1 $\frac{1}{2}x^{-\frac{1}{2}} - 3x^{-2}$ oe; iswB3need not be simplified B2 for one term correct ignore + cif B0 allow M1 for either $x^{1/2}$ or $x^{-1}$ se before differentiation deduct one mark for extra term in $x$ 2(5), 8, 11, (14),isw $a = 5$ and $d = 3$ soiB1 B1 B1 B1 3925B1 B2 S25 S3.4 M1 M1 M1 For evidence of correct order of operations used; may be implied by correct answer M1 M1 M1 For evidence of correct order of operations used; may be implied by correct answer M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M262.436.=16.199) NB 9.8sin53.4 = 7.87S3.4 = 7.87 M2.4 = 9.8 × sin 53 M2.4 = 9.8 × sin 53 M2.4 = 9.8 × sin 53.4 = 9.8 × sin 53.4 = 1.6 × 7.3 × b	Question		on	Answer	Marks	Guidance		
23(i) $2^{A^{-1} SA^{-0} SA$	1			$\frac{1}{r^{-1}}$ $r^{-\frac{1}{2}}$ - 3 $r^{-2}$ oe: isw	B3	need not be simplified	if B0 allow M1 for either $x^{1/2}$ or $x^{-1}$ seen	
Image: constraint of the extra term in xImage: constraint of the extra term in xImage: constraint of the extra term in x1(5), 8, