\left[2(0.1) + 59(0.05)\right]$ or $\frac{60}{2}\left[10 + 305\right]$ or $\frac{60}{2}\left[0.10 + 3.05\right]$. This mark can be implied by later working. **2nd A1:** for 9450 or 9450p or £94.50 and apply ISW. Otherwise, £9450 or 94.50 without £ sign is A0. **Note**: the bracketing error of $\frac{60}{2}\ 2(10) + 59(5)$ is A0 unless recovered from later working. Adding together the first 60 terms to obtain 9450 will then be awarded all three marks of M1A1A1.	

(c)	**1st M1:** for correct use of S_m formula with one of *a* or *d* correct. **1st A1:** for a correct expression for S_m. Eg: $\frac{m}{2}\left(2(10) + (m-1)(10)\right)$ or $\frac{m}{2}\times 10(m+1)$ or $5m(m+1)$ **2nd M1:** for forming a suitable equation using 63 or 6300 and their S_m. **Dependent on 1st M1.** **2nd A1cso:** for ***reaching the printed result*** with no incorrect working seen. Long multiplication is not necessary for the final accuracy mark. **Note:** $\frac{m}{2}\left(2(10) + (m-1)(10)\right) = 630$ and not either 6300 or 63 is dM0. **<u>Beware</u>:** Some candidates will try and fudge the result given on the question paper. **<u>Notes for awarding 2nd A1</u>** Going from $m(m+1) = 1260$ straight to $m(m+1) = 35\times 36$ is 2nd A1. Going from $m(m+1) =$ some factor decomposition of 6300 straight to $m(m+1) = 35\times 36$ is 2nd A1. Going from $10m(m+1) = 12600$ straight to $m(m+1) = 35\times 36$ is 2nd A0. Going from $m(m+1) = \frac{6300}{5}$ straight to $m(m+1) = 35\times 36$ is 2nd A0. ***<u>Alternative: working in an different letter, say n or p.</u>*** **M1A1:** for $\frac{n}{2}\left(2(10) + (n-1)(10)\right)$ (although mixing letters eg. $\frac{n}{2}\left(2(10) + (m-1)(10)\right)$ is M0A0). **dM1:** for 63 or $6300 = \frac{n}{2}\left(2(10) + (n-1)(10)\right)$ Leading to $6300 = \frac{n}{2}(10)(n+1) \Rightarrow 1260 = n(n+1) \Rightarrow 35\times 36 = n(n+1)$ The candidate then needs to write either $35\times 36 = m(m+1)$ or $m \equiv n$ or $m = n$ to gain the final A1.
(d)	**B1:** for 35 only.

Question Number	Scheme	Marks
	$P(4,-1)$ lies on C where $\mathrm{f}'(x)=\frac{1}{2}x-\frac{6}{\sqrt{x}}+3,\ \ x>0$	
7. (a)	$\mathrm{f}'(4)=\frac{1}{2}(4)-\frac{6}{\sqrt{4}}+3\,;=2$	M1; A1
	T: $y--1=2(x-4)$	dM1
	T: $y=2x-9$	A1
		[4]
(b)	$\mathrm{f}(x)=\frac{x^{1+1}}{2(2)}-\frac{6x^{-\frac{1}{2}+1}}{(\frac{1}{2})}+3x\,(+c)$ or equivalent.	M1 A1
	$\{\mathrm{f}(4)=-1\Rightarrow\}\ \frac{16}{4}-12(2)+3(4)+c=-1$	dM1
	$\{\,4-24+12+c=-1\quad\Rightarrow\ c=7\,\}$	
	So, $\{\mathrm{f}(x)=\}\ \frac{x^2}{2(2)}-\frac{6x^{\frac{1}{2}}}{(\frac{1}{2})}+3x+7$	A1 cso
	$\left\{\text{NB: }\ \mathrm{f}(x)=\frac{x^2}{4}-12\sqrt{x}+3x+7\right\}$	**[4]**
		8

	Notes	

(a)	**1st M1:** for clear attempt at $\mathrm{f}'(4)$. **1st A1:** for obtaining 2 from $\mathrm{f}'(4)$. **2nd dM1:** for $y--1=(\text{their }\mathrm{f}'(4))(x-4)$ or $\frac{y--1}{x-4}=(\text{their }\mathrm{f}'(4))$ or full method of $y=mx+c$, with $x=4,\ y=-1$ and their $\mathrm{f}'(4)$ to find a value for c. **Note:** this method mark is dependent on the first method mark being awarded. **2nd A1:** for $y=2x-9$ or $y=-9+2x$ **Note:** This work needs to be contained in part (a) only.
(b)	**1st M1**: for a clear attempt to integrate $\mathrm{f}'(x)$ with at least one correct application of $x^n\to x^{n+1}$ on $\mathrm{f}'(x)=\frac{1}{2}x-\frac{6}{\sqrt{x}}+3$. So seeing either $\frac{1}{2}x\to\pm\lambda x^{1+1}$ or $-\frac{6}{\sqrt{x}}\to\pm\mu x^{-\frac{1}{2}+1}$ or $3\to 3x^{0+1}$ is M1. **1st A1:** for correct un-simplified coefficients and powers (or equivalent) with or without $+c$. **2nd dM1:** for use of $x=4$ and $y=-1$ in an integrated equation to form a linear equation in c equal to -1. ie: applying $\mathrm{f}(4)=-1$. This mark is dependent on the first method mark being awarded. **A1:** For $\{\mathrm{f}(x)=\}\ \frac{x^2}{2(2)}-\frac{6x^{\frac{1}{2}}}{(\frac{1}{2})}+3x+7$ stated on one line where coefficients can be un-simplified or simplified, but must contain one term powers. Note this mark is for **correct solution only.** **<u>Note: For a candidate attempting to find f(x) in part (a)</u>** If it is clear that they understand that they are finding $\mathrm{f}(x)$ in part (a); ie. by writing $\mathrm{f}(x)=...$ or $y=...$ then you can give credit for this working in part (b).

Question Number	Scheme	Marks
	$4x - 5 - x^2 = q - (x - p)^2$, p, q are integers.	
8. (a)	$\{4x - 5 - x^2 =\}\ -[x^2 - 4x + 5] = -[(x-2)^2 - 4 + 5] = -[(x-2)^2 + 1]$	M1
	$= -1 - (x-2)^2$	A1 A1
		[3]
(b)	$\{"b^2 - 4ac" = \}\ 4^2 - 4(-1)(-5) \quad \{= 16 - 20\}$	M1
	$= -4$	A1
		[2]
(c)		
	Correct $\cap$ shape	M1
	Maximum **within** the 4th quadrant	A1
	Curve cuts through -5 or $(0, -5)$ marked on the *y*-axis	B1
		[3]
		8

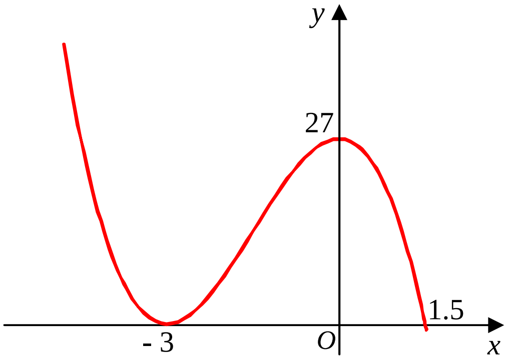
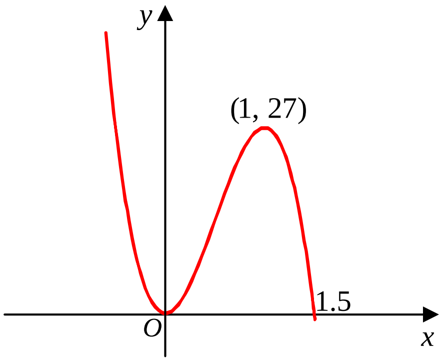
	Notes	
(a)	**M1:** for an attempt to complete the square eg: $\pm(\pm x \pm 2)^2 \pm k - 5,\ k \neq 0$ or $\pm(\pm x \pm 2)^2 \pm \lambda,\ \lambda \neq -5$ seen or implied in working. **1st A1:** for $p = -2$ or for $\pm\alpha - (x-2)^2$, α can be 0. **2nd A1:** for $q = -1$ **Note:** Allow M1A1A1 for a correct written down expression of $-1 - (x-2)^2$ Ignore $-1 - (x-2)^2 = 0$. **Note:** If a candidate states either $p = -2$ or $q = -1$ or writes $\pm k - (x-2)^2$ then imply the M1 mark. **Note:** A candidate who writes down with no working $p = 2, q = (\text{a value which is not } -1)$ gets M0A0A0. **Note:** Writing $(x-2)^2 - 1$, followed by $p = -2, q = -1$ is M1A1A0. ***<u>Alternative 1 to (a)</u>*** $\{4x - 5 - x^2 =\}\ -[x^2 - 4x] - 5 = -[(x-2)^2 - 4] - 5 = -(x-2)^2 + 4 - 5 = -1 - (x-2)^2$ ***<u>Alternative2 to (a)</u>*** $q - (x+p)^2 = q - (x^2 + 2px + p^2) = -x^2 - 2px + q - p^2$ Compare x terms: $-2p = 4 \Rightarrow \underline{p = -2}$ Compare constant terms: $q - p^2 = -5 \Rightarrow q - 4 = -5 \Rightarrow \underline{q = -1}$ **M1:** Either $\pm 2p = 4$ or $q \pm p^2 = -5$; **1st A1:** for $p = -2$; **2nd A1:** for $q = -1$	

	<u>Alternative 3 to (a)</u> Negating $4x-5-x^2$ gives x^2-4x+5 So, $x^2-4x+5=(x-2)^2-4+5$ $\{=(x-2)^2+1\}$ **M1** for $\pm(\pm x\pm 2)^2 \pm k+5$ then stating $p=-2$ is **1st A1** and/or $q=-1$ is **2nd A1**. or writing $-1-(x-2)^2$ is A1A1. **Special Case for part (a):** $q-(x+p)^2 = q-(x^2+2px+p^2) = -x^2-2px+q-p^2 = 4x-5-x^2$ $\Rightarrow -2px+q-p^2 = 4x-5 \Rightarrow q-p^2+5 = 4x+2px \Rightarrow q-p^2+5 = x(4+2p)$ $\Rightarrow x = \frac{q-p^2+5}{4+2p} \Rightarrow p \neq -2$ scores Special Case M1A1A1 **only once** $p\neq -2$ achieved.
(b)	**M1:** for correctly substituting any two of $a=-1, b=4, c=-5$ into b^2-4ac if this is quoted. If b^2-4ac is not quoted then the substitution must be correct. Substitution into $b^2<4ac$ or $b^2=4ac$ or $b^2>4ac$ is M0. **A1:** for -4 only. If they write $-4<0$ treat the <0 as ISW and award A1. If they write $-4\geq 0$ then score A0. So substituting into $b^2-4ac<0$ leading to $-4<0$ can score M1A1 **Note:** Only award marks for use of the discriminant in part (b). **Note:** Award M0 if the candidate uses the quadratic formula UNLESS they later go on to identify that the discriminant is the result of b^2-4ac. **Beware: A number of candidates are writing up their solution to part (b) at the bottom of the second page. So please look!**
(c)	**M1:** Correct $\cap$ shape in any quadrant. **A1:** The maximum must be ***within*** the fourth quadrant to award this mark. **B1:** Curve ***(and not line!)*** cuts through -5 or $(0,-5)$ marked on the *y*-axis Allow $(-5,0)$ rather than $(0,-5)$ if marked in the "correct" place on the *y*-axis. If the curve cuts through the negative *y*-axis and this is not marked, then you can recover $(0,-5)$ from the candidate's working in part (c). You are not allowed to recover this point, though, from a table of values. **Note:** Do not recover work for part (a) in part (c).

Question Number	Scheme	Marks
	$L_1:\ 4y+3=2x \Rightarrow y=\frac{1}{2}x-\frac{3}{4}$; $A(p,4)$ lies on L_1.	
9. (a)	$\{p=\}\ 9\frac{1}{2}$ or $\frac{19}{2}$ or 9.5	B1
		[1]
(b)	$\{4y+3=2x\} \Rightarrow y=\frac{2x-3}{4} \Rightarrow m(L_1)=\frac{1}{2}$ or $\frac{2}{4}$	M1 A1
	So $m(L_2)=-2$	B1ft
	$L_2:\ y-4=-2(x-2)$	M1
	$L_2:\ 2x+y-8=0$ or $L_2:\ 2x+1y-8=0$	A1
		[5]
(c)	$\{L_1=L_2\Rightarrow\}\ 4(8-2x)+3=2x$ or $-2x+8=\frac{1}{2}x-\frac{3}{4}$	M1
	$x=3.5,\ y=1$	A1, A1 cso
		[3]
(d)	$CD^2=("3.5"-2)^2+("1"-4)^2$	"M1"
	$CD=\sqrt{("3.5"-2)^2+("1"-4)^2}$	A1 ft
	$=\sqrt{1.5^2+3^2}=1.5\sqrt{1^2+2^2}=1.5\sqrt{5}$ or $\frac{3}{2}\sqrt{5}$ **(*)**	A1 **cso**
		[3]
(e)	Area = triangle ABC + triangle ABE	
	$=\frac{1}{2}\times\frac{3}{2}\sqrt{5}\times\sqrt{80}+\frac{1}{2}\times3\sqrt{5}\times\sqrt{80}$ — Finding the area of any triangle.	M1
	$=\frac{3}{4}\sqrt{5}\times4\sqrt{5}+\frac{3}{2}\sqrt{5}\times4\sqrt{5}$	
	$=\frac{3}{4}(20)+\frac{3}{2}(20)$	B1
	$=45$	A1
		[3]
		15

	Notes
9. (a)	**B1:** 9.5 oe.
(b)	**1st M1:** for an attempt to rearrange $4y+3=2x$ into $y=mx+c$. This mark can be implied by the correct gradient of L_1 or L_2. **1st A1:** for gradient of $L_1=\frac{1}{2}$ or $\frac{2}{4}$. Stating $m(L_1)=\frac{1}{2}$ without working is M1A1. **B1ft:** for applying $m(L_2)=\frac{-1}{\text{their } m(L_1)}$. Need not be simplified. **Note:** Writing down $m(L_2)=-2$ with ***no earlier incorrect working*** gains M1A1B1 **2nd M1:** for applying $y-4=\pm\lambda(x-2)$ where λ is a numerical value, $\lambda\neq0$. or full method of $y=mx+c$, with $x=2,\ y=4$ and (their $\pm\lambda$) to find c. **2nd A1:** $2x+y-8=0$ or $-2x-y+8=0$ or $y+2x-8=0$ or $4x+2y-16=0$ or $2x+1y-8=0$ etc. Must be " = 0". So do not allow $2x+y=8$ etc. **Note:** Condone the error of incorrectly rearranging L_1 to give $y=\frac{1}{2}x-3\Rightarrow m(L_1)=\frac{1}{2}$.

(c)	**M1:** for an attempt to solve. Must form a linear equation in one variable. **1st A1:** for $x = 3.5$ (correct solution only). **2nd A1:** for $y = 1$ (correct solution only). **Note:** If $x = 3.5,\ y = 1$ is found from no working, then send to review. **Note:** Use of trial and error to find one of *x* or *y* and then substitution into one of L_1 or L_2 can achieve M1A1A1.
(d)	**M1:** for an attempt at CD^2 - ft their point *D*. Eg: $("3.5"-2)^2 + ("1"-4)^2$ or simplified. This mark can be implied by finding *CD*. **1st A1ft:** for finding their *CD* - ft their point *D*. Eg: $\sqrt{("3.5"-2)^2 + ("1"-4)^2}$ or correctly simplified. **2nd A1:cso** for no incorrect working seen. **Note:** A candidate initially writing down $\sqrt{1.5^2 + 3^2}$ can be awarded M1A1. ***Alternatives part (d): Final accuracy*** **1.** $\left\{\sqrt{1.5^2+3^2} =\right\}\ \sqrt{\frac{9}{4}+9} = \sqrt{\frac{9}{4}+\frac{36}{4}} = \sqrt{\frac{45}{4}} = \frac{3\sqrt{5}}{2}$ **2.** $\left\{\sqrt{1.5^2+3^2} =\right\}\ \sqrt{11.25} = \sqrt{2.25}\sqrt{5} = 1.5\sqrt{5}$
(e)	**M1:** for an attempt at finding the area of either triangle *ABC* or triangle *ABE*. **B1:** Correct method for removing a square root. Eg: $\sqrt{80}\sqrt{5} = \sqrt{400} = 20$ or $\sqrt{5}\times 4\sqrt{5} = 20$ **Note:** This mark can be implied. **A1:** for 45 only. ***Alternative 1 to part (e):*** Area $= \frac{1}{2}\left(\frac{3}{2}\sqrt{5} + 3\sqrt{5}\right)\left(\sqrt{80}\right) = \frac{1}{2}(30+60) = 45$ **M1:** $\frac{1}{2}(AB)(CE)$. **B1:** Evidence of correct surd removal. **A1:** for 45. **Note:** Multiplying the diagonals (usually to find 90) is M0, B1 if surds are removed correctly, A0. ***Alternative 2 to part (e):*** Area = triangle *DAC* + triangle *DCB* + triangle *DEA* + triangle *DBE* $= \left(\frac{1}{2}\times\frac{3}{2}\sqrt{5}\times\sqrt{45}\right) + \left(\frac{1}{2}\times\frac{3}{2}\sqrt{5}\times\left(\sqrt{80}-\sqrt{45}\right)\right) + \left(\frac{1}{2}\times 3\sqrt{5}\times\sqrt{45}\right) + \left(\frac{1}{2}\times 3\sqrt{5}\times\left(\sqrt{80}-\sqrt{45}\right)\right)$ $= \left(\frac{1}{2}\times\frac{3}{2}(15)\right) + \left(\frac{1}{2}\times\frac{3}{2}(5)\right) + \left(\frac{1}{2}\times 3(15)\right) + \left(\frac{1}{2}\times 3(5)\right)$ $= \left(\frac{45}{4}\right) + \left(\frac{15}{4}\right) + \left(\frac{45}{2}\right) + \left(\frac{15}{2}\right)$ $= 45$ **M1:** For finding the area of one of the four triangles. **B1:** Evidence of correct surd removal. **A1:** for 45. ***Alternative 3 to part (e):*** $\left\{CE = CD + DE = \frac{3}{2}\sqrt{5} + 3\sqrt{5} = \frac{9}{2}\sqrt{5}\right\},\ \left\{BD = DA + \underline{AB} = 3\sqrt{5} + \underline{4\sqrt{5}} = 7\sqrt{5}\right\}$ Area = triangle *BCE* − triangle *ACE* $= \frac{1}{2}(CE)(BD) - \frac{1}{2}(CE)(BD)$ $= \frac{1}{2}\times\frac{9}{2}\sqrt{5}\times 7\sqrt{5} - \frac{1}{2}\times\frac{9}{2}\sqrt{5}\times 3\sqrt{5}$ **M1:** for an attempt at the area of triangle *BCE* or triangle *ACE*. $= \frac{63(5)}{4} - \frac{27(5)}{4} = \frac{36(5)}{4} = 9(5)$ **B1:** Evidence of correct surd removal. $= 45$ **A1:** for 45 only.

Question Number	Scheme		Marks	
10. (a)	{Coordinates of A are} $(4.5, 0)$	See notes below	B1	
				[1]
(b)(i)		Horizontal translation	M1	
		-3 and their ft 1.5 on postitive x-axis	A1 ft	
		Maximum at 27 marked on the y-axis	B1	
				[3]
(ii)		Correct shape, minimum at $(0, 0)$ and a maximum within the first quadrant.	M1	
		1.5 on x-axis	A1 ft	
		Maximum at $(1, 27)$	B1	
				[3]
(c)	$\{k =\}\ -17$		B1	**[1]**
				8

	Notes
(a)	**B1:** For stating either $x = 4.5$ or $\frac{9}{2}$ or $\frac{18}{4}$ etc. or $A = 4.5$ or $\frac{9}{2}$ or $(4.5, 0)$. Can be written on graph. Allow $(0, 4.5)$ marked on curve for B1. Otherwise $(0, 4.5)$ without reference to any of the above is B0.
(b)(i)	**M1:** for any horizontal (left-right) translation where minimum is still **on** x-axis not at $(0, 0)$. Ignore any values. **A1ft:** for -3 **(NOT 3)** and 1.5 (or their x in part (a) – 3) ***evaluated*** and marked on the positive x-axis. Allow $(0, -3)$ and/or $(0, \text{ft } 1.5)$ rather than $(-3, 0)$ and $(\text{ft } 1.5, 0)$ if marked in the "correct" place on the x-axis. **Note:** Candidate ***cannot*** gain this mark if their x in part (a) is less than 3. **B1:** Maximum at 27 marked on the y-axis. **Note**: the maximum must be on the y-axis for this mark.
(ii)	**M1:** for correct shape with minimum still at $(0, 0)$ and a maximum within the first quadrant. Ignore values. **A1ft:** for $\dfrac{\text{their } x \text{ in part } (a)}{3}$; as intercept on x-axis eg: $\dfrac{4.5}{3}$ or 1.5 or $\dfrac{3}{2}$ or $\dfrac{9}{6}$ **Note:** a generalised $\dfrac{A}{3}$ is A0. Allow $(0, \text{ft } 1.5)$ rather than $(\text{ft } 1.5, 0)$ if marked in the "correct" place on the x-axis. **B1:** Maximum at $(1, 27)$ or allow 1 marked on the x-axis and the corresponding 27 marked on the y-axis. **Note: Be careful to look at the correct graph. The candidate may draw another graph to help them to answer part (c).** **Note:** You can recover (b)(i) $(-3, 0)$ and $(\text{ft } 1.5, 0)$ or in (b)(ii) $(\text{ft } 1.5, 0)$ as ***correct coordinates only*** in candidate's working if these are not marked on their sketch(es).
(c)	**B1:** for $(k =)\ -17$ only. **BEWARE**: This could be written in the middle or at the bottom of a page.

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Rewarding Learning

Mark Scheme (Results)

January 2013

GCE Core Mathematics C1 (6663/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

General Principles for Core Mathematics Marking

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x = ...

2. Formula

Attempt to use correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm \frac{b}{2})^2 \pm q \pm c$, $q \neq 0$, leading to x = ...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required.

January 2013
6663 Core Mathematics C1
Mark Scheme

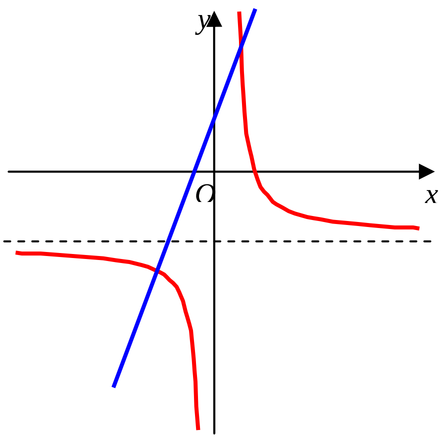
Question Number	Scheme	Marks
1.	$x(1-4x^2)$	B1
	Accept $x(-4x^2+1)$ or $-x(4x^2-1)$ or $-x(-1+4x^2)$ or even $4x(\frac{1}{4}-x^2)$ or equivalent quadratic (or initial cubic) into two brackets	M1
	$x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$	A1
		[3]
		3 marks
	Notes	
	B1: Takes out a factor of x or $-x$ or even $4x$. This line may be implied by correct final answer, but if this stage is shown it **must be correct**. So **B0** for $x(1+4x^2)$ **M1:** Factorises the quadratic resulting from their first factorisation using usual rules (see note 1 in General Principles). e.g. $x(1-4x)(x-1)$. Also allow attempts to factorise cubic such as $(x-2x^2)(1+2x)$ etc N.B. Should not be completing the square here. **A1:** Accept either $x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$. (No fractions for this final answer)	
	Specific situations	
	Note: $x(1-4x^2)$ followed by $x(1-2x)^2$ scores B1M1A0 as factors follow quadratic factorisation criteria **And** $x(1-4x^2)$ followed by $x(1-4x)(1+4x)$ **B1M0A0.**	
	Answers with no working: Correct answer gets all three marks B1M1A1	
	: $x(2x-1)(2x+1)$ gets B0M1A0 if **no working** as $x(4x^2-1)$ would earn B0	
	Poor bracketing: e.g. $(-1+4x^2)-x$ gets B0 unless subsequent work implies bracket round the $-x$ in which case candidate may recover the mark by the following correct work.	

Question Number	Scheme	Marks
2.	$(8^{2x+3} = \left(2^3\right)^{2x+3}) = 2^{3(2x+3)}$ or 2^{ax+b} with $a = 6$ **or** $b = 9$	M1
	$= 2^{6x+9}$ *or* $= 2^{3(2x+3)}$ as **final** answer with no errors or $(y =)6x + 9$ or $3(2x + 3)$	A1 **[2]**
		2 marks
	Notes	
	M1: Uses $8 = 2^3$, and **multiplies** powers $3(2x + 3)$. Does **not** add powers. (Just $8 = 2^3$ or $8^{\frac{1}{3}} = 2$ is M0) **A1:** Either 2^{6x+9} *or* $= 2^{3(2x+3)}$ or $(y =)6x + 9$ or $3(2x + 3)$	
	Note: Examples: 2^{6x+3} scores M1A0 **:** $8^{2x+3} = \left(2^3\right)^{2x+3} = 2^{3+2x+3}$ gets M0A0 **Special case:** **:** $= 2^{6x}2^9$ without seeing as single power M1A0 **Alternative method using logs:** $8^{2x+3} = 2^y \Rightarrow (2x+3)\log 8 = y\log 2 \Rightarrow y = \frac{(2x+3)\log 8}{\log 2}$ **So** $(y =)6x + 9$ or $3(2x + 3)$	 **M1** **A1 [2]**

Question Number	Scheme	Marks
3. (i)	$\left(5-\sqrt{8}\right)\left(1+\sqrt{2}\right)$ $= 5 + 5\sqrt{2} - \sqrt{8} - 4$ $= 5 + 5\sqrt{2} - 2\sqrt{2} - 4$ $\sqrt{8} = 2\sqrt{2}$, seen or implied at any point. $= 1 + 3\sqrt{2}$ $1 + 3\sqrt{2}$ or $a = 1$ and $b = 3$.	 M1 B1 A1 **[3]**
(ii)	Method 1 **Either** $\sqrt{80} + \frac{30}{\sqrt{5}}\left(\frac{\sqrt{5}}{\sqrt{5}}\right)$ $= 4\sqrt{5} + ...$ $= 4\sqrt{5} + 6\sqrt{5}$ Method 2 **Or** $\left(\frac{\sqrt{400}+30}{\sqrt{5}}\right)\frac{\sqrt{5}}{\sqrt{5}}$ $= \left(\frac{20+..}{..}\right)\frac{..}{..}$ $= \left(\frac{50\sqrt{5}}{5}\right)$ $= 10\sqrt{5}$ Method 3 $\sqrt{80} + \frac{\sqrt{900}}{\sqrt{5}} = \sqrt{80} + \sqrt{180}$ $= 4\sqrt{5} + ...$ $= 4\sqrt{5} + 6\sqrt{5}$	M1 B1 A1 **[3]**
Alternative for (i)	$\left(5-2\sqrt{2}\right)\left(1+\sqrt{2}\right)$ This earns the B1 mark. $= 5 + 5\sqrt{2} - 2\sqrt{2} - 2\sqrt{2}\sqrt{2}$ Multiplies out correctly with $2\sqrt{2}$. This may be seen or implied and may be simplified e.g. $= 5 + 3\sqrt{2} - 2\sqrt{4}$ o.e. For earlier use of $2\sqrt{2}$ $= 1 + 3\sqrt{2}$ $1 + 3\sqrt{2}$ or $a = 1$ and $b = 3$.	 M1 B1 A1 **[3]** **6 marks**
	Notes	
(i) (ii)	**M1:** Multiplies out brackets correctly giving four correct terms or simplifying to correct expansion. (This may be implied by correct answer) – can appear as table **B1:** $\sqrt{8} = 2\sqrt{2}$, seen or implied at any point **A1:** Fully and correctly simplified to $1 + 3\sqrt{2}$ or $a = 1$ and $b = 3$. **M1:** Rationalises denominator i.e. Multiplies $\left(\frac{k}{\sqrt{5}}\right)$ by $\left(\frac{\sqrt{5}}{\sqrt{5}}\right)$ or $\left(\frac{-\sqrt{5}}{-\sqrt{5}}\right)$, seen or implied or uses Method 3 or similar e.g. $\left(\frac{30}{\sqrt{5}}\right) = \frac{6\times 5}{\sqrt{5}} = 6\sqrt{5}$ **B1**: (Independent mark) States $\sqrt{80} = 4\sqrt{5}$ Or either $\sqrt{400} = 20$ *or* $\sqrt{80}\sqrt{5} = 20$ at any point if they use Method 2. **A1:** $10\sqrt{5}$ or $c = 10$.	
	N.B There are other methods e.g. $\sqrt{80} = \frac{20}{\sqrt{5}}$ (B1) then add $\frac{20}{\sqrt{5}} + \frac{30}{\sqrt{5}} = \frac{50}{\sqrt{5}}$ then M1 A1as before Those who multiply initial expression by $\sqrt{5}$ to obtain $\sqrt{400} + 30 = 20 + 30 = 50$ earn M0 B1 A0	

Question Number	Scheme		Marks
4.	$u_2 = 9,\ u_{n+1} = 2u_n - 1,\ \ n \geqslant 1$		
(a)	$u_3 = 2u_2 - 1 = 2(9) - 1 \quad (=17)$	$u_3 = 2(9) - 1.$	M1
	$u_4 = 2u_3 - 1 = 2(17) - 1 = 33$	Can be implied by $u_3 = 17$	
		Both $u_3 = 17$ and $u_4 = 33$	A1
			[2]
(b)	$\sum_{r=1}^{4} u_r = u_1 + u_2 + u_3 + u_4$		
	$(u_1) = 5$	$(u_1) = 5$	B1
	$\sum_{r=1}^{4} u_r = "5" + 9 + "17" + "33" = 64$	Adds their first four terms obtained legitimately (see notes below)	M1
		64	A1
			[3]
			5 marks
	Notes		
(a)	**M1**: Substitutes 9 into RHS of iteration formula **A1**: Needs **both** 17 and 33 (but **allow if either or both seen in part (b)**)		
(b)	**B1: for** u_1=5 (however obtained – may appear in (a)) May be called *a=5* **M1:** Uses their u_1 found from $u_2 = 2u_1 - 1$ stated explicitly, or uses $u_1 = 4$ *or* $5\frac{1}{2}$, and adds it to u_2, their u_3 and their u_4 only. (See special cases below). There should be no fifth term included. Use of sum of AP is irrelevant and scores M0 **A1**: 64		

Question Number	Scheme	Marks
5.		
(a)	Gradient of l_2 is $\frac{1}{2}$ or 0.5 or $\frac{-1}{-2}$	B1
	Either $y-6="\frac{1}{2}"(x-5)$ or $y="\frac{1}{2}"x+c$ and $6="\frac{1}{2}"(5)+c \Rightarrow c=("\frac{7}{2}")$	M1
	$x-2y+7=0$ or $-x+2y-7=0$ or $k(x-2y+7)=0$ with ***k* an integer**	A1 **[3]**
(b)	Puts $x = 0$, or $y = 0$ in **their** equation and solves to find appropriate co-ordinate	M1
	x-coordinate of *A* is -7 and *y*-coordinate of *B* is $\frac{7}{2}$.	A1 cao **[2]**
(c)	Area $OAB=\frac{1}{2}(7)\left(\frac{7}{2}\right)=\frac{49}{4}$ (units)^2 — Applies $\pm\frac{1}{2}$(base)(height)	M1
	$\frac{49}{4}$	A1**cso** **[2]**
		7 marks
	Notes	
(a)	**B1**: Must have ½ or 0.5 or $\frac{-1}{-2}$ o.e. stated and stops, or used in their line equation **M1:** Full method to obtain an equation of the line through (5,6) with their "*m*". So $y-6=m(x-5)$ with their gradient or uses $y=mx+c$ with $(5,6)$ and their gradient to find *c*. Allow any numerical gradient here including –2 or –1 but **not zero** . (Allow (6,5) as a slip **if** $y-y_1=m(x-x_1)$ is quoted first) **A1:** Accept any multiple of the correct equation, provided that the coefficients are integers and equation = 0 e.g. $-x+2y-7=0$ or $k(x-2y+7)=0$ or even $2y-x-7=0$	
(b)	**M1:** Either one of the *x* or *y* coordinates using their equation **A1:** Needs both correct values. Accept any correct equivalent.. Need not be written as co-ordinates. **Even** just –7 and 3.5 with **no** indication which is which may be awarded the A1.	
(c)	**M1:** Any correct method for area of triangle *AOB*, with their values for co-ordinates of *A* and *B* (may include negatives) *Method usually half base times height but determinants could be used.* **A1**: Any exact equivalent to 49/4, e.g. 12.25. (**negative final** answer is A0 but replacing by **positive** is A1) Do not need units. **c.s.o.** implies if A0 is scored in (b) then A0 is scored in (c) as well**. However** if candidate has correct line equation in (a) of wrong form may score A0 in (a) and A1 in (b) and (c)	
	Note: Special cases: $\frac{1}{2}(-7)\left(+\frac{7}{2}\right)=-\frac{49}{4}$ (units)^2 is M1 A0 but changing sign to area = $+\frac{49}{4}$ gets M1A1 (recovery) **N.B.** Candidates making sign errors in (b) and obtaining +7 and **-**$\frac{7}{2}$. may also get $\frac{49}{4}$ as their answer following previous errors. They should be awarded A0 as this answer is not ft and is for correct **solution** only **Special Case**: In (a) and (b): Produces parallel line instead of perpendicular line: So uses *m* = **-**2 This is not treated as a misread as it simplifies the question. The marks will usually be B0 M1 A0, M1 A0, M1 A0 i.e. maximum of 3/7	

Question Number	Scheme	Marks
6. (a)		
	$y = \frac{2}{x}$ is translated up or down.	M1
	$y = \frac{2}{x} - 5$ is in the correct position.	A1
	Intersection with x-axis at $\left(\frac{2}{5}, \{0\}\right)$ **only** Independent mark.	B1
	$y = 4x + 2$: attempt at straight line, with positive gradient with positive y intercept.	B1
	Intersection with x-axis at $\left(-\frac{1}{2}, \{0\}\right)$ **and** y-axis at $\left(\{0\}, 2\right)$.	B1 **[5]**
	Check graph in question for possible answers and space below graph for answers to part (b)	
(b)	Asymptotes : $x = 0$ (or y-axis) and $y = -5$. An asymptote stated correctly. Independent of (a)	B1
	(Lose second B mark for extra asymptotes) These two lines only. Not ft their graph.	B1 **[2]**
(c)	Method 1: $\frac{2}{x} - 5 = 4x + 2$ Method 2: $\frac{y-2}{4} = \frac{2}{y+5}$	M1
	$4x^2 + 7x - 2 = 0 \Rightarrow x =$ $y^2 + 3y - 18 = 0 \rightarrow y =$	dM1
	$x = -2, \frac{1}{4}$ $y = -6, 3$	A1
	When $x = -2,\ y = -6$, When $x = \frac{1}{4},\ y = 3$ When $y = -6,\ x = -2$ When $y = 3,\ x = \frac{1}{4}$.	M1A1 **[5]**
		12 marks

Notes

(a) **M1:** Curve implies y axis as asymptote and does not change shape significantly. Changed curve needs horizontal asymptote (roughly) Asymptote(s) need not be **shown** but shape of curve should be implying asymptote(s) parallel to x axis. Curve should not remain where it was in the given figure. Both sections move in the same direction. There should be no reflection

A1: Crosses positive x axis. Hyperbola has moved down. Both sections move by **almost** same amount. See sheet on page 19 for guidance.

B1: Check diagram and text of answer. Accept 2/5 or 0.4 shown on x -axis or x = 2/5, or (2/5 , 0) stated clearly in text or on graph. This is **independent** of the graph. Accept (0, 2/5) if clearly on x axis. Ignore any intersection points with y axis. Do not credit work in table of values for this mark.

B1: Must be attempt at a straight line, with positive gradient & with positive y intercept (need not cross x axis)

B1: Accept x = -1/2, or –0.5 shown on x -axis or (-1/2 , 0) or (-0.5,0) in text or on graph and similarly accept 2 on y axis or y = 2 or (0, 2) in text or on graph. **Need not cross curve and allow on separate axes.**

(b) **B1:** For either correct asymptote equation. Second **B1**: For both correct (lose this if extras e.g. $x = \pm 1$ are given also). These asymptotes may follow correctly from equation after wrong graph in (a)

Just y = -5 **is B1 B0 This may be awarded if given on the graph.** However for other B mark it must be clear that $x = 0$ (or the y-axis) is an asymptote. NB $x \neq 0,\ y \neq -5$ is B1B0

(c) **M1**: Either of these equations is enough for the method mark (May appear labelled as part (b))

dM1: Attempt to solve a 3 term quadratic by factorising, formula, completion of square or implied by correct answers. (see note 1) This mark depends on previous mark.

A1: Need both correct x answers (Accept equivalents e.g. 0.25) or both correct y values (Method 2)

M1: At least one attempt to find *second variable* (usually y) using their *first variable* (usually x) related to line meeting curve. Should not be substituting x or y values from part (a) or (b). This mark is **independent** of previous marks. Candidate may substitute in equation of line or equation of curve.

A1: Need both correct *second variable* answers Need not be written as co-ordinates (allow as in the scheme)

Note: Special case: Answer only with no working in part (c) can have 5 marks if completely correct, with **both** points found. If co-ordinates of just one of the points is correct – with no working – this earns M0 M0 A0 M1 A0 (i.e. 1 / 5)

Question Number	Scheme	Marks
7.	Lewis; arithmetic series, $a = 140$, $d = 20$.	
(a)	$T_{20} = 140 + (20-1)(20);\ = 520$ Or lists 20 terms to get to 520	M1; A1
	OR 120 + (20)(20)	**[2]**
	Method 1 / Method 2	
(b)	**Either:** Uses $\frac{1}{2}n(2a+(n-1)d)$ / **Or:** Uses $\frac{1}{2}n(a+l)$	M1
	$\frac{20}{2}\left(2\times140+(20-1)(20)\right)$ / $\frac{20}{2}\left(140+"520"\right)$ ft 520	A1
	6600	A1
		[3]
(c)	Sian; arithmetic series, $a = 300$, $l = 700$, $S_n = 8500$	
	Either: Attempt to use $8500 = \frac{n}{2}(a+l)$ / **Or:** May use both $8500 = \frac{1}{2}n(2a+(n-1)d)$ and $l = a+(n-1)d$ **and eliminate** d	M1
	$8500 = \frac{n}{2}(300+700)$ / $8500 = \frac{n}{2}(600+400)$	A1
	$\Rightarrow n = 17$	A1
		[3]
		8 marks
	Notes	
(a)	**M1:** Attempt to use formula for **20th term** of Arithmetic series with first term **140** and d = **20. Normal formula rules** apply – see General principles at the start of the mark scheme re "Method Marks" **Or:** uses 120 + 20n with n = 20 **Or: Listing method :** Lists 140, 160, 180, 200, 220, 240, 260, 280, … 520. M1A1 if correct M0A0 if wrong. (So 2 marks or zero) **A1:** For 520	
(b)	**M1:** An attempt to apply $\frac{1}{2}n(2a+(n-1)d)$ **or** $\frac{1}{2}n(a+l)$ with their values for a, n, d and l **A1:** Uses a = 140, d = 20, n = 20 in their formula (two alternatives given above) but **ft on their value of** l from (a) if they use Method 2. **A1:** 6600 cao **Or: Listing method :** Lists 140, 160, 180, 200, 220, 240, 260, 280, … 520 and adds **6600** gets M1A1A1- any other answer gets M1 A0A0 provided there are 20 numbers, the first is 140 and the last is 520.	
(c) **First method**	**M1:** Attempt to use $S_n = \frac{n}{2}(a+l)$ with their values for a, and l and S =8500 **A1:** Uses formula with correct values **A1:** Finds exact value 17	
Alternative method	**M1:** If both formulae $8500 = \frac{1}{2}n(2a+(n-1)d)$ and $l = a+(n-1)d$ are used, then d **must be eliminated** before this mark is awarded by valid work. Should not be using d = 400. This would be **M0**. **A1:** Correct equation in n only then **A1** for 17 exactly **Trial and error methods:** Finds d = 25 and n = 17 and list from 300 to 700 with total checked – 3/3	

Question Number	Scheme	Marks
8.	$\left(\frac{dy}{dx}=\right)\quad -x^{3}+"2"x^{-2}-"\left(\frac{5}{2}\right)"x^{-3}$	M1
	$(y=)\quad -\frac{1}{4}x^{4}+\frac{"2"x^{-1}}{(-1)}-"\left(\frac{5}{2}\right)"\frac{x^{-2}}{(-2)}\;(+c)$ — Raises power correctly on any one term. Any two follow through terms correct.	M1 A1ft
	$(y=)\quad -\frac{1}{4}x^{4}+\frac{2x^{-1}}{(-1)}-\frac{5}{2}\frac{x^{-2}}{(-2)}\;(+c)$ — This is not follow through – must be correct	A1
	Given that $y=7$, at $x=1$, then $7=-\frac{1}{4}-2+\frac{5}{4}+c \;\Rightarrow\; c=$	M1
	So, $(y=)\quad -\frac{1}{4}x^{4}-2x^{-1}+\frac{5}{4}x^{-2}+c,\;\; c=8$ **or** $(y=)-\frac{1}{4}x^{4}-2x^{-1}+\frac{5}{4}x^{-2}+8$	A1
		[6]
		6 marks
	Notes	

M1: Expresses as three term polynomial with powers 3, -2 and –3. Allow slips in coefficients.
This may be implied by later integration having all three powers 4, -1 and -2.

M1: An attempt to integrate at least one term so $x^{n}\to x^{n+1}$ (not a term in the numerator or denominator)

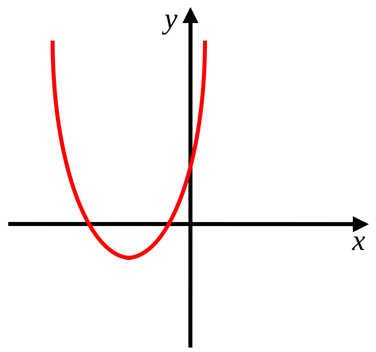
A1ft: Any two integrations are correct – coefficients may be unsimplified (follow through errors in **coefficients only here**) so should have two of the powers 4, -1 and –2 after integration – depends on 2nd method mark only. There should be a maximum of three terms here.

A1: Correct three terms – coefficients **may be unsimplified**- do not need constant for this mark
Depends on both Method marks

M1: Need constant for this mark. Uses $y=7$ and $x=1$ in their changed expression in order to find c, and attempt to find c. *This mark is available even after there is suggestion of differentiation.*

A1: Need **all four** correct terms to be **simplified** and need c = 8 here.

Question Number	Scheme	Marks
9. (a)	**Method 1:** Attempts $b^2 - 4ac$ for $a = (k+3)$, $b = 6$ and their *c*. $c \neq k$	M1
	$b^2 - 4ac = 6^2 - 4(k+3)(k-5)$	A1
	$(b^2 - 4ac =)\ -4k^2 + 8k + 96$ or $-(b^2 - 4ac =)\ 4k^2 - 8k - 96$ (with no prior algebraic errors)	B1
	As $b^2 - 4ac > 0$, then $-4k^2 + 8k + 96 > 0$ and so, $k^2 - 2k - 24 < 0$	A1 *
	Method 2: Considers $b^2 > 4ac$ for $a = (k+3)$, $b = 6$ and their *c*. $c \neq k$	M1
	$6^2 > 4(k+3)(k-5)$	A1
	$4k^2 - 8k - 96 < 0$ or $-4k^2 + 8k + 96 > 0$ or $9 > (k+3)(k-5)$ (with no prior algebraic errors)	B1
	and so, $k^2 - 2k - 24 < 0$ following correct work	A1 * **[4]**
(b)	Attempts to solve $k^2 - 2k - 24 = 0$ to give $k =$ ($\Rightarrow$ Critical values, $k = 6, -4$.)	M1
	$k^2 - 2k - 24 < 0$ gives $-4 < k < 6$	M1 A1 **[3]** **7 marks**
	Notes	
(a)	**Method 1: M1:** Attempts $b^2 - 4ac$ for $a = (k+3)$, $b = 6$ and their *c*. $c \neq k$ or uses quadratic formula and has this expression under square root. (ignore > 0, < 0 or = 0 for first 3 marks) **A1:** Correct expression for $b^2 - 4ac$ - need not be simplified (may be under root sign) **B1:** Uses algebra to manipulate result **without error** into **one of these** three term quadratics. Again may be under root sign in quadratic formula. If inequality is used early in "proof" may see $4k^2 - 8k - 96 < 0$ and B1 would be given for $4k^2 - 8k - 96$ correctly stated. **A1:** Applies $b^2 - 4ac > 0$ correctly (**or writes** $b^2 - 4ac > 0$ **)** to achieve the **result given** in the question. No errors should be seen. Any incorrect line of argument should be penalised here. There are several ways of reaching the answer; either multiplication of both sides of inequality by –1, or taking every term to other side of inequality. **Need conclusion i.e. printed answer.** **Method 2: M1:** Allow $b^2 > 4ac$, $b^2 < 4ac$ or $b^2 = 4ac$ for $a = (k+3)$, $b = 6$ and their *c*. $c \neq k$ **A1:** Correct expressions on either side (ignore >, < or =). **B1:** Uses algebra to manipulate result into one of the two three term quadratics or divides both sides by 4 **again without error** **A1:** Produces result with no errors seen from initial consideration of $b^2 > 4ac$ **.**	
(b)	**M1:** Uses factorisation, formula, completion of square method to find two values for *k* , or finds two **correct** answers with no obvious method **M1:** Their Lower Limit < *k* < Their Upper Limit . Allow the M mark mark for $\leq$. (Allow *k* < upper and *k* > lower) **A1:** $-4 < k < 6$ Lose this mark for $\leq$ Allow (-4, 6) [not square brackets] or *k* > -4 **and** *k* < 6 (must be **and** not **or**) Can also use intersection symbol $\cap$ **NOT** *k* > -4, *k* < 6 (M1A0)	
	Special case : **In part (a)** uses *c* = *k* instead of *k* - 5 - scores 0 . Allow *k* + 5 for method marks	
	Special Case: In part (b) Obtaining –6 < *k* < 4 This is a common wrong answer. Give M1 M1 A0 special case.	
	Special Case: In part (b) Use of *x* instead of *k* – M1M1A0	
	Special Case: $-4 < k < 6$ and *k* < -4, *k* > 6 both given is M0A0 for last two marks. Do not treat as isw.	

Question Number	Scheme	Marks
10. (a)	This may be done by completion of square or by expansion and comparing coefficients	
	$a = 4$	B1
	$b = 1$	B1
	All three of $a = 4$, $b = 1$ and $c = -1$	B1
		[3]
(b)		
	U shaped quadratic graph.	M1
	The curve is correctly positioned with the minimum in the third quadrant. . It crosses x axis twice on negative x axis and y axis once on positive y axis.	A1
	Curve cuts y-axis at $(\{0\}, 3)$.only	B1
	Curve cuts x-axis at $\left(-\frac{3}{2}, \{0\}\right)$ and $\left(-\frac{1}{2}, \{0\}\right)$.	B1
		[4]
		7 marks
	Notes	
(a)	**B1:** States $a = 4$ or obtains $4(x+b)^2 + c$, **B1:** States $b = 1$ or obtains $a(x+1)^2 + c$, **B1:** States $a = 4$, $b = 1$ **and** $c = -1$ or $4(x+1)^2 - 1$ (Needs all 3 correct for final mark) **Special cases:** If answer is left as $(2x+2)^2 - 1$ treat as misread B1B0B0 or as $2(x+1)^2 - 1$ then the mark is B0B1B0 from scheme	
(b)	**M1:** Any position provided U shaped (be generous in interpretation of U shape but V shape is M0) **A1 :** The curve is correctly positioned with the minimum in the third quadrant. It crosses x axis twice on negative x axis and y axis once on positive y axis. **B1:** Allow 3 on y axis and allow either $y = 3$ or (0 , 3) if given in text Curve does not need to pass through this point and this mark may be given even if there is no curve at all or if it is drawn as a line. **B1:** Allow –3/2 and –1/2 if given on x axis – need co-ordinates if given in text or x = -3/2, x = -1/2 . Accept decimal equivalents. Curve does not need to pass through these points and this mark may be given even if there is no curve. Ignore third point of intersection and allow touching instead of cutting. So even a cubic curve *might* get M0A0 B1 B1. A V shape with two ruled lines for example might get M0A0B1B1	

Question Number	Scheme	Marks
11.	$C: y = 2x - 8\sqrt{x} + 5, \quad x \geqslant 0$	
(a)	So, $y = 2x - 8x^{\frac{1}{2}} + 5$	
	$\frac{dy}{dx} = 2 - 4x^{-\frac{1}{2}} + \{0\} \qquad (x > 0)$	M1 A1 A1
		[3]
(b)	(When $x = \frac{1}{4}$, $y = 2\left(\frac{1}{4}\right) - 8\sqrt{\left(\frac{1}{4}\right)} + 5$ so) $\quad y = \frac{3}{2}$	B1
	(gradient $= \frac{dy}{dx} =$) $2 - \frac{4}{\sqrt{\left(\frac{1}{4}\right)}}$ $\{= -6\}$	M1
	Either: $y - "\frac{3}{2}" = "-6"\left(x - \frac{1}{4}\right)$ **or**: $y = "-6"x + c$ and $"\frac{3}{2}" = "-6"\left(\frac{1}{4}\right) + c \Rightarrow c = "3"$	dM1
	So $\underline{y = -6x + 3}$	A1
		[4]
(c)	Tangent at Q is parallel to $2x - 3y + 18 = 0$	
	($y = \frac{2}{3}x + 6 \Rightarrow$) Gradient $= \frac{2}{3}$. so tangent gradient is $\frac{2}{3}$	B1
	So, $"2 - \frac{4}{\sqrt{x}}" = "\frac{2}{3}"$ Sets their gradient function = their numerical gradient.	M1
	$\Rightarrow \frac{4}{3} = \frac{4}{\sqrt{x}} \Rightarrow x = 9$ Ignore extra answer x = -9	A1
	When $x = 9$, $y = 2(9) - 8\sqrt{9} + 5 = -1$ Substitutes their found x into equation of curve. $y = -1$.	dM1 A1
		[5]
		12 marks
	Notes	
(a)	**M1:** Evidence of differentiation, so $x^n \to x^{n-1}$ at least once so $x^1 \to 1$ or x^0 or $x^{\frac{1}{2}} \to x^{-\frac{1}{2}}$ not just $5 \to 0$ **A1:** Any two of the three terms correct – do not need to see zero – the 5 disappearing is sufficient; need not be simplified. **A1:** $2 - 4x^{-\frac{1}{2}}$ Both terms correct, and simplified. Do not need to include domain $x > 0$	
(b)	**B1:** Obtaining $y = 3/2$ or fractional or decimal equivalent (no working need be seen) **M1:** An attempt to substitute $x = \frac{1}{4}$ into $\frac{dy}{dx}$ to establish **gradient**. This may be implied by –6 or m = -6 but not y = - 6. Can earn this M mark if they go on to use $m = \frac{1}{6}$ or use their numerical value of $\frac{dy}{dx}$. **dM1: This depends on previous method mark.** Complete method for obtaining the equation of the tangent, using their **tangent** gradient and their value for y_1 (obtained from x = ¼, allow slip) i.e. $y - y_1 = m_T\left(x - \frac{1}{4}\right)$ with their tangent gradient and their y_1 or uses $y = mx + c$ with $\left(\frac{1}{4}, \text{ their } y_1\right)$ and their tangent gradient. **A1:** $y = -6x + 3$ or $y = 3 - 6x$ or a = -6 and b = 3	
(c)	**B1:** For the value 2/3 **not** 2/3 x **not** -3/2 **M1:** Sets their gradient function dy/dx = their numerical gradient **A1:** Obtains x = 9 **dM1:** Substitutes their x (from gradient equation) into original equation of curve C i.e. original expression y = **A1:** (9, -1) or x = 9, y = -1, or just y = -1	
	Special Cases: In (b) Finds normal could get B1 M1 M0 A0 i.e. max of 2/4	
	In (c) Uses **perpendicular** instead of **parallel** then award B0 M1 A0 M1 A0 i.e max 2/5 – see over	

edexcel

Mark Scheme (Results)

Summer 2013

GCE Core Mathematics 1 (6663/01R)

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Summer 2013
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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes:

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
    - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
    - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x =

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x =

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c, \quad q \neq 0,$ leading to x =...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. $(x^n \to x^{n-1})$

2. Integration

Power of at least one term increased by 1. $(x^n \to x^{n+1})$

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required.

Question Number	Scheme	Notes	Marks
1.	$y = x^3 + 4x + 1 \Rightarrow \dfrac{dy}{dx} = 3x^2 + 4(+0)$	M1: $x^n \to x^{n-1}$ including $1 \to 0$	M1A1
		A1: Correct differentiation (Do not allow $4x^0$ unless $x^0 = 1$ is implied by later work)	
	substitute $x = 3 \Rightarrow$ gradient = 31	M1: Substitutes $x = 3$ into their $\dfrac{dy}{dx}$ (not y) Substitutes $x = 3$ into a "changed" function. They may even have integrated.	M1A1
		A1: cao	
			[4]

Question Number	Scheme	Notes	Marks
2.	$\dfrac{15}{\sqrt{3}}=\dfrac{15}{\sqrt{3}}\times\dfrac{\sqrt{3}}{\sqrt{3}}=5\sqrt{3}$	M1: Attempts to multiply numerator and denominator by √3. This may be implied by a correct answer. A1: $5\sqrt{3}$	M1A1
	$\sqrt{27}=3\sqrt{3}$		B1
	$\dfrac{15}{\sqrt{3}}-\sqrt{27}=2\sqrt{3}$		A1
	Correct answer only scores full marks		
			[4]
Way 2	$\dfrac{15}{\sqrt{3}}-\sqrt{27}=\dfrac{15-\sqrt{81}}{\sqrt{3}}\left(=\dfrac{6}{\sqrt{3}}\right)$	Terms combined correctly with a common denominator (Need not be simplified)	B1
	$\dfrac{6}{\sqrt{3}}\times\dfrac{\sqrt{3}}{\sqrt{3}}=\dfrac{6\sqrt{3}}{3}$	M1: Attempts to multiply numerator and denominator by √3. This may be implied by a correct answer. A1: $\dfrac{6\sqrt{3}}{3}$	M1A1
	$\dfrac{15}{\sqrt{3}}-\sqrt{27}=2\sqrt{3}$		A1
			[4]
	Note that $\dfrac{15}{\sqrt{3}}-\sqrt{27}=\dfrac{15\sqrt{3}}{3}-3\sqrt{3}=15\sqrt{3}-9\sqrt{3}=6\sqrt{3}$ is quite common and scores M1A0B1A0 (i.e. $5\sqrt{3}$ is never seen)		

Question Number	Scheme	Notes	Marks
3.	$\int 3x^2 - \frac{4}{x^2}\mathrm{d}x = 3\frac{x^3}{3} - 4\frac{x^{-1}}{-1}$	M1: $x^n \to x^{n+1}$ for either term. If they write $\frac{4}{x^2}$ *as* $4x^2$ allow $x^2 \to x^3$ here.	M1,A1,A1
		A1: $3\frac{x^3}{3}$ **or** $-4\frac{x^{-1}}{-1}$ (one correct term which may be un-simplified)	
		A1: $3\frac{x^3}{3}$ **and** $-4\frac{x^{-1}}{-1}$ (both terms correct which may be un-simplified)	
	Note that M1A0A1 is not possible		
	$= x^3 + \frac{4}{x} + c$ or $x^3 + 4x^{-1} + c$	Fully correct simplified answer with + c all appearing on the same line.	A1
			[4]

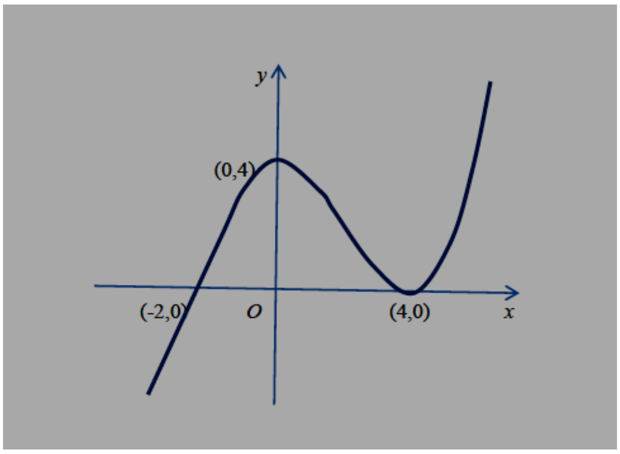
Question Number	Scheme	Notes	Marks
4.(a)	$4x+2y-3=0 \Rightarrow y=-2x+\frac{3}{2}$	Attempt to write in the form $y =$	M1
	$\Rightarrow$ gradient $= -2$	Accept any un-simplified form and allow even with an incorrect value of "c"	A1
(a) Way 2	Alternative: $4+2\frac{dy}{dx}=0$	Attempt to differentiate Allow $p \pm q\frac{dy}{dx}=0,\ p,q \neq 0$	M1
	$\Rightarrow$ gradient $= -2$	Accept any un-simplified form	A1
	Answer only scores M1A1		
			[2]
(b)	Using $m_N = -\frac{1}{m_T}$	Attempt to use $m_N =$ $-\frac{1}{gradient\ from\ (a)}$	M1
	$y-5='\frac{1}{2}'(x-2)$ or Uses $y = mx + c$ in an attempt to find c	Correct straight line method using a 'changed' gradient and the point (2, 5)	M1
	$y=\frac{1}{2}x+4$	Cao (Isw)	A1
			(3)
			[5]

Question Number	Scheme	Notes	Marks
5.(a)	$2^y = 8 \Rightarrow y = 3$	Cao (Can be implied i.e. by 2^3)	B1
	(Alternative: Takes logs base 2: $\log_2 2^y = \log_2 8 \Rightarrow y\log_2 2 = 3\log_2 2 \Rightarrow y = 3$)		
			(1)
(b)	$8 = 2^3$	Replaces 8 by 2^3 (May be implied)	M1
	$4^{x+1} = (2^2)^{x+1}$ or $(2^{x+1})^2$	Replaces 4 by 2^2 **correctly.**	M1
	$2^{3x+2} = 2^3 \Rightarrow 3x + 2 = 3 \Rightarrow x = \frac{1}{3}$	M1: Adds their powers of 2 on the lhs and puts this equal to 3 leading to a solution for *x*. A1: $x = \frac{1}{3}$ or $x = 0.\dot{3}$ or awrt 0.333	M1A1
			(4)
(b) Way 2	$4^{x+1} = 4 \times 4^x$	Obtains 4^{x+1} in terms of 4^x **correctly**	M1
	$2^x \times 4^x = 8^x$	Combines their 2^x and 4^x **correctly**	M1
	$4 \times 8^x = 8 \Rightarrow 8^x = 2 \Rightarrow x = \frac{1}{3}$	M1: Solves $8^x = k$ leading to a solution for *x*. A1: $x = \frac{1}{3}$ or $x = 0.\dot{3}$ or awrt 0.333	M1A1
			[5]

Question Number	Scheme	Notes	Marks
6.(a)	$x_2 = 1 - k$	Accept un-simplified e.g. 1^2 - 1k	B1
			(1)
(b)	$x_3 = (1-k)^2 - k(1-k)$	Attempt to substitute their x_2 into $x_3 = (x_2)^2 - kx_2$ with their x_2 in terms of k.	M1
	$= 1 - 3k + 2k^2$ *	Answer given	A1*
			(2)
(c)	$1 - 3k + 2k^2 = 1$	Setting $1 - 3k + 2k^2 = 1$	M1
	$\left(2k^2 - 3k = 0\right)$		
	$k(2k-3) = 0 \Rightarrow k = ..$	Solving their quadratic to obtain a value for k. **Dependent on the previous M1.**	dM1
	$k = \frac{3}{2}$	Cao and cso (ignore any reference to k = 0)	A1
			(3)
(d)	$\sum_{n=1}^{100} x_n = 1 + \left(-\frac{1}{2}\right) + 1 + ...$ Or $= 1 + \left(1 - 'k'\right) + 1 + ...$		M1
	Writing out at least 3 terms with the third term equal to the first term. Allow in terms of k as well as numerical values. Evidence that the sequence is oscillating between 1 and 1 – k. This may be implied by a correct sum.		
	$50 \times \frac{1}{2}$ or $50 \times 1 - 50 \times \frac{1}{2}$ or $\frac{1}{2} \times 50 \times (1 - \frac{1}{2})$	An attempt to combine the terms correctly. Can be in terms of k here e.g 100 – 50k	M1
	= 25	Allow an equivalent fraction, e.g. 50/2 or 100/4	A1
	Note that the use of $\frac{1}{2}n(a+l)$ is acceptable here but $\frac{1}{2}n(2a+(n-1)d)$ is not.		
			(3)
	Allow correct answer only		
			[9]

Question Number	Scheme	Notes	Marks
7.(a)	$U_{10} = 500 + (10-1)\times 200$	Uses $a+(n-1)d$ with a=500, d=200 and n = 9,10 or 11	M1
	=(£)2300		A1
	If the term formula is not quoted and the numerical expression is incorrect score M0. A correct answer with no working scores full marks.		**(2)**
(b)	**Mark parts (b) and (c) together**		
	$\frac{n}{2}\{2\times 500 + (n-1)\times 200\} = 67200$	M1: Attempt to use $S = \frac{n}{2}\{2a+(n-1)d\}$ with , $S_n = 67200$, $a = 500$ *and* $d = 200$	M1A1
		A1: Correct equation	
	If the sum formula is not quoted and the equation is incorrect score M0.		
	$n^2 + 4n - 672 = 0$	M1: An attempt to remove brackets and collect terms. **Dependent on the previous M1**	dM1A1
		A1: A correct **three term** equation in any form	
	E.g. allow $n^2 + 4n = 672$, $n^2 = 672 - 4n$, $672 - 4n - n^2 = 0$, $200n^2 + 800n = 134400$ etc.		
	$n^2 + 4n - 24\times 28 = 0$ *	Replaces 672 with 24×28 with the equation **as printed** (including = 0) with no errors. (= 0 may not appear on the last line but must be seen at some point)	A1
			(5)
(c)	$(n-24)(n+28) = 0 \Rightarrow n = ..$ or $n(n+4) = 24\times 28 \Rightarrow n = ..$	Solves the **given** quadratic in an attempt to find n. They may use the quadratic formula.	M1
	24	States that n = 24, or the number of years is 24	A1
	Allow correct answer only in (c)		
			(2)
			[9]

Question Number	Scheme	Notes	Marks
	Ignore any references to the units in this question		
8.(a)	length is '$x + 4$'	May be implied	B1
	$x + x + x + 4 + x + 4 > 19.2 \Rightarrow x > ..$	$2x + 2(x \pm 4) > 19.2$ and proceeds to $x >$ ..... (Accept 'invisible' brackets) Attempts 2 widths + 2 lengths > 19.2 leading to $x >$	M1
	E.g. $x + x + 4x + 4x > 19.2 \Rightarrow x > 1.92$ scores B0M1A0		
	$x > 2.8$ *	Achieves $x > 2.8$ with no errors	A1(*)
			(3)
	Mark parts (b) and (c) together		
(b)(i)	$x(x+4) < 21$	Cao	B1
b(ii)	$x^2 + 4x - 21 < 0$ $(x+7)(x-3) < 0 \Rightarrow x = ...$	Multiply out lhs, produce 3TQ = 0 and attempt to solve leading to x =... according to general guidelines	M1
	Either -7 < x < 3 **or** 0 < x < 3	M1: Attempts the 'inside' for their critical values (may be from a 2TQ here) A1: Accept either -7 < x < 3 or 0 < x < 3 or (x > -7 **and** x < 3) or (x > 0 **and** x < 3) but not e.g. (x > -7, x < 3) or (x > -7 **or** x < 3) (There is no specific need for them to realise x > 0)	M1A1
	Note that <u>many</u> candidates stop here		
			(4)
(c)	2.8 < x < 3	Follow through their answers to (a) and (b) Provided "their 3" > 2.8	B1ft
			(1)
			[8]
	Examples		
	$x(x-4) < 21 \Rightarrow x^2 - 4x - 21 < 0$ $(x-7)(x+3) < 0,\ x = 7, x = -3$ $-3 < x < 7\ or\ 0 < x < 7$ $2.8 < x < 7$ Scores B0M1M1A0B1ft	$x \times 4x < 21 \Rightarrow 4x^2 - 21 < 0$ $(2x - \sqrt{21})(2x + \sqrt{21}) < 0,\ x = \pm\frac{\sqrt{21}}{2}$ $-\frac{\sqrt{21}}{2} < x < \frac{\sqrt{21}}{2}\ or\ 0 < x < \frac{\sqrt{21}}{2}$ $2.8 < x < \frac{\sqrt{21}}{2}$ Scores B0M0M1A0B0	

Question Number	Scheme	Notes	Marks
9.(a)	$f(x) = (x+1)(x-2)^2$	M1: Either stating or writing down that ($x \pm 1$) **or** ($x \pm 2$) is a factor – may be implied by their f(x) A1: **Both** (x + 1) **and** (x - 2) are factors - may be implied by their f(x) B1: y or f(x)= (x + 1)(x - 2)^2	M1A1B1
	$= (x+1)(x^2-4x+4) = x^3-3x^2+4$	M1: Multiplying out a quadratic to get 3 terms and then multiplying by the linear term to form a cubic. A1: x^3-3x^2+4 or a = -3, b = 0, c = 4	M1A1
			(5)
(b)		Same shape and position (ignore any coordinates) with the maximum on the y-axis	B1
		y intercept = 4 or their 'c'	B1ft
		x coordinates at -2 and 4 or marked as coordinates. Allow (0, -2) and (0, 4) if they are marked in the correct position. The curve must cross or at least stop at x = -2	B1
			(3)
			[8]
(a) Way 2	$x=0, y=4 \Rightarrow c=4$	Uses (0, 4) to obtain c = 4 (can be just stated)	B1
	$x=-1, y=0 \Rightarrow -1+a-b+c=0$ $x=2, y=0 \Rightarrow 8+4a+2b+c=0$	Uses both (-1, 0) and (2, 0) in $y = x^3+ax^2+bx+c$ to form 2 simultaneous equations. Allow the equations to contain c here.	M1
	$a-b=-3$ $4a+2b=-12$ $\Rightarrow a = .. \text{ or } b = ...$	Solves simultaneously with a value for c to obtain a value for a or a value for b	M1
	Either a = -3 **or** b = 0		A1
	Both a = -3 **and** b = 0		A1

Question Number	Scheme	Notes	Marks
9.(a) Way 3	$\frac{dy}{dx} = 3x^2 + 2ax + b$	M1: $x^n \to x^{n-1}$ at least once including c → 0	M1
	$x = 0 \Rightarrow \frac{dy}{dx} = 0 \Rightarrow b = 0$	Correct value for *b*	A1
	$x = 0, y = 4 \Rightarrow c = 4$	Uses (0, 4) to obtain $c = 4$ (can be just stated)	B1
	$3(2)^2 + 2a(2) + b = 0$ or $(-1)^3 + a(-1)^2 + b(-1) + 4 = 0$	Obtains an equation in *a*	M1
	$a = -3$	Correct value for *a*	A1
			(5)
	Special case: A common incorrect approach is to assume the cubic is of the form e.g. $f(x) = x(x \pm 1)(x \pm 2) + 4$ This scores B1 only for $c = 4$		
			[8]

Question Number	Scheme	Notes	Marks
10.(a)	$f'(x)=\dfrac{x+9}{\sqrt{x}}=\dfrac{x}{\sqrt{x}}+\dfrac{9}{\sqrt{x}}=x^{\frac{1}{2}}+9x^{-\frac{1}{2}}$	M1: Correct attempt to split into 2 separate terms or fractions. May be implied by one correct term. Divides by $x^{\frac{1}{2}}$ or multiplies by $x^{-\frac{1}{2}}$. A1: $x^{\frac{1}{2}}+9x^{-\frac{1}{2}}$ or equivalent	M1A1
	$f(x)=\dfrac{x^{\frac{3}{2}}}{\frac{3}{2}}+9\dfrac{x^{\frac{1}{2}}}{\frac{1}{2}}(+c)$	M1: Independent method mark for $x^n \rightarrow x^{n+1}$ **on separate terms** A1: Allow un-simplified answers. No requirement for + c here	M1A1
	$\dfrac{(9)^{\frac{3}{2}}}{\frac{3}{2}}+9\dfrac{(9)^{\frac{1}{2}}}{\frac{1}{2}}+c=0\Rightarrow c=...$	Substitutes x = 9 and y = 0 into their integrated expression leading to a value for c. If no c at this stage M0A0 follows unless their method implies that they are correctly finding a constant of integration.	M1
	$f(x)=\dfrac{2}{3}x^{\frac{3}{2}}+18x^{\frac{1}{2}}-72$	There is no requirement to simplify their f(x) so accept any correct un-simplified form.	A1
			(6)
(b)	$f'(x)=\dfrac{x+9}{\sqrt{x}}=10\Rightarrow x+9=10\sqrt{x}$	Sets $f'(x)=\dfrac{x+9}{\sqrt{x}}=10$ and multiplies by $\sqrt{x}$. The terms in x must be in the numerator. E.g. allow $\dfrac{x+9}{10}=\sqrt{x}$	M1
	They must be setting either the **original** $f'(x)=10$ or an equivalent **<u>correct</u>** expression = 10		
	$(\sqrt{x}-9)(\sqrt{x}-1)=0\Rightarrow\sqrt{x}=...$	Correct attempt to solve a relevant 3TQ in $\sqrt{x}$ leading to solution for $\sqrt{x}$. **Dependent on the previous M1.**	dM1
	x = 81, x = 1	Note that the x = 1 solution could be just written down and is B1but must come from a <u>correct</u> equation.	A1, B1
			(4)
			[10]
Alternative to part (b)	$\left(\dfrac{x+9}{\sqrt{x}}\right)^2=10^2\Rightarrow x^2+18x+81=100x$	Sets $\dfrac{x+9}{\sqrt{x}}=10$, squares and multiplies by x. They must be setting either the original $f'(x)=10$ or an equivalent **<u>correct</u>** expression = 10	M1
	$(x-81)(x-1)=0\Rightarrow x=..$	Correct attempt to solve a relevant 3TQ leading to solution for x. **Dependent on the previous M1.**	dM1
	x = 81, x = 1	Note that the x = 1 solution could be just written down and is B1but must come from a <u>correct</u> equation.	A1, B1

Question Number	Scheme	Notes	Marks
11. (a)	$y = x + 2 \Rightarrow x^2 + 4(x+2)^2 - 2x = 35$	Substitute $y = \pm x \pm 2$ into $x^2 + 4y^2 - 2x = 35$ to obtain an equation in x only.	M1
	Alternative: $\frac{2x - x^2 + 35}{4} = (x+2)^2$ or $\sqrt{\frac{2x - x^2 + 35}{4}} = (x+2)$		
	$5x^2 + 14x - 19 = 0$	Multiply out and collects terms producing 3 term quadratic in any form.	M1
	$(5x+19)(x-1) = 0 \Rightarrow x = ..$	Solves their quadratic, usual rules, as far as x = ... **Dependent on the first M1** i.e. a correct method for eliminating y (or x – see below)	dM1
	$x = -\frac{19}{5}, x = 1$	Both correct	A1 for both
	$y = -\frac{9}{5}, y = 3$	M1: Substitutes back into either given equation to find a value for y	M1
	Coordinates are ($-\frac{19}{5}, -\frac{9}{5}$) and (1, 3)	Correct matching pairs. Coordinates need not be given explicitly but it must be clear which x goes with which y	A1
			(6)
Alternative to part (a)	$x = y - 2 \Rightarrow (y-2)^2 + 4y^2 - 2(y-2) =$	Substitutes $x = \pm y \pm 2$ into $x^2 + 4y^2 - 2x = 35$	M1
	$5y^2 - 6y - 27 = 0$	Multiply out, collect terms producing 3 term quadratic in any form.	M1
	$(5y+9)(y-3) = 0 \Rightarrow y = ..$	Solves their quadratic, usual rules, as far as y = ... **Dependent on the first M1** i.e. a correct method for eliminating x	dM1
	$y = -\frac{9}{5}, y = 3$	Both correct	A1 for both
	$x = -\frac{19}{5}, x = 1$	M1: Substitutes back into either given equation to find a value for x	M1
	Coordinates are ($-\frac{19}{5}, -\frac{9}{5}$) and (1,3)	Correct matching pairs as above.	A1
(b)	$d^2 = (1 - -\frac{19}{5})^2 + (3 - -\frac{9}{5})^2$ or $d = \sqrt{(1 - -\frac{19}{5})^2 + (3 - -\frac{9}{5})^2}$	M1: Use of $d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$ or $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ where neither $(x_1 - x_2)$ nor $(y_1 - y_2)$ are zero. A1ft: Correct ft expression for d or d^2 (may be un-simplified)	M1A1ft
	$d = \frac{24}{5}\sqrt{2}$	Allow $4.8\sqrt{2}$	A1cao
			(3)
			[9]

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Mark Scheme (Results)

Summer 2013

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- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes:

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⌈ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x =

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x =

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c$, $q \neq 0$, leading to x =...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. $(x^n \to x^{n-1})$

2. Integration

Power of at least one term increased by 1. $(x^n \to x^{n+1})$

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required.

Question Number	Scheme		Marks
1	$\dfrac{7+\sqrt{5}}{\sqrt{5}-1}\times\dfrac{(\sqrt{5}+1)}{(\sqrt{5}+1)}$	Multiplies top and bottom by a correct expression. This statement is sufficient.	M1
	(Allow to multiply top and bottom by $k(\sqrt{5}+1)$)		
	$=\dfrac{\dots}{4}$	Obtains a denominator of 4 or sight of $(\sqrt{5}-1)(\sqrt{5}+1)=4$	A1cso
	Note that M0A1 is not possible. The 4 must come from a correct method.		
	$(7+\sqrt{5})(\sqrt{5}+1)=7\sqrt{5}+5+7+\sqrt{5}$	An attempt to multiply the numerator by $(\pm\sqrt{5}\pm1)$ and get 4 terms with at least 2 correct for their $(\pm\sqrt{5}\pm1)$. (May be implied)	M1
	$3+2\sqrt{5}$	Answer as written or a = 3 and b = 2. (Allow $2\sqrt{5}+3$)	A1cso
	Correct answer with no working scores full marks		
			[4]
Way 2	$\dfrac{7+\sqrt{5}}{\sqrt{5}-1}\times\dfrac{(-\sqrt{5}-1)}{(-\sqrt{5}-1)}$	Multiplies top and bottom by a correct expression. This statement is sufficient.	M1
	(Allow to multiply top and bottom by $k(-\sqrt{5}-1)$)		
	$=\dfrac{\dots}{-4}$	Obtains a denominator of -4	A1cso
	$(7+\sqrt{5})(-\sqrt{5}-1)=-7\sqrt{5}-5-7-\sqrt{5}$	An attempt to multiply the numerator by $(\pm\sqrt{5}\pm1)$ and get 4 terms with at least 2 correct for their $(\pm\sqrt{5}\pm1)$. (May be implied)	M1
	$3+2\sqrt{5}$	Answer as written or a = 3 and b = 2	A1cso
	Correct answer with no working scores full marks		
			[4]
	Alternative using Simultaneous Equations: $\dfrac{(7+\sqrt{5})}{\sqrt{5}-1}=a+b\sqrt{5}\Rightarrow 7+\sqrt{5}=(a-b)\sqrt{5}+5b-a$ M1 Multiplies and collects rational and irrational parts $a-b=1,\ \ 5b-a=7$ A1 Correct equations $a=3,\ \ b=2$ M1 for attempt to solve simultaneous equations A1 both answers correct		`

Question Number	Scheme		Marks
2	$\left(\int =\right)\dfrac{10x^5}{5}-\dfrac{4x^2}{2},-\dfrac{3x^{\frac{1}{2}}}{\frac{1}{2}}$	M1: Some attempt to integrate: $x^n \to x^{n+1}$ on at least one term. (not for + c) (If they think $\dfrac{3}{\sqrt{x}}$ is $3x^{\frac{1}{2}}$ you can still award the method mark for $x^{\frac{1}{2}} \to x^{\frac{3}{2}}$	M1A1, A1
		A1: $\dfrac{10x^5}{5}$ **and** $\dfrac{-4x^2}{2}$ or better	
		A1: $-\dfrac{3x^{\frac{1}{2}}}{\frac{1}{2}}$ or better	
	$= \underline{2x^5 - 2x^2 - 6x^{\frac{1}{2}} + c}$	Each term correct and simplified and the + c all appearing together on the same line. Allow $\sqrt{x}$ for $x^{\frac{1}{2}}$. Ignore any spurious integral or signs and/or dy/dx's.	A1
	Do **not** apply isw. If they obtain the correct answer and then e.g. divide by 2 they lose the last mark.		
			[4]

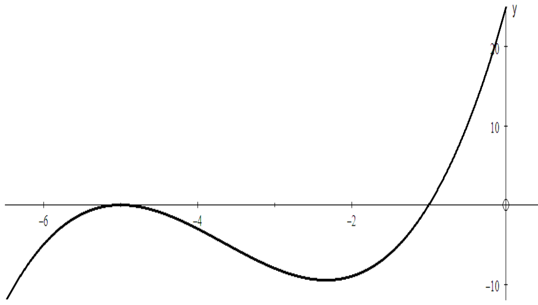
Question Number	Scheme		Marks
3(a)	$8^{\frac{1}{3}} = 2$ or $8^5 = 32768$	A correct attempt to deal with the $\frac{1}{3}$ or the 5. $8^{\frac{1}{3}} = \sqrt[3]{8}$ or $8^5 = 8\times8\times8\times8\times8$	M1
	$\left(8^{\frac{5}{3}} =\right)$ 32	Cao	A1
	A correct answer with no working scores full marks		
	Alternative $8^{\frac{5}{3}} = 8\times 8^{\frac{2}{3}} = 8\times 2^2 =$ M1 (Deals with the 1/3) = 32 A1		
			(2)
(b)	$\left(2x^{\frac{1}{2}}\right)^3 = 2^3 x^{\frac{3}{2}}$	One correct power either 2^3 or $x^{\frac{3}{2}}$. $\left(2x^{\frac{1}{2}}\right)\times\left(2x^{\frac{1}{2}}\right)\times\left(2x^{\frac{1}{2}}\right)$ on its own is not sufficient for this mark.	M1
	$\frac{8x^{\frac{3}{2}}}{4x^2} = 2x^{-\frac{1}{2}}$ or $\frac{2}{\sqrt{x}}$	M1: Divides coefficients of x **and** subtracts their powers of x. **Dependent on the previous M1**	dM1A1
		A1: Correct answer	
	Note that unless the power of x implies that they have subtracted their powers you would need to see evidence of subtraction. E.g. $\frac{8x^{\frac{3}{2}}}{4x^2} = 2x^{\frac{1}{2}}$ would score dM0 unless you see some evidence that 3/2 – 2 was intended for the power of x.		
	Note that there is a misconception that $\frac{\left(2x^{\frac{1}{2}}\right)^3}{4x^2} = \left(\frac{2x^{\frac{1}{2}}}{4x^2}\right)^3$ - this scores 0/3		
			(3)
			[5]

Question Number	Scheme		Marks
	For this question, mark (a) and (b) together and ignore labelling.		
4(a)	$(a_2 =)\ k(4+2)\ \ (=6k)$	Any correct (possibly un-simplified) expression	B1
			(1)
(b)	$a_3 = k(\text{their } a_2 + 2)\ (=6k^2 + 2k)$	An attempt at a_3. Can follow through their answer to (a) but a_2 must be an expression in k.	M1
	$a_1 + a_2 + a_3 = 4 + (6k) + (6k^2 + 2k)$	An attempt to find their $a_1 + a_2 + a_3$	M1
	$4 + (6k) + (6k^2 + 2k) = 2$	A **<u>correct</u>** equation in any form.	A1
	Solves $6k^2 + 8k + 2 = 0$ to obtain $k =$ $(6k^2 + 8k + 2 = 2(3k+1)(k+1))$	Solves their 3TQ as far as $k =$ .... according to the general principles. (An independent mark for solving their three term quadratic)	M1
	$k = -1/3$	Any equivalent fraction	A1
	$k = -1$	Must be from a correct equation. (Do not accept un-simplified)	B1
	Note that it is quite common to think the sequence is an AP. Unless they find a_3, this is likely only to score the M1 for solving their quadratic.		
			(6)
			[7]

Question Number	Scheme		Marks
5 (a)	$6x + x > 1 - 8$	Attempts to expand the bracket and collect x terms on one side and constant terms on the other. Condone sign errors and allow one error in expanding the bracket. Allow $<, \leq, \geq, =$ instead of $>$.	M1
	$x > -1$	Cao	A1
	Do not isw here, mark their final answer.		
			(2)
(b)	$(x+3)(3x-1)[=0]$ $\Rightarrow x = -3$ and $\frac{1}{3}$	M1: Attempt to solve the quadratic to obtain two critical values A1: $x = -3$ **and** $\frac{1}{3}$ (may be implied by their inequality). Allow all equivalent fractions for -3 and 1/3. (Allow 0.333 for 1/3)	M1A1
	$-3 < x < \frac{1}{3}$	M1: Chooses "inside" region (The letter x does not need to be used here) A1ft: Allow $x < \frac{1}{3}$ **and** $x > -3$ or $\left(-3, \frac{1}{3}\right)$ or $x < \frac{1}{3} \cap x > -3$. Follow through their critical values. (must be in terms of x here) Allow all equivalent fractions for -3 and 1/3. Both ($x < \frac{1}{3}$ **or** $x > -3$) and ($x < \frac{1}{3}$**,** $x > -3$) as a final answer score A0.	M1A1ft
			(4)
			[6]
	Note that use of $\leq$ or $\geq$ appearing in an otherwise correct answer in (a) or (b) should only be penalised once, the first time it occurs.		

Question Number	Scheme		Marks
6	(-1, 3) , (11, 12)		
(a)	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12-3}{11-(-1)}, = \frac{3}{4}$	M1:Correct method for the gradient A1: Any correct fraction or decimal	M1,A1
	$y - 3 = \frac{3}{4}(x+1)$ or $y - 12 = \frac{3}{4}(x - 11)$ or $y = \frac{3}{4}x + c$ with attempt at substitution to find c	Correct straight line method using either of the given points and a numerical gradient.	M1
	$4y - 3x - 15 = 0$	Or equivalent with integer coefficients (= 0 **is** required)	A1
	This A1 should only be awarded in (a)		
			(4)
(a) Way 2	$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1} \Rightarrow \frac{y-3}{12-3} = \frac{x+1}{11+1}$	M1: Use of a correct formula for the straight line A1: Correct equation	M1A1
	$12(y-3) = 9(x+1)$	Eliminates fractions	M1
	$4y - 3x - 15 = 0$	Or equivalent with integer coefficients (= 0 **is** required)	A1
			(4)
(b)	Solves their equation from part (a) and L_2 simultaneously to eliminate one variable	Must reach as far as an equation in x only or in y only. (Allow slips in the algebra)	M1
	$x = 3$ or $y = 6$	One of $x = 3$ or $y = 6$	A1
	Both $x = 3$ **and** $y = 6$	Values can be un-simplified fractions.	A1
	Fully correct answers with no working can score 3/3 in (b)		
			(3)
(b) Way 2	$(-1,3) \rightarrow -a + 3b + c = 0$ $(11,12) \rightarrow 11a + 12b + c = 0$	Substitutes the coordinates to obtain two equations	M1
	$\therefore a = -\frac{3}{4}b,\ b = -\frac{4}{15}c$	Obtains sufficient equations to establish values for a, b and c	A1
	e.g. $c = 1 \Rightarrow b = -\frac{4}{15},\ a = \frac{3}{15}$	Obtains values for a, b and c	M1
	$\frac{3}{15}x - \frac{4}{15}y + 1 = 0 \Rightarrow 4y - 3x - 15 = 0$	Correct equation	A1
			(4)
			[7]

Question Number	Scheme		Marks
7(a)	$600 = 200 + (N-1)20 \Rightarrow N = ...$	Use of 600 with a **correct** formula in an attempt to find N. A correct formula could be implied by a correct answer.	M1
	$N = 21$	cso	A1
	Accept correct answer only.		
	$600 = 200 + 20N \Rightarrow N = 20$ is M0A0 (wrong formula) $\frac{600-200}{20} = 20 \therefore N = 21$ is M1A1 (correct formula implied)		
	Listing: All terms must be listed up to 600 and 21 correctly identified. A solution that scores 2 if fully correct and 0 otherwise.		
			(2)
(b)	**Look for an AP first:**		
	$S = \frac{21}{2}(2\times 200 + 20\times 20)$ or $\frac{21}{2}(200+600)$ or $S = \frac{20}{2}(2\times 200 + 19\times 20)$ or $\frac{20}{2}(200+580)$ (= 8400 or 7800)	M1: Use of correct sum formula with their **integer** $n = N$ or $N - 1$ from part (a) where $3 < N < 52$ and $a = 200$ and $d = 20$. A1: Any correct un-simplified numerical expression with $n = 20$ or $n = 21$ (No follow through here)	M1A1
	Then for the constant terms:		
	$600\times(52 - "N")$ (= 18600)	M1: $600\times k$ where k is an integer and $3 < k < 52$ A1: A correct un-simplified follow through expression with their k consistent with n so that $n + k = 52$	M1A1ft
	So total is 27000	Cao	A1
	Note that for the constant terms, they may correctly use an AP sum with $d = 0$.		
	There are no marks in (b) for just finding S_{52}		
			(5)
			[7]
	If they obtain $N = 20$ in (a) (0/2) and then in (b) proceed with, $S = \frac{20}{2}(2\times 200 + 19\times 20) + 32\times 600 = 7800 + 19\ 200 = 27\ 000$ allow them to 'recover' and score full marks in (b) Similarly If they obtain $N = 22$ in (a) (0/2) and then in (b) proceed with, $S = \frac{21}{2}(2\times 200 + 20\times 20) + 31\times 600 = 8400 + 18\ 600 = 27\ 000$ allow them to 'recover' and score full marks in (b)		

Question Number	Scheme		Marks
8 **(a)**		Horizontal translation – does **not** have to cross the *y*-axis on the right but must at least reach the *x*-axis.	B1
		Touching at (-5, 0). This could be stated anywhere or -5 could be marked on the *x*-axis. Or (0, -5) **marked in the correct place.** Be fairly generous with 'touching' if the intention is clear.	B1
		The right hand tail of their cubic shape crossing at (-1, 0). This could be stated anywhere or -1 could be marked on the *x*-axis. Or (0, -1) **marked in the correct place.** The curve must **cross** the *x*-axis and not stop at -1.	B1
			(3)
(b)	$(x+5)^2(x+1)$	Allow $(x+3+2)^2(x-1+2)$	B1
			(1)
(c)	When $x = 0$, $y = 25$	M1: Substitutes $x = 0$ into their expression in **part (b)** which is not f(x). This may be implied by their answer. Note that the question asks them to use part (b) but allow independent methods.	M1 A1
		A1: $y = 25$ (Coordinates not needed)	
	If they expand <u>incorrectly</u> prior to substituting $x = 0$, score M1 A0 **NB f(x + 2) =** $x^3+11x^2+35x+25$		
			(2)
			[6]

Question Number	Scheme		Marks
9 (a)	$(3-x^2)^2 = 9-6x^2+x^4$	An attempt to expand the numerator obtaining an expression of the form $9 \pm px^2 \pm qx^4,\quad p,q \neq 0$	M1
	$9x^{-2}+x^2$	Must come from $\dfrac{9+x^4}{x^2}$	A1
	-6	Must come from $\dfrac{-6x^2}{x^2}$	A1
	Alternative 1: Writes $\dfrac{(3-x^2)^2}{x^2}$ as $(3x^{-1}-x)^2$ and attempts to expand = M1 then A1A1 as in the scheme.		
	Alternative 2: Sets $(3-x^2)^2 = 9+Ax^2+Bx^4$, expands $(3-x^2)^2$ and compares coefficients = M1 then A1A1 as in the scheme.		
			(3)
	$(\mathrm{f}'(x) = 9x^{-2}-6+x^2)$		
(b)	$-18x^{-3}+2x$	M1: $x^n \to x^{n-1}$ on separate terms at least once. Do not award for $A \to 0$ (Integrating is M0) A1ft: $-18x^{-3}+2\text{"}B\text{"}x$ with a numerical B and no extra terms. (A may have been incorrect or even zero)	M1 A1ft
			(2)
(c)	$\mathrm{f}(x) = -9x^{-1}-6x+\dfrac{x^3}{3}(+c)$	M1: $x^n \to x^{n+1}$ on separate terms at least once. (Differentiating is M0) A1ft: $-9x^{-1}+Ax+\dfrac{Bx^3}{3}(+c)$ with numerical A and B, $A, B \neq 0$	M1A1ft
	$10 = \dfrac{-9}{-3}-6(-3)+\dfrac{(-3)^3}{3}+c$ so c = ...	Uses x = -3 and y =10 in what they think is f(x) (They may have differentiated here) but it must be a changed function i.e. not the original $\mathrm{f}'(x)$, to form a linear equation in c and attempts to find c. No + c gets M0 and A0 unless their method implies that they are correctly finding a constant.	M1
	c = -2	cso	A1
	$(\mathrm{f}(x) =) -9x^{-1}-6x+\dfrac{x^3}{3}$ + their c	Follow through their c in an otherwise (possibly un-simplified) **correct expression**. Allow $-\dfrac{9}{x}$ for $-9x^{-1}$ or even $\dfrac{9x^{-1}}{-1}$.	A1ft
	Note that if they integrate in (b), no marks there but if they then go on to use their integration in (c), the marks for integration are available.		
			(5)
			[10]

Question Number	Scheme	Marks	
10(a)	$x^2 - 4k(1-2x) + 5k(=0)$	Makes *y* the subject from the first equation and substitutes into the second equation (= 0 not needed here) or eliminates *y* by a correct method.	M1
	So $x^2 + 8kx + k = 0$ *	Correct completion to printed answer. There must be no incorrect statements.	A1cso
			(2)
(b)	$(8k)^2 - 4k$	M1: <u>Use</u> of $b^2 - 4ac$ (Could be in the quadratic formula or an inequality, = 0 not needed yet). There must be some correct substitution but there must be no *x*'s. No formula quoted followed by e.g. $8k^2 - 4k = 0$ is M0. A1: Correct expression. Do not condone missing brackets unless they are implied by later work but can be implied by $(8k)^2 > 4k$ etc.	M1 A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0) but there must be no contradictory earlier statements. A fully correct solution with no errors.	A1
			(3)
(b) Way 2 Equal roots	$\Rightarrow x^2 + 8kx + k = (x + \sqrt{k})^2$ $\Rightarrow 8k = 2\sqrt{k}$	M1: Correct strategy for equal roots A1: Correct equation	M1A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0)	A1
(b) Way 3	Completes the Square $x^2 + 8kx + k = (x+4k)^2 - 16k^2 + k$ $\Rightarrow 16k^2 - k = 0$	M1: $(x \pm 4k)^2 \pm p \pm k,\ p \neq 0$ A1: Correct equation	M1A1
	$k = \frac{1}{16}$ (oe)	Cso (Ignore any reference to *k* = 0)	A1
			(3)
(c)	$x^2 + \frac{1}{2}x + \frac{1}{16} = 0$ so $(x + \frac{1}{4})^2 = 0 \Rightarrow x =$	Substitutes their value of *k* into the given quadratic and attempt to solve their 2 or 3 term quadratic as far as *x* = (may be implied by substitution into the quadratic formula) or starts again and substitutes their value of *k* into the second equation and solves simultaneously to obtain a value for *x*.	M1
	$x = -\frac{1}{4},\ y = 1\frac{1}{2}$	First A1 one answer correct, second A1 both answers correct.	A1A1
	Special Case: $x^2 + \frac{1}{2}x + \frac{1}{16} = 0 \Rightarrow x = -\frac{1}{4},\ \frac{1}{4} \Rightarrow y = 1\frac{1}{2},\ \frac{1}{2}$ allow M1A1A0		
			(3)
			[8]

Question Number	Scheme		Marks
11 (a)	$\left(-\frac{3}{4}, 0\right)$. Accept $x=-\frac{3}{4}$		B1
			(1)
(b)	$y = 4$	B1: One correct asymptote	B1B1
	$x = 0$ or 'y-axis'	B1: Both correct asymptotes and no extra ones.	
	Special case $x \neq 0$ **and** $y \neq 4$ scores B1B0		
			(2)
(c)	$\frac{dy}{dx} = -3x^{-2}$	$\frac{dy}{dx} = kx^{-2}$ (Allow $\frac{dy}{dx} = kx^{-2} + 4$)	M1
	At $x=-3$, gradient of curve = $-\frac{1}{3}$	Cao (may be un-simplified but must be a fraction with no powers) e.g. $-3(-3)^{-2}$ scores A0 unless evaluated as e.g. $\frac{-3}{9}$ or is implied by their normal gradient.	A1
	Gradient of normal = -1/*m*	Correct perpendicular gradient rule applied to a numerical gradient that must have come from substituting *x* = -3 into their derivative. **Dependent on the previous M1.**	dM1
	Normal at *P* is $(y-3)=3(x+3)$	M1: Correct straight line method using (-3, 3) and a "changed" gradient. A wrong equation with no formula quoted is M0. **Also dependent on the first M1.**	dM1A1
		A1: Any correct equation	
			(5)
(d)	(-4, 0) and (0, 12).	Both correct (May be seen on a sketch)	B1
	So *AB* has length $\sqrt{160}$ or AB^2 has length 160	M1: Correct use of Pythagoras for their *A* and *B* one of which lies on the *x*-axis and the other on the *y*-axis, obtained from their equation in (c). A correct method for AB^2 or *AB*.	M1 A1cso
		A1: $\sqrt{160}$ or better e.g. $4\sqrt{10}$ **with no errors seen**	
			(3)
			[11]

Mark Scheme (Results)

January 2014

Pearson Edexcel International Advanced Level

Core Mathematics 1 (6663A/01)

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1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⌈ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
    - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
    - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$$(x^2 + bx + c) = (x + p)(x + q), \text{ where} |pq| = |c|, \text{ leading to } x = \ldots$$

$$(ax^2 + bx + c) = (mx + p)(nx + q), \text{ where} |pq| = |c| \text{ and } |mn| = |a|, \text{ leading to } x = \ldots$$

2. Formula

Attempt to use the correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c = 0, \quad q \neq 0,$ leading to x = …

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners" reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners" reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required.

Question Number	Scheme	Marks
1.	(a) $\left(2\sqrt{x}\right)^2 = 4x$	B1
		(1)
	(b) $\dfrac{(5+\sqrt{7})}{(2+\sqrt{7})} \times \dfrac{(2-\sqrt{7})}{(2-\sqrt{7})}$	
	$= \dfrac{10-7+2\sqrt{7}-5\sqrt{7}}{-3}$	M1, A1
	$= -1+\sqrt{7}$	A1
		(3)
		(4 marks)

Notes

(a)	B1	$4x$. Accept alternatives such as $x4$, $4\times x$, $x\times 4$
(b)	M1	For multiplying numerator and denominator by $2-\sqrt{7}$ and attempting to expand the brackets. There is no requirement to get the expanded numerator or denominator correct- seeing the brackets removed is sufficient.
	A1	All four terms correct (unsimplified) on the numerator **OR** the correct denominator of -3
	A1	Correct answer $-1+\sqrt{7}$. Accept $\sqrt{7}-1$, $-1+1\sqrt{7}$ and other fully correct simplified forms

Question Number	Scheme	Marks
2.	(a) $2x^2-\frac{4}{\sqrt{x}}+1=2x^2-4x^{-\frac{1}{2}}+1$	
	$\frac{\mathrm{d}y}{\mathrm{d}x}=2\times 2x-4\times -\frac{1}{2}x^{-\frac{3}{2}}(+0)\quad (x^n\to x^{n-1})$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x}=4x+2x^{-\frac{3}{2}}$ or $4x+\frac{2}{x^{\frac{3}{2}}}$ *oe*	A1,A1
		(3)
	(b) $x^n\to x^{n-1}$	M1
	$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=4-3x^{-\frac{5}{2}}$ or $4-\frac{3}{x^{\frac{5}{2}}}$	A1
		(2) **(5 marks)**

Notes

(a)	M1 $x^n\to x^{n-1}$ for any term. The sight of $2x^2\to Ax$ OR $Cx^{-\frac{1}{2}x}\to Dx^{-\frac{3}{2}x}$ OR $1\to 0$ is sufficient Do not follow through on an incorrect index of $\frac{4}{\sqrt{x}}$ for this mark. A1 One of the first two terms correct and simplified. Either $4x$ or $2x^{-\frac{3}{2}}$ Accept equivalents such as $4\times x$ and $2\times x^{-\frac{3}{2}}=\frac{2}{x^{1.5}}$ Ignore +c for this mark. Do not accept unsimplified terms like $2\times 2x$ A1 A completely correct solution with no +c. That is $4x+2x^{-\frac{3}{2}}$ Accept simplified equivalent expressions such as $4\times x+2\times x^{-\frac{3}{2}}$ or $4x+\frac{2}{x^{\frac{3}{2}}}$ There is no requirement to give the lhs ie $\frac{\mathrm{d}y}{\mathrm{d}x}=$. However if the lhs is incorrect withhold the last A1
(b)	M1 For either $4x\to 4$ or $x^n\to x^{n-1}$ for a fractional term. Follow through on incorrect answers in (a). A1 A completely correct solution $4-3x^{-\frac{5}{2}}$ Award for expressions such as $4-3\times x^{-\frac{5}{2}}$ or $4-\frac{3}{x^{\frac{5}{2}}}$ or $-3\times x^{-2.5}+4$ There is no requirement to give the lhs ie $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=....$ However if the lhs is incorrect withhold the last A1

Question Number	Scheme		Marks
3.	$x=2y+1$	$2y=x-1$	
	$(2y+1)^2+4y^2-10(2y+1)+9=0$	$x^2+(x-1)^2-10x+9=0$	M1
	$8y^2-16y=0$	$2x^2-12x+10=0$	M1,A1
	$8y(y-2)=0$ Alt $y(8y-16)=0$	$2(x-1)(x-5)=0$ Alt $(2x-2)(x-5)=0$	M1
	$y=0, y=2$	$x=1, x=5$	
	$y=0$ in $x=2y+1 \Rightarrow x=1$	$x=1$ in $y=\dfrac{x-1}{2}=0$	M1
	$y=2$ in $x=2y+1 \Rightarrow x=5$	$x=5$ in $y=\dfrac{x-1}{2}=2$	
	x=1,y=0 and x=5,y=2	x=1,y=0 and x=5,y=2	A1,A1
			(7 marks)

Notes

M1 Rearrange $x-2y-1=0$ into $x=..$, or $y=..$, or $2y=..$ **and** attempt to fully substitute into 2nd equation.
It does not need to be correct but a clear attempt must be made.
Condone missing brackets $(2y+1)^2+4y^2-10\times 2y+1+9=0$

M1 Collect like terms to produce a quadratic equation in x (or y) =0

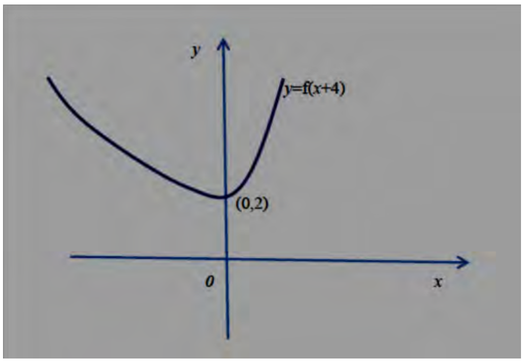
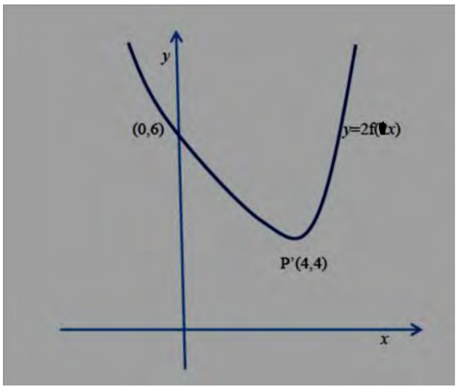
A1 Correct quadratic equation in x (or y)=0. Either $A(y^2-2y)=0$ or $B(x^2-6x+5)=0$

M1 Attempt to solve, with usual rules. Check the first and last terms only for factorisation. See appendix for completing the square and use of formula. Condone a solution from cancelling in a case like $A(y^2-2y)=0$. They must proceed to find at least one solution $x=..$ or $y=..$

M1 Substitute at least one value of their x to find y or vice versa. This may be implied by their solution- you will need to check!

A1 Both x"s or both y"s correct **or** a correct matching pair. Accept as a coordinate.
Do not accept correct answers that are obtained from incorrect equations.
A1 Both „pairs" correct. Accept as coordinates $(1,0)\ (5,2)$

Special Cases where candidates write down answers with little or no working as can be awarded above.
One correct solution – B2.
Two correct solutions – B2, B2
To score all 7 marks candidates must prove that there are **only** two solutions. This could be justified by a sketch.

Question Number	Scheme		Marks
4.	(a) 	Horizontal translation of ±4	M1
		Minimum point on the *y*- axis at (0,2)	A1
			(2)
	(b) 	Correct „shape" with P' adapted	M1
		y intercept (0,6) and P"(4,4)	A1
			(2)
			(4 marks)

Notes

(a)	M1	A horizontal translationof ± 4. The *y* coordinate of *P* remains unchanged at 2. Look for $P' = (0,2)$ or $(8,2)$. Condone U shaped curves
	A1	The shape remains unchanged and has a minimum at (0,2). Condone U shaped curves
(b)	M1	The curve remains in quadrant 1 and quadrant 2 with the minimum in quadrant 1. The shape must be correct. Condone U shaped curves. *P′* must have been adapted. The mark cannot be scored for drawing the original curve with *P′*=(4,2).
	A1	Correct shape, condoning U shapes with the *y* intercept at (0, 6) and *P′*=(4,4) The coordinates of the points may appear in the text or besides the diagram. This is acceptable but if they contradict the diagram, the diagram takes precedence.

Question Number	Scheme	Marks
5.	(a) $\sum_{r=1}^{5} a_r = 12+4\times5^2 = ..$	M1
	$= 112$	A1
		(2)
	(b) $\sum_{r=1}^{6} a_r = 12+4\times6^2$	M1
	$a_6 = \sum_{r=1}^{r=6} a_r - (\text{part } a)$	dM1
	$a_6 = 156-112 = 44$	A1
		(3) **(5 marks)**

Notes	
(a)	M1 Substitutes n=5 into the expression $12+4n^2$ and attempt to find a numerical answer for $\sum_{r=1}^{5} a_r$. Accept as evidence expressions such as $12+4\times5^2 = ..$, $12+4(5)^2 = ..$, even $12+20^2 = 412$ Accept for this mark solutions which add $12+4\times1^2, 12+4\times2^2, 12+4\times3^2, 12+4\times4^2, 12+4\times5^2$ and as a result 112 appears in a sum. A1 cao 112. Accept this answer with no incorrect working for both marks. If it is consequently summed it will be scored A0
(b)	M1 Substitutes n =6 into the expression $12+4n^2$ Accept as evidence $12+4\times6^2 = ..$, $12+4(6^2) = ..$ $12+24^2 = ..$ or indeed 156. You **can** accept the appearance of $12+4\times6^2 = ..$ in a sum of terms. dM1 Attempts to find their answer to $\sum_{r=1}^{6} a_r$ − their answer to part a This is dependent upon the previous M mark. Also accept a restart where they attempt $\sum_{r=1}^{6} a_r - \sum_{r=1}^{5} a_r$ A1 cao 44 Alternative to 5(b) M1 Writes down an expression for $a_n = (12+4n^2)-(12+4(n-1)^2) = 4(n^2-(n-1)^2) = 4(2n-1)$ dM1 Subs $n=6$ into the expression for $a_n = 4(2n-1) = ...$ A1 cao 44

Question Number	Scheme	Marks
6.	(a) (i) $\frac{3}{2}$ or equivalents such as 1.5	B1
	(ii) (0, 3.5) Accept y=$3\frac{1}{2}$	B1
		(2)
	(b) Perpendicular gradient $l_2 = = -\frac{2}{3}$	B1ft
	Equation of line is: $y-5=-\frac{2}{3}(x-1)$	M1A1
	$3y+2x-17=0$	A1
		(4)
	(c) Point C: $y=0 \Rightarrow 2x=17 \Rightarrow x=8.5$ oe	M1, A1
	$AB=\sqrt{(1-0)^2+(5-3.5)^2}=\left(\frac{\sqrt{13}}{2}\right)$	M1 (either)
	$BC=\sqrt{(8.5-1)^2+(5-0)^2}=\left(\frac{\sqrt{325}}{2}\right)$	
	Area rectangle = AB×BC=$\frac{\sqrt{13}}{2}\times\frac{\sqrt{325}}{2}=\frac{\sqrt{13}}{2}\times\frac{\sqrt{13}\sqrt{25}}{2}=\frac{5\times13}{4}=16.25$ oe	dM1A1
		(5)
		(11 marks)

Notes

(a)

B1 cao gradient =1.5. Accept equivalences such as $\frac{3}{2}$

B1 cao intercept =(0,3.5). Accept 3.5, y=3.5 and equivalences such as $\frac{7}{2}$

(b)

B1ft For using the perpendicular gradient rule, $m_1=-\frac{1}{m_2}$ on their „1.5".

Accept $-\frac{1}{'1.5'}$ or this as part of their equation for l_2 Eg. $-\frac{1}{'1.5'}=\frac{y-...}{x-...}$

M1 For an attempt at finding the equation of l_2 using (1,5) and their adapted gradient.

Condone for this mark a gradient of $\frac{3}{2}$ going to $\frac{2}{3}$.Eg. Allow for $\frac{y-5}{x-1}=\frac{2}{3}$

If the form $y=mx+c$ is used it must be a full method to find c with (1,5) and an adapted gradient.

A1 For an a correct unsimplified equation of the line through (1,5) with the correct gradient.

Allow $\frac{y-5}{x-1}=-\frac{2}{3}$ and $5=-\frac{2}{3}\times1+c \Rightarrow c=\frac{17}{3}$

A1 cso $\pm(3y+2x-17)=0$

An example of B1ftM0A0A0 would be $-\frac{1}{3}=\frac{y-5}{x+1}$ following a gradient of „3"in part (a)

An example of B1ftM1A0A0 would be $-\frac{1}{3}=\frac{y-5}{x-1}$ following a gradient of „3"in part (a)

An example of B0ftM1A0A0 would be $\frac{1}{3}=\frac{y-5}{x-1}$ following a gradient of „3"in part (a)

Question Number	Scheme	Marks
	Notes for Question 6 continued	
(c)	M1 An attempt to use their equation found in part b to find the *x* coordinate of *C* They must either use the equation of l_2 and set $y = 0 \Rightarrow x = ...$ or use its gradient $\frac{17.5}{x} = \frac{3}{2} \Rightarrow x = ..$ A1 *C*= (8.5, 0). Allow equivalents such as *x* =8.5 at *C* M1 An attempt to use $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ for *AB* or *BC*. There is no need to „calculate" these. Evidence of an attempt would be $AB^2 = 1^2 + 1.5^2 \Rightarrow AB = ..$ dM1 Multiplying together their values of *AB* and *BC* to find area *ABCD* It is dependent upon both M"s having been scored. A1 cao16.25 or equivalents such as $\frac{65}{4}$.	

Question Number	Scheme	Marks
7.	(a) 14000+8×1500=14000+12000 =£26000	M1 A1* (2)
	(b) $S_n = \frac{n}{2}(a+l) = \frac{9}{2}\times(14000+26000)$ OR $S_9 = \frac{n}{2}(2a+(n-1)d) = \frac{9}{2}\times(28000+8\times1500)$ =£180000	M1 A1 (2)
	(c) Use $a+(n-1)d$ to find A $A+(10-1)\times1000 = 26000$ $A = 17000$ Use $S_n = \frac{n}{2}(a+l)$ or $S_n = \frac{n}{2}(2a+(n-1)d)$ to find S for Anna $S_{10} = \frac{10}{2}(17000+26000)$ $(=£215000)$ or $S_{10} = \frac{10}{2}(2\times17000+9\times1000)(=£215000)$ Shelim earns 180000+26000 in 10 years =(£206000) Difference= £9000	M1 A1 M1A1 B1ft A1 (6) **(10 marks)**

Notes

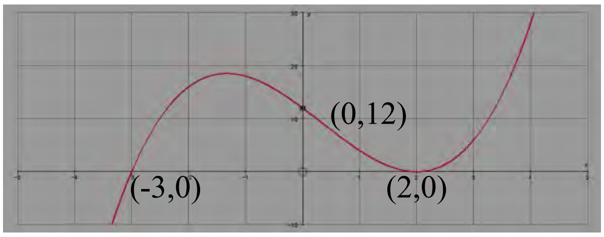
(a)	M1 Uses $S = a+(n-1)d$ with a=14000, d=1500 and n=8, 9 or 10 in an attempt to find salary in year 9 Accept a sequence written out only if all terms up to year 9 are included-Allow no errors. A1* csa 26000. It is acceptable to write a sequence for both the 2 marks FYI the terms are $14000, 15500, 17000, 18500, 20000, 21500, 23000, 24500, 26000$ Alt (a) Alternative working backwards M1 Uses $S = a+(n-1)d$ with a=14000, d=1500 and S =26000 in attempt to find n. It must reach n=.. A1 n=9
(b)	M1 Uses $S_n = \frac{n}{2}(a+l)$ with a=14000, l=26000 and n=8, 9 or 10. Do not allow ft"s on incorrect l"s . Alternatively uses $S_n = \frac{n}{2}(2a+(n-1)d)$ with a=14000, d=1500 and n=8, 9 or 10. Weaker candidates may list the individual salaries. This is acceptable as long as all terms are included. For example $14000+15500+17000+18500+20000+21500+23000+24500+26000$ A1 Cao (£) 180000.

Question Number	Scheme	Marks
	Notes for Question 7 continued	
(c)	M1 Use $l = a + (n-1)d$ to find A. It must be a full method with d=1000, l=26000a=A and n=9, 10 or 11 leading to a value for A A1 A=17000. Accept A=17000 written down for 2 marks as long as no incorrect work seen in its calculation. M1 Use $S_n = \frac{n}{2}(a+l)$ to find S for Anna. Follow through on their A, but l=26000 and n=9, 10 or 11 Alternatively uses $S_n = \frac{n}{2}(2a+(n-1)d)$ with their numerical value of A, d=1000 and n=9, 10 or 11 Accept a series of terms with their value of A, rising in £1000‟s up to a maximum of £26000. A1 Anna earns $S_{10} = \frac{10}{2}(17000+26000)$ OR $S_{10} = \frac{10}{2}(2\times 17000 + 9\times 1000)$ in 10 years This is an intermediate answer. There is no requirement to state the value £215 000 B1ft Shelim earns (b)+26000 in 10 years. This may be scored at the start of part c. A1 CAO and CSO Difference =£9000	

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>8.</td><td>(a) $b^2-4ac=(2k)^2-4\times2\times(k+2)$
$b^2-4ac>0\Rightarrow4k^2-4\times2\times(k+2)>0\Rightarrow k^2-2k-4>0$

(b) $k^2-2k-4=0\Rightarrow(k-1)^2=5$
$k=1\pm\sqrt{5}$ oe
$k>1+\sqrt{5},\quad k<1-\sqrt{5}$</td><td>M1A1
A1*
(3)
M1
A1
dM1A1
(4)
(7 marks)</td></tr>
<tr><td></td><td>Alt (a) $b^2>4ac\Rightarrow(2k)^2>4\times2\times(k+2)$
$\Rightarrow k^2-2k-4>0$</td><td>M1A1
A1*
(3)</td></tr>
<tr><td colspan="3">Notes</td></tr>
<tr><td>(a)</td><td colspan="2">M1 For attempting to use b^2-4ac with the values of a, b and c from the given equation.
Condone invisible brackets. $2k^2-4\times2\times k+2$ could be evidence
A1 Fully correct (unsimplified) expression for $b^2-4ac=(2k)^2-4\times2\times(k+2)$
The bracketing must be correct. You can accept with or without any inequality signs.
Accept $a=2,b=2k,c=k+2\Rightarrow b^2-4ac=(2k)^2-4\times2\times(k+2)$
A1* Full proof, no errors, this is a given answer. It must be stated or implied that $b^2-4ac>0$
Do not accept recovery from poor or incorrect bracketing or incorrect inequalities.
Do not accept the answer written down without seeing an intermediate line such as
$4k^2-4\times2\times(k+2)>0\Rightarrow k^2-2k-4>0$
Or $4k^2-8k-8>0\Rightarrow k^2-2k-4>0$
The inequality must have been seen at least once before the final line for this mark to have been awarded.
Eg accept $D=4k^2-8k-8\Rightarrow4k^2-8k-8>0\Rightarrow k^2-2k-2>0$</td></tr>
<tr><td>(b)</td><td colspan="2">M1 Attempt to solve the given 3 term quadratic (=0) by formula or completing the square.
Do NOT accept an attempt to factorise in this question.
If the formula is given it must be correct.
It can be implied by seeing either $\frac{-(-2)\pm\sqrt{(-2)^2-4\times1\times-4}}{2\times1}$ or
$\frac{--2\pm\sqrt{-2^2-4\times1\times-4}}{2\times1}$
If completing the square is used it can be implied by $(k-1)^2\pm1-4=0\Rightarrow k=...$
A1 Obtains critical values of $1\pm\sqrt{5}$. Accept $\frac{2\pm\sqrt{20}}{2}$
dM1 Outsides of their values chosen. It is dependent upon the previous M mark having been awarded. States $k>$ their largest value, $k<$ their smallest value
Do not award simply for a diagram or a table- they must have chosen their 'outside regions'
A1 Correct answer only. Accept $k>1+\sqrt{5}$ or $k<1-\sqrt{5}$, $k>1+\sqrt{5}$ $k<1-\sqrt{5}$,
$(-\infty,1-\sqrt{5})\cup(1+\sqrt{5},\infty)$
but not $k>1+\sqrt{5}$ and $k<1-\sqrt{5}$, $1+\sqrt{5}<k<1-\sqrt{5}$</td></tr>
</table>

Question Number	Scheme	Marks
	Notes for Question 8 continued	
	Also accept exact alternatives as a simplified form is not explicitly asked for in the question Accept versions such as $k > \frac{2+\sqrt{20}}{2}$ or $k < \frac{2-\sqrt{20}}{2}$	

Question Number	Scheme	Marks
9.	(a) $f'(x)=(x-2)(3x+4)$	
	$=3x^2-2x-8$	B1
	$y=\int 3x^2-2x-8\,dx=3\times\frac{x^3}{3}-2\times\frac{x^2}{2}-8x+c$	M1A1
	$x=3, y=6 \Rightarrow 6=27-9-24+c$	
	$c=..$	M1
	$f(x)=x^3-x^2-8x+12$ cso	A1
		(5)
	(b) $f(x)=(x-2)^2(x+p)$ $p=3$	B1
	$f(x)=(x^2-4x+4)(x+3)$	
	$f(x)=x^3-4x^2+3x^2+4x-12x+12$	
	$f(x)=x^3-x^2-8x+12$ cso	M1A1
		(3)
	(c)	
	 Shape	B1
	Min at (2,0)	B1
	Crosses x- axis at (-3,0)	B1ft
	Crosses y- axis at (0,12)	B1
		(4)
		(12 marks)

Notes

(a)	B1	Writes $(x-2)(3x+4)$ as $3x^2-2x-8$
	M1	$x^n \to x^{n+1}$ in any one term. For this M to be scored there must have been an attempt to expand the brackets and obtain a quadratic expression
	A1	Correct (unsimplified) expression for $f(x)$, no need for +c. Accept $3\frac{x^3}{3}-2\frac{x^2}{2}-8x$
	M1	Substitutes x=3 and y=6 into their f(x) containing a constant „c" and proceed to find its value.
	A1	Cso $f(x)=x^3-x^2-8x+12$. Allow $y=..$ **Do not accept an answer produced from part (b)**
(b)	B1	States $p=3$ This may be obtained from subbing (3,6) into $f(x)=(x-2)^2(x+p)$
	M1	Multiplies out a pair of brackets first, usually $(x-2)^2$ and then attempts to multiply by the third.The minimum criteria should be the first multiplication is a 3T quadratic with correct first and last terms and the second is a 4T cubic with correct first and last terms. Accept an expression involving p for M1 $(x-2)^2(x+p)=(x^2+..x+4)(x+p)=x^3+..x^2+..x+4p$
	A1	cso $f(x)=x^3-x^2-8x+12$, which must be the same as their answer for part (a)

	Notes for Question 9 continued
	Candidates who have experienced Core 2 could take their answer to (a) and factorise. The mark scheme can be applied with M1 for division by $(x-2)$ and further factorisation of the quotient $$x-2\overline{)x^3+.........}\quad x^2$$ Alternatively the candidate could divide by (x^2-4x+4) to obtain $(x+..)$ $$x^2-4x+4\overline{)x^3+.........}\quad x+..$$ The A1 is scored for $\mathrm{f}(x)=(x-2)^2(x+3)$ The B1 is awarded for a statement of $p=3$ and not just $(x-2)^2(x+3)$
(c)	B1 Shape $+x^3$ graph with one maximum and one minimum. Its position is not important for this mark. It must appear to tend to + infinity at the rhs and – infinity at the lhs. The curve must extend beyond its „maximum" point and minimum points.  Eg. These are NOT acceptable. B1 There is a turning point at (2, 0). Accept 2 marked as a maximum or minimum on the x- axis. B1ft Graph crosses the x- axis at (-3, 0). Accept -3 marked at the point where the curve crosses the x-axis. You may follow through on their values of $'-p'$ as long as $p<2$ B1 Graph crosses the y-axis at (0, 12). Accept 12 marked on the y- axis.

Question Number	Scheme	Marks
10.	(a) $x^n \to x^{n-1}$ $\frac{dy}{dx} = 3x^2 - 2\times 2x - 1$	M1A1
	Sub x=2 $\frac{dy}{dx} = 3\times 2^2 - 2\times 4 - 1 = (3)$	M1
	$3 = \frac{y-1}{x-2}$	dM1
	$y = 3x - 5$ cso	A1*
		(5)
	(b) At Q $\frac{dy}{dx} = 3x^2 - 4x - 1 = 3$	
	$3x^2 - 4x - 4 = 0$	M1
	$(3x+2)(x-2) = 0$	dM1
	$x = -\frac{2}{3}$	A1
	Sub $x = -\frac{2}{3}$ into $y = x^3 - 2x^2 - x + 3$	dM1
	$y = \frac{67}{27}$	A1
		(5)
		(10 marks)

Notes

(a)	M1 $x^n \to x^{n-1}$ for any term including 3→0.
	A1 $\left(\frac{dy}{dx}\right) = 3x^2 - 2\times 2x - 1$ There is no need to see any simplification
	M1 Sub x=2 into their $f'(x)$
	dM1 Uses their numerical gradient with (2, 1) to find an equation of a tangent to y = f(x). It is dependent upon both M's. Accept their $\left.\frac{dy}{dx}\right\|_{x=2} = \frac{y-1}{x-2}$. Both signs must be correct
	If $y = mx + c$ is used then it must be a full attempt to find a numerical „c"
	A1* Cso $y = 3x - 5$. This is a given answer and all steps must be correct. Look for gradient =3 having been achieved by differentiation.
(b)	M1 Sets their $\frac{dy}{dx} = 3$ and proceeds to a 3TQ=0. Condone errors on $\left(\frac{dy}{dx}\right)$
	dM1 Factorises their 3TQ (usual rules) leading to a solution x=… . It is dependent upon the previous M. Award also for use of formula/ completion of square as long as the previous M has been awarded.
	A1 $x = -\frac{2}{3}$
	d M1 Sub their $x = -\frac{2}{3}$ into $y = x^3 - 2x^2 - x + 3$. It is dependent only upon the first M in (b) having been scored
	A1 Correct y coordinate $y = \frac{67}{27}$ or equivalent

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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCE in Core Mathematics 1R (6663_01R)

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Summer 2014
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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

PEARSON EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: Method marks are awarded for ‘knowing a method and attempting to apply it’, unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\sqrt{}$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - ∗ The answer is printed on the paper or ag- answer given
   - ⎣ or d… The second mark is dependent on gaining the first mark

4. All A marks are ‘correct answer only’ (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x = ...

2. Formula

Attempt to use the correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c = 0, \quad q \neq 0$, leading to x = ...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are small errors in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Question Number	Scheme	Marks
1.	$25x-9x^3 = x(25-9x^2)$	B1
	$(25-9x^2)=(5+3x)(5-3x)$	M1
	$25x-9x^3 = x(5+3x)(5-3x)$	A1
		(3)

B1 Take out a common factor, usually *x*, to produce $x(25-9x^2)$. Accept $(x\pm 0)(25-9x^2)$ or $-x(9x^2-25)$ Must be correct.
Other possible options are $(5+3x)(5x-3x^2)$ or $(5-3x)(5x+3x^2)$

M1 For factorising their quadratic term, usually $(25-9x^2)=(5+3x)(5-3x)$ Accept sign errors
If $(5\pm 3x)$ has been taken out as a factor first, this is for an attempt to factorise $(5x\mp 3x^2)$

A1 cao $x(5+3x)(5-3x)$ or any equivalent with three factors
e.g. $x(5+3x)(-3x+5)$ or $x(3x-5)(-3x-5)$ etc including $-x(3x+5)(3x-5)$
isw if they go on to show that $x = 0, \pm\frac{5}{3}$

Question Number	Scheme	Marks
2.(a)	$81^{\frac{3}{2}} = (81^{\frac{1}{2}})^3 = 9^3$ or $81^{\frac{3}{2}} = (81^3)^{\frac{1}{2}} = (531441)^{\frac{1}{2}}$	M1
	$=729$	A1
		(2)
(b)	$(4x^{-\frac{1}{2}})^2 = 16x^{-\frac{2}{2}}$ or $\frac{16}{x}$ or equivalent	M1
	$x^2(4x^{-\frac{1}{2}})^2 = 16x$	A1
		(2)
		(4 marks)

(a) M1 Dealing with either the 'cube' or the 'square root' first. A correct answer will imply this mark.

Also accept a law of indices approach $81^{\frac{3}{2}} = 81^1 \times 81^{\frac{1}{2}} = 81 \times 9$

A1 Cao 729. Accept $(\pm)729$

(b) M1 For correct use of power 2 on both 4 and the $x^{-\frac{1}{2}}$ term.

A1 Cao $=16x$

Question Number	Scheme	Marks
3.(a)	$(a_2 =)\quad 4k-3$	B1 (1)
(b)	$a_3 = 4(4k-3)-3$	M1
	$\sum_{r=1}^{3} a_r = k+4k-3+4(4k-3)-3 = ..k \pm ...$	M1
	$21k-18=66 \Rightarrow k = ...$	dM1
	$k=4$	A1 (4) (5 marks)

(a) B1 $4k-3$ cao

(b) M1 An attempt to find a_3 from iterative formula $a_3 = 4a_2 - 3$. Condone bracketing errors for the M mark

M1 Attempt to sum their a_1, a_2 and a_3 to get a linear expression in *k* (Sum of Arithmetic series is M0)

dM1 Sets their linear expression to 66 and solves to find a value for *k*. It is dependent upon the previous M mark

A1 cao $k=4$

Question Number	Scheme	Marks
4.(a)	$y = 2x^5 + \frac{6}{\sqrt{x}}$	
	$x^n \to x^{n-1}$	M1
	$\frac{dy}{dx} = 10x^4 - 3x^{-\frac{3}{2}}$ oe	A1A1
		(3)
(b)	$\int 2x^5 + \frac{6}{\sqrt{x}} dx$	
	$x^n \to x^{n+1}$	M1
	$= \frac{x^6}{3} + 12x^{\frac{1}{2}} + c$	A1 A1
		(3) (6 marks)

(a) M1 For $x^n \to x^{n-1}$. ie. x^4 or $x^{-\frac{3}{2}}$ or $\left(\frac{1}{x^{\frac{3}{2}}}\right)$ seen

A1 For $2\times 5x^4$ **or** $6\times -\frac{1}{2}x^{-\frac{3}{2}}$ (oe). (Ignore +c for this mark)

A1 For simplified expression $10x^4 - 3x^{-\frac{3}{2}}$ or $10x^4 - \frac{3}{x^{\frac{3}{2}}}$ o.e. and no +c

Apply ISW here and award marks when first seen.

(b) M1 For $x^n \to x^{n+1}$. ie. x^6 or $x^{\frac{1}{2}}$ or $\left(\sqrt{x}\right)$ seen

Do not award for integrating their answer to part (a)

A1 For either $2\frac{x^6}{6}$ **or** $6\times\frac{x^{\frac{1}{2}}}{\frac{1}{2}}$ or simplified or unsimplified equivalents

A1 For fully correct and simplified answer with +c.

Question Number	Scheme	Marks
5 **Method 1**	$x\sqrt{8}+10=\dfrac{6x}{\sqrt{2}}$	
	$\times\sqrt{2}\Rightarrow x\sqrt{16}+10\sqrt{2}=6x$	M1,A1
	$4x+10\sqrt{2}=6x\Rightarrow 2x=10\sqrt{2}$ $x=5\sqrt{2}$ or $a = 5$ and $b = 2$	M1A1
		(4)
5 **Method 2**	$x\sqrt{8}+10=\dfrac{6x}{\sqrt{2}}$	
	$2\sqrt{2}x+10=3\sqrt{2}x$	M1A1
	$\sqrt{2}x=10\Rightarrow x=\dfrac{10}{\sqrt{2}}=\dfrac{10\sqrt{2}}{2},=5\sqrt{2}$ oe	M1,A1
		(4)

Method 1

M1 For multiplying both sides by √2 – allow a slip e.g. $\sqrt{2}x\sqrt{8}+10=\dfrac{6x}{\sqrt{2}}\times\sqrt{2}$ or

$\sqrt{2}\times10+x\sqrt{8}=\dfrac{6x}{\sqrt{2}}\times\sqrt{2}$, where one term has an error or the correct $\sqrt{2}(10+x\sqrt{8})=\dfrac{6x}{\sqrt{2}}\times\sqrt{2}$

NB $x\sqrt{8}+10=6x\sqrt{2}$ is M0

A1 A correct equation in x with no fractional terms. Eg $x\sqrt{16}+10\sqrt{2}=6x$ oe.

M1 An attempt to solve their linear equation in x to produce an answer of the form $a\sqrt{2}$ or $a\sqrt{50}$

A1 $5\sqrt{2}$ oe (accept $1\sqrt{50}$)

Method 2

M1 For writing √8 as 2√2 or $\dfrac{6}{\sqrt{2}}$ as 3√2

A1 A correct equation in x with no fractional terms. Eg $2\sqrt{2}x+10=3\sqrt{2}x$ *or* $x\sqrt{8}+10=3\sqrt{2}x$ oe.

M1 An attempt to solve their linear equation in x to produce an answer of the form $a\sqrt{2}$ or $a\sqrt{50}$

$\sqrt{2}x=10\Rightarrow x=\dfrac{10}{\sqrt{2}}=\dfrac{10\sqrt{2}}{2},=5\sqrt{2}$

or $\sqrt{2}x=10\Rightarrow 2x^2=100\Rightarrow x^2=50\Rightarrow x=\sqrt{50}$ or $5\sqrt{2}$

A1 $5\sqrt{2}$ oe Accept $1\sqrt{50}$

Question Number	Scheme	Marks
6(a).	$P = 20x + 6$ o.e $20x + 6 > 40 \Rightarrow x >$ $x > 1.7$	B1 M1 A1* (3)
	Mark parts (b) and (c) together	
(b)	$A = 2x(2x+1) + 2x(6x+3) = 16x^2 + 8x$	B1
	$16x^2 + 8x - 120 < 0$	M1
	Try to solve their $2x^2 + x - 15 = 0$ e.g. $(2x-5)(x+3) = 0$ so $x =$ Choose inside region $-3 < x < \frac{5}{2}$ or $0 < x < \frac{5}{2}$ (as x is a length)	M1 M1 A1 (5)
(c)	$1.7 < x < \frac{5}{2}$	B1cao (1)
		(9 marks)

(a) B1 Correct expression for perimeter but may not be simplified so accept $2x + 1 + 2x + 4x + 2 + 2x + 6x + 3 + 4x$ or $2(10x + 3)$ or any equivalent

M1: Set $P > 40$ with their linear expression for P (this may not be correct but should be a sum of sides) and manipulate to get $x >$…

A1* cao $x > 1.7$. This is a given answer, there must not be any errors, but accept $1.7 < x$

(b) Marks parts (b) and (c) together

B1 Writes a correct statement in x for the area. It need not be simplified. You may isw Amongst numerous possibilities are.
$2x(2x+1) + 2x(6x+3)$, $16x^2 + 8x$, $4x(6x+3) - 2x(4x+2)$, $4x(2x+1)+2x(4x+2)$

M1 Sets their quadratic expression < 120 and collects on one side of the inequality

M1 For an attempt to solve a 3 Term quadratic equation producing two solutions by factorising, formula or completion of the square with the usual rules (see notes)

M1 For choosing the 'inside' region. Can follow through from their critical values – must be stated – not just a table or a graph. Can also be implied by $0 < x <$ upper value

A1 $-3 < x < \frac{5}{2}$. Accept $x > -3$ **and** $x < 2.5$ or (-3, 2.5)

As x is a width, accept $0 < x < \frac{5}{2}$ Also accept $\frac{10}{4}$ or 2.5 instead of $\frac{5}{2}$. $\leq$ would be M1A0

Allow this final answer to part (b) to appear as answer to part (c) This would score final M1A1 in (b) then B0 in (c)

(c) B1cao $1.7 < x < \frac{5}{2}$. Must be correct. [This does not imply final M1 in (b)]

Question Number	Scheme	Marks
	Method 1 | Method 2	
7.(a)	Method 1: $gradient = \frac{y_1 - y_2}{x_1 - x_2} = \frac{2-(-4)}{-1-7}, = -\frac{3}{4}$ | Method 2: $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$, so $\frac{y - y_1}{6} = \frac{x - x_1}{-8}$	M1, A1
	$y - 2 = -\frac{3}{4}(x+1)$ or $y + 4 = -\frac{3}{4}(x-7)$ or $y = their\text{'}-\frac{3}{4}\text{'}x + c$	M1
	$\Rightarrow \pm(4y + 3x - 5) = 0$	A1 (4)
	Method 3: Substitute $x = -1, y = 2$ and $x = 7, y = -4$ into $ax + by + c = 0$	M1
	$-a + 2b + c = 0$ and $7a - 4b + c = 0$	A1
	Solve to obtain $a = 3$, $b = 4$ and $c = -5$ or multiple of these numbers	M1 A1 (4)
(b)	Attempts $gradient\ LM \times gradient\ MN = -1$ so $-\frac{3}{4} \times \frac{p+4}{16-7} = -1$ or $\frac{p+4}{16-7} = \frac{4}{3}$ | Or $(y+4) = \frac{4}{3}(x-7)$ equation with $x =$ 16 substituted	M1
	$p + 4 = \frac{9 \times 4}{3} \Rightarrow p = ...$, $p = 8$ | So $y =$, $y = 8$	M1, A1
		(3)
Alternative for (b)	Attempt Pythagoras: $(p+4)^2 + 9^2 + (6^2 + 8^2) = (p-2)^2 + 17^2$	M1
	So $p^2 + 8p + 16 + 81 + 36 + 64 = p^2 - 4p + 4 + 289 \Rightarrow p = ...$	M1
	$p = 8$	A1
		(3)
(c)	Either $(y=)\ p + 6$ or $2 + p + 4$ | Or use 2 perpendicular line equations through L and N and solve for y	M1
	$(y =)\ 14$	A1
		(2) (9 marks)

(a) M1 Uses the gradient formula with points L and M i.e. quote $gradient = \frac{y_1 - y_2}{x_1 - x_2}$ and attempt to substitute correct numbers. Formula may be implied by the correct $\frac{2-(-4)}{-1-7}$ or equivalent.

A1 Any correct single fraction gradient i.e $\frac{6}{-8}$ or equivalent

M1 Uses their gradient with either (-1, 2) or (7, -4) to form a linear equation

Eg $y - 2 = their\text{'}-\frac{3}{4}\text{'}(x+1)$ or $y + 4 = their\text{'}-\frac{3}{4}\text{'}(x-7)$ or $y = their\text{'}-\frac{3}{4}\text{'}x + c$ then find a value for c by substituting (-1,2) or (7, -4) in the correct way(not interchanging x and y)

A1 Accept $\pm k(4y + 3x - 5) = 0$ with k an integer (This implies previous M1)

(b) M1 Attempts to use $gradient\ LM \times gradient\ MN = -1$. ie. $-\frac{3}{4} \times \frac{p+4}{16-7} = -1$ (allow sign errors)

Or Attempts Pythagoras correct way round (allow sign errors)

M1 An attempt to solve their linear equation in 'p'. A1 cao $p = 8$

(c) M1 For using their numerical value of p and adding 6 . This may be done by any complete method (vectors, drawing, perpendicular straight line equations through L and N) or by no method. Assuming $x = 7$ is M0

A1 Accept 14 for both marks as long as no incorrect working seen (Ignore left hand side – allow k) . If there is wrong working resulting fortuitously in 14 give M0A0. Allow (8, 14) as the answer.

Question Number	Scheme	Marks
8.	$\frac{dy}{dx} = 6x^{-\frac{1}{2}} + x\sqrt{x}$	
	$x\sqrt{x} = x^{\frac{3}{2}}$	B1
	$x^n \to x^{n+1}$	M1
	$y = \frac{6}{\frac{1}{2}}x^{\frac{1}{2}} + \frac{x^{\frac{5}{2}}}{\frac{5}{2}}(+c)$	A1, A1
	Use $x=4$, $y=37$ to give equation in c, $37 = 12\sqrt{4} + \frac{2}{5}(\sqrt{4})^5 + c$	M1
	$\Rightarrow c = \frac{1}{5}$ or equivalent eg. 0.2	A1
	$(y) = 12x^{\frac{1}{2}} + \frac{2}{5}x^{\frac{5}{2}} + \frac{1}{5}$	A1
		(7 marks)

B1 $x\sqrt{x} = x^{\frac{3}{2}}$. This may be implied by $+\frac{x^{\frac{5}{2}}}{\frac{5}{2}}$ oe in the subsequent work.

M1 $x^n \to x^{n+1}$ in at least one case so see either $x^{\frac{1}{2}}$ or $x^{\frac{5}{2}}$ or both

A1 One term integrated correctly. It does not have to be simplified Eg. $\frac{6}{\frac{1}{2}}x^{\frac{1}{2}}$ or $+\frac{x^{\frac{5}{2}}}{\frac{5}{2}}$.

No need for $+c$

A1 Other term integrated correctly. See above. No need to simplify nor for $+c$. Need to see

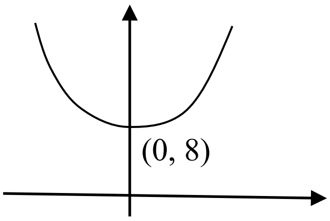
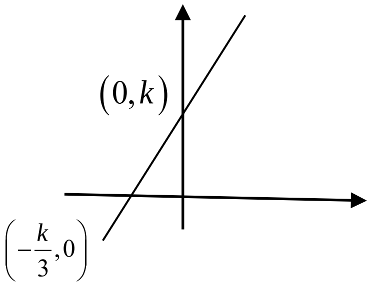
$\frac{6}{\frac{1}{2}}x^{\frac{1}{2}} + \frac{x^{\frac{5}{2}}}{\frac{5}{2}}$ or a simplified correct version

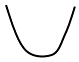
M1 Substitute $x = 4$, $y = 37$ to produce an equation in c.

A1 Correctly calculates $c = \frac{1}{5}$ or equivalent e.g. 0.2

A1 cso $y = 12x^{\frac{1}{2}} + \frac{2}{5}x^{\frac{5}{2}} + \frac{1}{5}$. Allow $5y = 60x^{\frac{1}{2}} + 2x^{\frac{5}{2}} + 1$ and accept fully simplified equivalents.

e.g. $y = \frac{1}{5}(60x^{\frac{1}{2}} + 2x^{\frac{5}{2}} + 1)$, $y = 12\sqrt{x} + \frac{2}{5}\sqrt{x^5} + \frac{1}{5}$

Question Number	Scheme	Marks
9.(a)	 U shaped parabola – symmetric about y axis	B1
	Graph passes through (0, 8)	B1
	 Shape and position for L	M1
	Both $\left(-\frac{k}{3},0\right)$ and $(0,k)$	A1
		(4)
	Allow marks **even if** on the **same** diagram	
9(b)	Method 1:	
	Equate curves $\frac{1}{3}x^2+8=3x+k$ and proceed to collect terms on one side	M1
	$\frac{1}{3}x^2-3x+(8-k)$	A1
	Method 1a: Uses "$b^2=4ac$" | Method 1b: Attempt $\frac{1}{3}(x-\frac{9}{2})^2-\lambda+8-k$	dM1
	Method 1a: $9=4\times\frac{1}{3}\times(8-k)\Rightarrow k=..$ | Method 1b: Deduce that $k = 8 - \lambda$	dM1
	$k=\frac{5}{4}$ o.e.	A1
		(5)
	Method 2 :	
	Attempts to set $\frac{\mathrm{d}y}{\mathrm{d}x}=3$	M1
	$\frac{2}{3}x=3\Rightarrow x=4.5$	A1
	Method 2a: Substitutes $x="4.5"$ into $y=\frac{1}{3}x^2+8\Rightarrow y=....(14.75)$ | Method 2b: Substitutes $x="4.5"$ into $\frac{1}{3}x^2+8=3x+k$	dM1
	Method 2a: Substitutes both their x and y into $y=3x+k$ to find k | Method 2b: Finds $k=$	dM1
	$k=1.25$ o.e.	A1
		(5)
		(9 marks)

(a) B1 Shape for C.  Approximately Symmetrical about the y axis

B1 Coordinates of (0, 8) There must be a graph.
Accept graph crossing positive y axis with only 8 marked. Accept (8,0) if given on y axis.

M1 Shape for L. A straight line with positive gradient and positive intercept

A1 Coordinates of (0, k) and ($-k/3$, 0) or k marked on y axis, and $-k/3$ marked on x axis or even
Accept (k, 0) on y axis and (0, $-k/3$) on x axis

(b) Either

Methods 1

M1 Equate curves $\frac{1}{3}x^2+8=3x+k$ and proceed to collect x terms on one side and $(8-k)$ terms together on the same side or on the other side

A1 Achieves an expression that leads to the point of intersection e.g $\frac{1}{3}x^2-3x+(8-k)$

Method 1a

dM1 (depends on previous M mark) Uses the fact that $b^2=4ac$ or 'b^2-4ac' $=0$ is true

dM1 (depends on previous M mark) Solves their $b^2=4ac$, leading to k=..

A1 cso $k=\frac{5}{4}$ Accept equivalents like 1.25 etc.

Method 1b

dM1 (depends on previous M mark) Uses completion of the square as shown in scheme

dM1 (depends on previous M mark) Uses $k=8-\lambda$

A1 cso $k=\frac{5}{4}$ Accept equivalents like 1.25 etc.

Methods 2

M1 Equate $\frac{dy}{dx}=3$ Not given just for derivative

A1 Solves to get $x=4.5$

Method 2a

dM1 Substitutes their 4.5 into equation for C to give y coordinate

dM1 Substitutes both their x and y into $y=3x+k$ to find k

A1 cso $k=\frac{5}{4}$ Accept equivalents like 1.25 etc.

Method 2b

dM1 Substitutes their 4.5 into $\frac{1}{3}x^2+8=3x+k$

dM1 Finds k

A1 cso $k=\frac{5}{4}$ Accept equivalents like 1.25 etc.

Question Number	Scheme	Marks
10(a).	Attempts to use $a+(n-1)"d"$ with a=A and "d"=d+1 and n = 14	M1
	$A+13(d+1)=A+13d+13$ *	A1*
		(2)
(b)	Calculates time for Yi on Day 14=$(A-13)+13(2d-1)$	M1
	Sets **times** equal $A+13d+13=\ (A-13)+13(2d-1)\Rightarrow d=...$	M1
	$d=3$	A1 cso
		(3)
(c)	Uses $\frac{n}{2}\{2A+(n-1)(D)\}$ with n =14, and with D=d or d + 1	M1
	Attempts to solve $\frac{14}{2}\{2A+13\times'(d+1)'\}=784\Rightarrow A=...$	dM1
	$A=30$	A1
		(3)
		(8 marks)

(a) M1 Attempts to use $a+(n-1)d$ with a=A and d =d+1 AND n =14

A1* cao This is a given answer and there is an expectation that the intermediate answer is seen and that **all work is correct** with correct brackets.

The expressions $A+13(d+1)$ and $A+13d+13$ should be seen

N.B. If **brackets are missing and formula is not stated**

e.g. $A+13d+1\Rightarrow A+13d+13$ or $A+(13)d+1\Rightarrow A+13d+13$ then this is **M0A0**

If **formula is quoted and *a* = *A* and *d* = *d* + 1 is quoted or implied** , then M1 A0 may be given

So $a+(n-1)d$ followed by $A+(13)d+1=A+13d+13$ achieves **M1A0**

(b) M1 States a time for Yi on Day 14 = $(A-13)+13(2d-1)$

M1 Sets their **time** for Yi, equal to $A+13d+13$ and uses this equation to proceed to d =

A1 cso d =3 Needs both M marks and must be simplified to 3 (not 39/13)

[NB Setting **each** of the times separately equal to 0 leads to d = 3 – this will gain M0A0]

(c) M1 Uses the sum formula $\frac{n}{2}\{2A+(n-1)(D)\}$ with n = 14 and D = d +1 or allow D = d (usually 4 or 3)

NB May use $\frac{n}{2}\{A+(A+13D)\}$ with n = 14 and and D = d +1 or allow D = d (usually 4 or 3)

dM1 Attempts to solve $\frac{14}{2}\{2A+13\times'4'\}="784"\Rightarrow A=...$ (Must use their d + 1 this time)

Allow miscopy of 784

A1 cao $A=30$

Question Number	Scheme	Marks
11.(a)	Substitutes $x = 2$ into $y = 20 - 4\times 2 - \frac{18}{2}$ and gets 3	B1
	$\frac{dy}{dx} = -4 + \frac{18}{x^2}$	M1 A1
	Substitute $x = 2 \Rightarrow \frac{dy}{dx} = \left(\frac{1}{2}\right)$ then finds negative reciprocal (-2)	dM1
	Method 1: States or uses $y - 3 = -2(x-2)$ or $y = -2x + c$ with their (2, 3) / **Method 2:** Or: Check that (2, 3) lies on the line $y = -2x + 7$	dM1
	Method 1: to deduce that $y = -2x + 7$ * / **Method 2:** Deduce equation of normal as it has the **same gradient** and passes through **a common point**	A1*
		(6)
(b)	Put $20 - 4x - \frac{18}{x} = -2x + 7$ and simplify to give $2x^2 - 13x + 18 = 0$	M1 A1
	Or put $y = 20 - 4\left(\frac{7-y}{2}\right) - \frac{18}{\left(\frac{7-y}{2}\right)}$ to give $y^2 - y - 6 = 0$	
	$(2x-9)(x-2) = 0$ so $x =$ or $(y-3)(y+2) = 0$ so $y =$	dM1
	$x = \frac{9}{2}, y = -2$	A1, A1
		(5)
		(11 marks)

PTO for notes on this question.

(a) B1 Substitutes $x = 2$ into expression for y and gets 3 cao (must be in part (a) and **must use curve equation – not line equation) This must be seen to be substituted.**

M1 For an attempt to differentiate the negative power with $x^{-1} \rightarrow x^{-2}$.

A1 Correct expression for $\frac{dy}{dx} = -4 + \frac{18}{x^2}$, accept equivalents

dM1 Dependent on **first** M1 Substitutes $x = 2$ into their derivative to obtain a numerical gradient and find negative reciprocal or states that $-2 \times \frac{1}{2} = -1$

(Method 1)

dM1 Dependent on **first** M1 Finds equation of line using changed gradient (not their ½ but -1/2, 2 or -2) e.g. $y - "3" = -"2"(x - 2)$ or y = "-2"x + c and use of (2, "3") to find c=

A1* CSO. This is a given answer $y = -2x + 7$ obtained with no errors seen and equation should be stated

(Method 2)- checking given answer

dM1 Uses given equation of line and checks that (2, 3) lies on the line

A1* CSO. This is a given answer $y = -2x + 7$ so statement that normal and line **have the same gradient** and **pass through the same point** must be stated

(b) M1 Equate the **two given** expressions, collect terms and simplify to a 3TQ. There may be sign errors when collecting terms But putting for example $20x - 4x^2 - 18 = -2x + 7$ is M0 here

A1 Correct 3TQ = 0 (need = 0 for A mark) $2x^2 - 13x + 18 = 0$

dM1 Attempt to solve an appropriate quadratic by factorisation, use of formula, or completion of the square (see general instructions).

A1 $x = \frac{9}{2}$ oe or y = -2 (allow second answers for this mark so ignore x = 2 or y = 3)

A1 Correct solution only so both $x = \frac{9}{2}, y = -2$ or $\left(\frac{9}{2}, -2\right)$

If x = 2, y = 3 is included as an answer and point B is not identified then last mark is A0
Answer only – with no working – send to review. The question stated "use algebra"

Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCE in Core Mathematics 1 (6663_01)

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Summer 2014
Publications Code UA038449

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

PEARSON EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\sqrt{}$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $\ast$ The answer is printed on the paper or ag- answer given
   - $\llcorner$ or d… The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x = ...

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x = ...

2. Formula

Attempt to use the correct formula (with values for a, b and c).

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c = 0, \quad q \neq 0$, leading to x = ...

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are small errors in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Question Number	Scheme	Marks
1.	$\int (8x^3+4)\,dx \;=\; \frac{8x^4}{4}+4x$	M1, A1
	$= 2x^4+4x+c$	A1
		(3 marks)

Notes

M1 $x^n \to x^{n+1}$ so $x^3 \to x^4$ or $4 \to 4x$ or $4x^1$

A1 This is for either term with coefficient unsimplified (power must be simplified)– so $\frac{8}{4}x^4$ or $4x$ (accept $4x^1$)

A1 Fully correct simplified solution with c i.e. $2x^4 + 4x + c$ [allow $2x^4+4x+cx^0$]

If the answer is given as $\int\ 2x^4+4x+c$, with an integral sign – having never been seen as the fully correct simplified answer without an integral sign – then give M1A1A0 but allow anything before the = sign e.g. $y = 2x^4 + 4x + c$, $f(x) = 2x^4 + 4x + c$, $\int = \ 2x^4+4x+c$, etc….

If this answer is followed by (for example) x^4+2x+k then treat this as **isw** (ignore subsequent work)
If they follow it by finding a value for c, also **isw**, provided correct answer with c has been seen and credited

Question Number	Scheme	Marks
2.	(a) $32^{\frac{1}{5}} = 2$	B1 (1)
	(b) For 2^{-2} or $\frac{1}{4}$ or $\left(\frac{1}{2}\right)^2$ or 0.25 as coefficient of x^k, for any value of k including $k = 0$	M1
	Correct index for x so Ax^{-2} or $\frac{A}{x^2}$ o.e. for any value of A	B1
	$= \frac{1}{4x^2}$ or $0.25\,x^{-2}$	A1 cao (3)
		4 Marks

Notes

(a) B1 Answer 2 must be in part (a) for this mark

(b) Look at their final answer

M1 For 2^{-2} or $\frac{1}{4}$ or $\left(\frac{1}{2}\right)^2$ or 0.25 in their answer as coefficient of x^k for numerical value of k (including $k = 0$) so final answer $\frac{1}{4}$ is M1 B0 A0

B1 Ax^{-2} or $\frac{A}{x^2}$ or equivalent e.g. $Ax^{-\frac{10}{5}}$ or $Ax^{-\frac{50}{25}}$ i.e. correct power of x seen in final answer

May have a bracket provided it is $(Ax)^{-2}$ or $\left(\frac{A}{x}\right)^2$

A1 $\frac{1}{4x^2}$ or $\frac{1}{4}x^{-2}$ or $0.25\,x^{-2}$ oe but must be correct power **and** coefficient combined correctly and must not be followed by a different wrong answer.

Poor bracketing: $2x^{-2}$ earns M0 B1 A0 as correct power of x is seen in this solution (They can recover if they follow this with $\frac{1}{4x^2}$ etc)

Special case $(2x)^{-2}$ as a **final** answer and $\left(\frac{1}{2x}\right)^2$ can have M0 B1 A0 if the correct expanded answer is not seen

The correct answer $\frac{1}{4x^2}$ etc. followed by $\left(\frac{1}{2x}\right)^2$ or $(2x)^{-2}$, treat $\frac{1}{4x^2}$ as final answer so M1 B1 A1 isw

But the correct answer $\frac{1}{4x^2}$ etc clearly followed by the wrong $2x^{-2}$ or $4x^{-2}$, gets M1 B1 A0 do not ignore subsequent wrong work here

Question Number	Scheme	Marks
3.	(a) $3x-7>3-x$	
	$4x>10$	M1
	$x>2.5,\quad x>\frac{5}{2},\quad \frac{5}{2}<x$ o.e.	A1
		(2)
	(b) Obtain $x^2-9x-36$ and attempt to solve $x^2-9x-36=0$	
	e.g. $(x-12)(x+3)=0$ so $x=\quad ,$ or $x=\frac{9\pm\sqrt{81+144}}{2}$	M1
	$12,\ -3$	A1
	$-3\le x\le 12$	M1A1
		(4)
	(c) $2.5<x\le 12$	A1cso
		(1)
		(7 marks)

Notes

(a) M1 Reaching $px>q$ with one or both of p or q correct. Also give for $-4x<-10$

A1 Cao $x>2.5$ o.e. Accept alternatives to 2.5 like $2\frac{1}{2}$ and $\frac{5}{2}$ even allow $\frac{10}{4}$ and allow $\frac{5}{2}<x$ o.e. This answer must occur and be credited as part (a) A correct answer implies M1A1

Mark parts (b) and (c) together.

(b) M1 Rearrange 3TQ ≤ 0 or 3TQ $= 0$ or even 3TQ > 0 Do not worry about the inequality at this stage AND attempt to solve by factorising, formula or completion of the square with the usual rules (see notes)

A1 12 and –3 seen as critical values

M1 Inside region for their critical values – must be stated – not just a table or a graph

A1 $-3\le x\le 12$ Accept $x\ge -3$ **and** $x\le 12$ or [-3, 12]

For the A mark: Do not accept $x\ge -3$ **or** $x\le 12$ nor $-3<x<12$ nor (-3, 12) nor $x\ge -3, x\le 12$

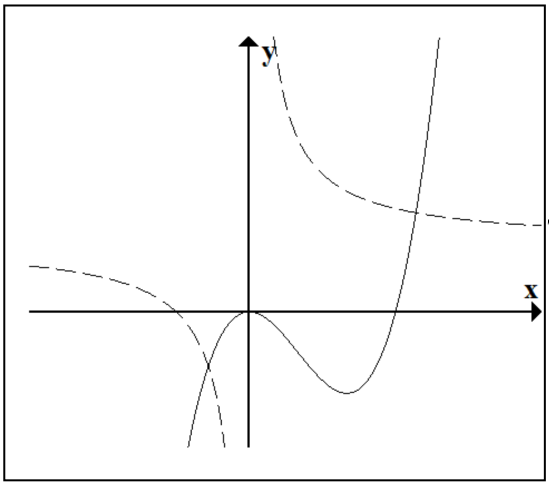
However allow recovery if they follow these statements by a correct statement, either in (b) or as they start part (c)

N.B. $-3\le 0\le 12$ and $x\ge -3, x\le 12$ are poor notation and get M1A0 here.

(c) A1 cso $2.5<x\le 12$ Accept $x>2.5$ and $x\le 12$ Allow $\frac{10}{4}$ Do not accept $x>2.5$ **or** $x\le 12$

Accept (2.5, 12] A graph or table is not sufficient. **Must follow correct earlier work** – except for special case

Special case (c) $x>2.5, x\le 12$; $2.5<0\le 12$ are poor notation – but if this poor notation has been penalised in (b) then allow A1 here. Any other errors are penalised in both (b) and (c).

Question Number	Scheme		Marks
4.	(a) - 1 accept (–1, 0)		B1
			(1)
	(b)		
		Shape	B1
		Touches at (0,0)	B1
		Crosses at (2,0) **only**	B1
			(3)
	(c) 2 solutions as **curves** cross twice		B1 ft
			(1)
			(5 marks)

Notes

N.B. Check original diagram as answer may appear there.

(a) B1 The x coordinate of A is –1. Accept -1 or (–1,0) on the diagram or stated with or without diagram
Allow (0, -1) on the diagram if it is on the correct axis.

(b) *If no graph is drawn then no marks are available in part (b)*

B1 Correct shape. The position is not important for this mark but the curve must have two clear turning points and be a +ve x^3 curve (with a maximum and minimum)

B1 The graph touches the origin. Accept touching as a maximum or minimum. There must be a sketch for this mark but sketch may be wrong and this mark is independent of previous mark. Origin is where axes cross and may not be labelled. This may be a quadratic or quartic curve for this mark.

B1 The graph crosses the x-axis at the point (2,0) **only**. If it crosses at (2,0) and (0,0) this is B0. Accept (0,2) or 2 marked on the correct axis. Accept (2, 0) in the text of the answer provided that the curve crosses the positive x axis. There must be a sketch for this mark. Do not give credit if (2,0) appears only in a table with no indication that this is the intersection point. (If in doubt send to review) Graph takes precedence over text for third B mark.

(c) B1ft Two (solutions) **as there are two intersections** (**of the curves)** N.B. Just states 2 with no reason is B0
If the answer states 2 roots and two intersections – or crosses twice this is enough for B1
BUT B0 If there is any wrong **reason** given – e.g. crosses x axis twice, or crosses asymptote twice
Isw – is not used for this mark so any wrong statement listed to follow a correct statement will result in B0
Allow ft – so if their graph crosses the hyperbola once – allow "one solution as there is one intersection"
And if it crosses three times – allow "three solutions as there are three intersections" or four etc..
If it does not cross at all (e.g.negative cubic) – allow "no solutions as there are no intersections"
However in (c) if they have sketched a curve (even a fully correct one) but not extended it to intersect the hyperbola and they put "no points of intersection so no solutions" then this scores B0.
Accept "lines or curves cross over twice, or touch twice, or meet twice…etc as explanation, but need some form of words)

Question Number	Scheme	Marks
5.	(a) $7 = 5a_1 - 3 \quad \Rightarrow a_1 = ..$	M1
	$a_1 = 2$	A1
		(2)
	(b) $a_3 = "32"$ and $a_4 = "157"$	M1
	$\sum_{r=1}^{r=4} a_r = a_1 + a_2 + a_3 + a_4$	
	= "2"+ "7"+ "32"+ "157"	dM1
	= 198	A1
		(3)
		(5 marks)

Notes

(a) M1 Writes $7 = 5a_1 - 3$ and attempts to solve leading to an answer for a_1 . If they rearrange wrongly before any substitution this is M0

A1 Cao $a_1 = 2$

Special case: Substitutes $n = 1$ into $5n - 3$ and obtains answer 2. This is fortuitous and gets M0A0 but full marks are available on (b).

(b) M1 Attempts to find either their a_3 or their a_4 using $a_{n+1} = 5a_n - 3,\ a_2 = 7$
Needs clear attempt to use formula or is implied by correct answers or correct follow through of their a_3

dM1 (Depends on previous M mark) Sum of their four adjacent terms from the given sequence.
n.b May be given for 9 + a_3 + a_4 as they may add 2 + 7 to give 9
(dM0 for sum of an Arithmetic series)

A1 cao 198

Special case
(a) $a_1 = 32$ is M0 A0
(b) Adds for example 7+32+157 + 782 = or 32+157 + 782 + 3907 is M1 M1 A0
Total mark possible is 2 / 5
(This is not treated as a misread – as it changes the question)

Question Number	Scheme	Marks
6.	(a) $80 = 5\times16$ $\sqrt{80} = 4\sqrt{5}$	B1 (1)
	Method 1 (b) $\dfrac{\sqrt{80}}{\sqrt{5}+1}$ or $\dfrac{c\sqrt{5}}{\sqrt{5}+1}$ **Method 2** $(p+q\sqrt{5})(\sqrt{5}+1)=\sqrt{80}$	B1ft
	Method 1: $=\dfrac{\sqrt{80}}{\sqrt{5}+1}\times\dfrac{\sqrt{5}-1}{\sqrt{5}-1}$ or $\dfrac{\sqrt{80}}{1+\sqrt{5}}\times\dfrac{1-\sqrt{5}}{1-\sqrt{5}}$ Method 2: $p\sqrt{5}+q\sqrt{5}+p+5q = 4\sqrt{5}$	M1
	Method 1: $=\dfrac{20-4\sqrt{5}}{4}$ or $\dfrac{4\sqrt{5}-20}{-4}$ Method 2: $p + 5q = 0$, $p + q = 4$	A1
	Method 1: $= 5-\sqrt{5}$ Method 2: $p = 5,\ q = -1$	A1cao
		(4) **(5 marks)**

Notes

(a) B1 Accept 4√5 or $c = 4$ – no working necessary

(b)

(Method 1)

B1ft Only ft on c See $\dfrac{\sqrt{80}}{\sqrt{5}+1}$ or $\dfrac{c\sqrt{5}}{\sqrt{5}+1}$

M1 State intention to multiply by √5 – 1 or 1– √5 in the numerator **and** the denominator

A1 Obtain denominator of 4 (for √5 – 1) **or** -4 (for 1– √5) **or** correct simplified numerator of 20 – 4√5 or 4(5 – √5) **or** 4√5 – 20 or 4(√5 –5) **So either numerator or denominator must be correct**

A1 Correct answer only. Both **numerator and denominator must have been correct and d**ivision of numerator and denominator by 4 has been performed.

Accept $p = 5,\ q = -1$ or accept $5-\sqrt{5}$ or $-\sqrt{5}+5$ Also accept $5-1\sqrt{5}$

(Method 2)

B1ft Only ft on c $(p+q\sqrt{5})(\sqrt{5}+1)=\sqrt{80}$ or $c\sqrt{5}$

M1 Multiply out the lhs and replace √80 by $c\sqrt{5}$

A1 Compare rational and irrational parts to give $p + q = 4$, **and** $p + 5q = 0$

A1 Solve equations to give $p = 5,\ q = -1$

Common error:

$\dfrac{\sqrt{80}}{1+\sqrt{5}}\times\dfrac{1-\sqrt{5}}{1-\sqrt{5}} = \dfrac{4\sqrt{5}-20}{4} = \sqrt{5}-5$ gets B1 M1 A1 (for correct numerator – denominator is wrong for their product) then A0

Correct answer with no working – send to review – have they used a calculator?

Correct answer after trial and improvement with evidence that (5- √5)(√5+1)=√80 could earn all four marks

Question Number	Scheme	Marks
7.	(a) $(1-2x)^2 = 1-4x+4x^2$ $\frac{\mathrm{d}}{\mathrm{d}x}(1-2x)^2 = \frac{\mathrm{d}}{\mathrm{d}x}(1-4x+4x^2) = -4+8x$ o.e.	M1 M1A1 (3)
	Alternative method using chain rule: Answer of -4 (1 – 2 *x*)	M1M1A1 (3)
	(b) $\frac{x^5+6\sqrt{x}}{2x^2} = \frac{x^5}{2x^2} + 6\frac{\sqrt{x}}{2x^2}, = \frac{1}{2}x^3 + 3x^{-\frac{3}{2}}$ Attempts to differentiate $x^{-\frac{3}{2}}$ to give $k\ x^{-\frac{5}{2}}$ $= \frac{3}{2}x^2 - \frac{9}{2}x^{-\frac{5}{2}}$ o.e. Quotient Rule (May rarely appear) – See note below	M1,A1 M1 A1 (4) **(7 marks)**

Notes

(a) M1 Attempt to multiply out bracket. Must be 3 or 4 term quadratic and **must have constant term 1**

M1 $x^n \to x^{n-1}$. Follow through on any term in an incorrect expression. Accept a constant → 0

A1 $-4+8x$ Accept -4 (1 – 2*x*) or equivalent. This is not cso and may follow error in the constant term
Following correct answer by -2 + 4*x* – apply isw

Correct answer with no working – assume chain rule and give M1M1A1 i.e. 3/3

Common errors: $(1-2x)^2 = 2-4x+4x^2$ is M0, then allow M1A1 for -4 + 8*x*

$(1-2x)^2 = 1-4x^2$ is M0 then -8*x* earns M1A0 or $(1-2x)^2 = 1-2x^2$ is M0 then -4*x* earns M1A0

Use of Chain Rule:

M1M1: first M1 for complete method so $2\times(\pm 2)(1-2x)$ second M1 for (1 – 2*x*) (as power reduced)

Then A1 for -4 (1 – 2*x*) or for -4 + 8*x*

So (i) 2(1 – 2*x*) gets M0 M1A0 for reducing power and (ii) 2×2(1 – 2*x*) gets M1 M1A0

(b) M1 An attempt to divide by $2x^2$ first. This can be implied by the sight of the following

Some correct working e.g. $\frac{x^5}{2x^2} + 6\frac{\sqrt{x}}{2x^2}$ or $(x^5+6\sqrt{x})(2x^2)^{-1}$ **leading to** $ax^p + bx^q$ in either case

or can be **implied by** $\frac{1}{2}x^3 + 3x^p$ (after no working) i.e. both coefficients correct and power 3 correct

Common error: $(x^5+6\sqrt{x})2x^{-2}$ is M0 (may earn next M mark for the differentiation $x^{-\frac{3}{2}} \to x^{-\frac{5}{2}}$)

A1 Writing the given expression as $\frac{1}{2}x^3 + 3x^{-\frac{3}{2}}$ or $0.5x^3 + \frac{6}{2}x^{-\frac{3}{2}}$ or $0.5x^3 + \frac{6}{2}x^{-1\frac{1}{2}}$ or etc…

M1 $x^{-\frac{3}{2}} \to x^{-\frac{5}{2}}$ A1 Cao $\frac{3}{2}x^2 - \frac{9}{2}x^{-\frac{5}{2}}$ o.e. e.g. $\frac{3}{2}x^2 - \frac{9}{2x^2\sqrt{x}}$ then isw. Allow factorised form. Do not penalise $+-\frac{9}{2}x^{-\frac{5}{2}}$ used instead of $-\frac{9}{2}x^{-\frac{5}{2}}$

Use of Quotient Rule : M1,A1:Reaching $\frac{2x^2(5x^4+3x^{-\frac{1}{2}}) - 4x(x^5+6x^{\frac{1}{2}})}{4x^4}, = \frac{6x^6-18x^{\frac{3}{2}}}{4x^4}$

Send to review if doubtful M1A1: Simplifying (e.g.dividing numerator and denominator by 2) to reach $\frac{3x^6-9x^{\frac{3}{2}}}{2x^4}$ o.e.

Question Number	Scheme	Marks
8.	(a) Use $n^{th}\text{term} = a+(n-1)d$ with d = 10; a = 150 and n = 8, or a = 160 and n = 7, or a = 170 and n = 6 : = 150+7×10 or 160 +6 ×10 or 170 + 5 ×10 = 220* (Or gives clear list – see note)	M1 A1* (2)
Or	If answer 220 is assumed and 150 + (n – 1) 10 =220 or variation is solved for n= Then n = 8, so 2007 is the year (must conclude the year)	M1 A1* (2)
	(b) Use $S_n = \frac{n}{2}\{2a+(n-1)10\}$ | Or $S_n = \frac{n}{2}\{a+l\}$ **and** $l = a + (n-1)10$ = 7(300+13×10) or 7(150 + 280) = 7×430 = 3010	M1 A1 A1 (3)
	(c) Cost in year n = 900+(n–1)×-20 Sales in year n = 150+(n–1)×10 Cost =3×Sales ⇒ 900+(n–1)×-20 = 3×(150+(n–1)×10) 900–20n+20 = 450+30n–30 500 = 50n n =10 Year is 2009 As n is not defined they may work correctly from another base year to get the answer 2009 and their n may not equal 10. If doubtful – send to review.	M1 M1 M1 A1 (4) (9 marks)

Notes

(a) M1 Attempt to use $n^{th}\text{term} = a+(n-1)d$ with d = 10, and correct combination of a and n i.e. a = 150 and n = 8 or a = 160 and n = 7, or a = 170 and n = 6

A1 * Shows that 220 computers are sold in 2007 with no errors

Note that this is a given solution, so needed 150+7×10 or 160+6×10 or 170+5×10 or equivalent.

Accept a correct list showing all values and years for both marks Just 150,160,170,180,190,200,210,220 is M1A0

Need some reference to years as well as the list of numbers of computers for A1.

(b) M1 Attempts to use $S_n = \frac{n}{2}\{2a+(n-1)d\}$ with d = 10, and correct combination of a and n i.e. a = 150 and n = 14, or a = 160 and n = 13, or a = 170 and n =12

A1 Uses $S_n = \frac{n}{2}\{2a+(n-1)d\}$ with a = 150, d = 10 and n = 14 [N.B. $S_n = \frac{n}{2}\{a+l\}$ needs $l = a + (n - 1)d$ as well

NB A0 for a = 160 and n = 13 or a = 170 and n = 12 unless they then add the first, or first two terms respectively.

A1 Cao 3010 . This answer (with no working) implies correct method M1A1A1.

Special case: If a complete list 150+160+170+180+190+200+210+220+230+240+250+260+270+280 is seen, then there is an error finding the sum then score M1A1A0, but incomplete or wrong lists score M0A0A0

(c) M1 Writes down an expression for the cost = 900+(n–1)×–20 or writes 900 + (n – 1) d and states d = -20
Allow 900 + n ×–20. Allow recovery from invisible brackets.

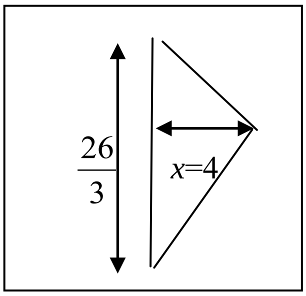
M1 **Attempts** to write down an equation in n for statement 'cost =3×sales'
900+(n-1)×-20 = 3×(150+(n-1)×10). Accept the 3 on the wrong side and allow use of 20 instead of -20 and allow n (consistently) instead of n – 1 for this mark. Ignore £ signs in equation.

M1 Solves the correct linear equation in n to achieve n = 10 (for those using n – 1) or n = 9 (for those using n).
Ignore £ signs.

A1 Cso Year 2009 (A0 for the answer Year 10 if 2009 is not given)

Special case. **Just answer or trial and improvement** with no equation leading to answer scores SC 0,0,1,1

Equations satisfying the method mark descriptors followed by trial and improvement could get all four marks

Question Number	Scheme	Marks
9.	(a) $2x+3y=26 \Rightarrow 3y=26\pm 2x$ and attempt to find m from $y=mx+c$	M1
	$\left(\Rightarrow y=\frac{26}{3}-\frac{2}{3}x\right)$ so gradient = $-\frac{2}{3}$	A1
	Gradient of perpendicular $=\frac{-1}{\text{their gradient}}$ $\left(=\frac{3}{2}\right)$	M1
	Line goes through (0,0) so $y=\frac{3}{2}x$	A1
		(4)
	(b) Solves their $y=\frac{3}{2}x$ with their $2x+3y=26$ to form equation in x or in y	M1
	Solves their equation in x or in y to obtain $x=$ **or** $y=$	dM1
	x=4 or any equivalent e.g. 156/39 or $y=6$ o.a.e	A1
	$B=(0,\frac{26}{3})$ used or stated in (b)	B1
	 **Method 1** (see other methods in notes below)	
	Area $=\frac{1}{2}\times "4"\times\frac{"26"}{3}$	dM1
	$=\frac{52}{3}$ (oe with integer numerator and denominator)	A1
		(6) **(10 marks)**

Notes

(a) M1 Complete method for finding gradient. (This may be implied by later correct answers.)
e.g. Rearranges $2x+3y=26\Rightarrow y=mx+c$ so $m=$
Or finds coordinates of two points on line and finds gradient e.g. $(13,0)$ *and* $(1,8)$ *so* $m=\frac{8-0}{1-13}$

A1 States or implies that gradient $=-\frac{2}{3}$ - condone $-\frac{2}{3}x$ if they continue correctly. Ignore errors in constant term in straight line equation

M1 Uses $m_1\times m_2=-1$ to find the gradient of l_2. This can be implied by the use of $\frac{-1}{\text{their gradient}}$

A1 $y=\frac{3}{2}x$ or $2y-3x=0$ Allow $y=\frac{3}{2}x+0$ Also accept $2y=3x$, $y=39/26x$ or even $y-0=\frac{3}{2}(x-0)$ and isw

Notes Continued

(b) M1 Eliminates variable between their $y=\frac{3}{2}x$ and their (possibly rearranged) $2x+3y=26$ to form an equation in *x* or *y*. (They may have made errors in their rearrangement)

dM1 (Depends on previous M mark) Attempts to solve their equation to find the value of *x* or *y*

A1 $x=4$ or equivalent or $y=6$ or equivalent

B1 *y* coordinate of *B* is $\frac{26}{3}$ (stated or implied) - isw if written as ($\frac{26}{3}$, 0). **Must be used or stated in (b)**

dM1 (Depends on previous M mark) Complete method to find area of triangle *OBC* (using their values of *x* and/or *y* at point *C* and their 26/3)

A1 Cao $\frac{52}{3}$ or $\frac{104}{6}$ or $\frac{1352}{78}$ o.e

Method 1:
Uses the area of a triangle formula ½×*OB* ×(*x* coordinate of *C*)

Alternative methods: Several Methods are shown below. The only mark which differs from Method 1 is the last M mark and its use in each case is described below:

Method 2 in 9(b) using $\frac{1}{2}\times BC\times OC$

dM1 Uses the area of a triangle formula ½×*BC* ×*OC* Also finds OC (=√52) and BC= ($\frac{4}{3}\sqrt{13}$)

Method 3 in 9(b) using $\frac{1}{2}\begin{vmatrix}0 & 4 & 0 & 0\\ 0 & 6 & \frac{26}{3} & 0\end{vmatrix}$

dM1 States the area of a triangle formula $\frac{1}{2}\begin{vmatrix}0 & 4 & 0 & 0\\ 0 & 6 & \frac{26}{3} & 0\end{vmatrix}$ or equivalent with their values

Method 4 in 9(b) using area of triangle *OBX* – area of triangle *OCX* where *X* is point (13, 0)

dM1 Uses the correct subtraction $\frac{1}{2}\times 13\times"\frac{26}{3}"-\frac{1}{2}\times 13\times"6"$

Method 5 in 9(b) using area = ½ (6 × 4) + ½ (4 × 8/3) drawing a line from C parallel to the *x* axis and dividing triangle into two right angled triangles

dM1 for correct method area = ½ (“6” × “ 4”) + ½ (“4” × [“26/3”-“6”])

Method 6 Uses calculus

dM1 $\int_0^4 "\frac{26}{3}"-\frac{2x}{3}-\frac{3x}{2}\mathrm{d}x=\left[\frac{26}{3}x-\frac{x^2}{3}-\frac{3x^2}{4}\right]_0^4$

Question Number	Scheme	Marks
10.	(a) $\mathrm{f}(x)=\int\left(\frac{3}{8}x^2-10x^{-\frac{1}{2}}+1\right)\mathrm{d}x$	
	$x^n \to x^{n+1} \Rightarrow \mathrm{f}(x)=\frac{3}{8}\times\frac{x^3}{3}-10\frac{x^{\frac{1}{2}}}{\frac{1}{2}}+x(+c)$	M1, A1, A1
	Substitute $x=4, y=25 \Rightarrow 25 = 8 - 40 + 4 + c \Rightarrow c =$	M1
	$(\mathrm{f}(x))=\frac{x^3}{8}-20x^{\frac{1}{2}}+x+53$	A1
		(5)
	(b) Sub x=4 into $\mathrm{f}'(x)=\frac{3}{8}x^2-10x^{-\frac{1}{2}}+1$	M1
	$\Rightarrow \mathrm{f}'(4)=\frac{3}{8}\times 4^2-10\times 4^{-\frac{1}{2}}+1$	
	$\Rightarrow \mathrm{f}'(4)=2$	A1
	Gradient of tangent $= 2 \Rightarrow$ Gradient of normal is –1/2	dM1
	Substitute $x=4, y=25$ into line equation with their changed gradient e.g. $y-25=-\frac{1}{2}(x-4)$	dM1
	$\pm k(2y+x-54)=0$ o.e. (but must have integer coefficients)	A1cso
		(5)
		(10 Marks)

Notes

(a) M1 Attempt to integrate $x^n \to x^{n+1}$

A1 Term in x^3 **or** term in $x^{\frac{1}{2}}$ correct, coefficient need not be simplified, no need for $+x$ nor +c

A1 ALL three terms correct, coefficients need not be simplified, no need for +c

M1 For using $x = 4$, $y = 25$ in their f(x) to form a linear equation in c and attempt to find c

A1 $=\frac{x^3}{8}-20x^{\frac{1}{2}}+x+53$ cao (all coefficients and powers must be simplified to give this answer- do not need a left hand side and if there is one it may be f(x) or y). Need full expression with 53

These marks need to be scored in part (a)

(b) M1 Attempt to substitute $x = 4$ into $\mathrm{f}'(x)$ must be in part (b)

A1 $\mathrm{f}'(x)=2$ at $x=4$

dM1 (Dependent on first method mark in part (b)) Using $m_1\times m_2=-1$ to find the gradient of the normal from their tangent gradient (Give mark if gradient of 1 becomes -1 as they will lose accuracy)

dM1 (Dependent on first method mark in part (b)) Attempt to find the equation of the normal (not tangent). Eg use x=4, y=25 in y= '–1/2'x+c to find a value of c or use $'-\frac{1}{2}'=\frac{y-25}{x-4}$ with their adapted gradient.

A1 cso $\pm k(2y+x-54)=0$ (where k is any integer)

Question Number	Scheme	Marks
11.	(a) Discriminant = $b^2 - 4ac = 8^2 - 4\times 2\times 3, = 40$	M1, A1
		(2)
	(b) $2x^2 + 8x + 3 = 2(x^2 + ...)$ or p=2	B1
	$= 2((x+2)^2 \pm ...)$ or $q = 2$	M1
	$= 2(x+2)^2 - 5$ or $p = 2,\ q = 2$ and $r = -5$	A1
		(3)
	(c) Method 1A: Sets derivative "$4x + 8$" $= 4 \Rightarrow x =,\quad x = -1$	M1, A1
	Substitute $x = -1$ in $y = 2x^2 + 8x + 3$ $(\Rightarrow y = -3)$	dM1
	Substitute $x = -1$ and y= -3 in $y = 4x + c$ or into $(y + 3)=4(x + 1)$ and expand	dM1
	$c = 1$ or writing $y = 4x + 1$	A1cso
		(5)
	Method 1B: Sets derivative "$4x + 8$" $= 4 \Rightarrow x =,\quad x = -1$	M1, A1
	Substitute $x = -1$ in $2x^2 + 8x + 3 = 4x + c$	dM1
	Attempts to find value of c	dM1
	$c = 1$ or writing $y = 4x + 1$	A1cso
		(5)
	Method 2: Sets $2x^2 + 8x + 3 = 4x + c$ and collects x terms together	M1
	Obtains $2x^2 + 4x + 3 - c = 0$ or equivalent	A1
	States that $b^2 - 4ac = 0$	dM1
	$4^2 - 4\times 2\times(3 - c) = 0$ and so $c =$	dM1
	$c = 1$	A1cso
		(5)
	Method 3: Sets $2x^2 + 8x + 3 = 4x + c$ and collects x terms together	M1
	Obtains $2x^2 + 4x + 3 - c = 0$ or equivalent	A1
	Uses $2(x+1)^2 - 2 + 3 - c = 0$ or equivalent	dM1
	Writes -2 +3 –c = 0	dM1
	So c = 1	A1cso
		(5)
	Also see special case for using a perpendicular gradient (overleaf)	**(10 marks)**

Notes

(a) M1 Attempts to calculate $b^2 - 4ac$ using $8^2 - 4\times 2\times 3$ - must be correct – not just part of a quadratic formula

A1 Cao 40

(b) B1 See 2(….) or $p = 2$

M1 $..((x+2)^2 \pm ...)$ is sufficient evidence or obtaining $q = 2$

A1 Fully correct values. $2(x+2)^2 - 5$ or $p = 2, q = 2, r = -5$ cso.

Ignore inclusion of "=0".

[In many respects these marks are similar to three B marks.
$p = 2$ is B1; $q = 2$ is B1 and $p = 2,\ q = 2$ and $r = -5$ is final B1 but they must be entered on epen as **B1 M1 A1]**

Special case: Obtains $2x^2 + 8x + 3 = 2(x+2) - 1$ This may have first B1, for $p = 2$ then M0A0 (c) Method 1A (Differentiates and puts gradient equal to 4. Needs both x and y to find c)

M1 Attempts to solve their $\frac{dy}{dx} = 4$. They must reach x =... (Just differentiating is M0 A0)

A1 $x = -1$ (If this follows $\frac{dy}{dx} = 4x + 8$, then give M1 A1 by implication)

dM1 (Depends on previous M mark) Substitutes **their** x = -1 into f(x) or into "their f(x) from (b)" to find y

dM1 (Depends on both previous M marks) Substitutes **their** x = -1 and **their** y = -3 values into $y = 4x + c$ to find c or uses equation of line is $(y + \text{"3"})=4(x + \text{"1"})$ and rearranges to $y = mx + c$

A1 c = 1 or allow for $y = 4x + 1$ cso

(c) Method 1B (Differentiates and puts gradient equal to 4. Also equates equations and uses x to find c)

M1A1 Exactly as in Method 1A above

dM1 (Depends on previous M mark) Substitutes **their** x = -1 into $2x^2 + 8x + 3 = 4x + c$

dM1 Attempts to find value of c then A1 as before

(c) Method 2 (uses repeated root to find c by discriminant)

M1 Sets $2x^2 + 8x + 3 = 4x + c$ and tries to collect x terms together

A1 Collects terms e.g. $2x^2 + 4x + 3 - c = 0$ or $-2x^2 - 4x - 3 + c = 0$ or $2x^2 + 4x + 3 = c$ or even $2x^2 + 4x = c - 3$ Allow "=0" to be missing on RHS.

dM1 (If the line is a tangent it meets the curve at just one point so repeated root and $b^2 - 4ac = 0$)
Stating that $b^2 - 4ac = 0$ is enough

dM1 Using $b^2 - 4ac = 0$ to obtain equation in terms of c
(Eg. $4^2 - 4 \times 2 \times (3 - c) = 0$) AND leading to a solution for c

A1 c = 1 or allow for $y = 4x + 1$ cso

(c) Method 3 (Similar to method 2 but uses completion of the square on the quadratic to find repeated root)

M1 Sets $2x^2 + 8x + 3 = 4x + c$ and tries to collect x terms together. May be implied by $2x^2 + 8x + 3 - 4x \pm c$ on one side

A1 Collects terms e.g. $2x^2 + 4x + 3 - c = 0$ or $-2x^2 - 4x - 3 + c = 0$ or $2x^2 + 4x + 3 = c$ or even $2x^2 + 4x = c - 3$ Allow "=0" to be missing on RHS.

dM1 Then use completion of square $2(x+1)^2 - 2 + 3 - c = 0$ (Allow $2(x+1)^2 - k + 3 - c = 0$) where k is non zero. It is enough to give the correct or almost correct (with k) completion of the square

dM1 $-2 + 3 - c = 0$ AND leading to a solution for c (Allow $-1 + 3 - c = 0$) (x = -1 has been used)

A1 c = 1 cso

In Method 1 they may use part (b) and differentiate their f(x) and put it equal to 4
They can earn M1, but do not follow through errors.

In Methods 2 and 3 they may use part (b) to write
their $2(x+2)^2 - 5 = 4x + c$. They need to expand and collect x terms together for M1
Then expanding gives $2x^2 + 4x + 3 - c = 0$ for A1 – do not follow through errors
Then the scheme is as before

If they just state c = 1 with little or no working – please send to review,

PTO for special case

Special case uses perpendicular gradient (maximum of 2/5)

Sets $4x+8=-\frac{1}{4}\Rightarrow x=,\quad x=-\frac{33}{16}$ M1 A0

Substitute $x=-\frac{33}{16}$ in $y=2x^2+8x+3\quad(\Rightarrow y=-\frac{639}{128})$ M0

Substitute $x=-\frac{33}{16}$ and $y=-\frac{639}{128}$ into $y=4x+c$ or into $(y+\frac{639}{128})=4(x+\frac{33}{16})$ and expand M1 A0

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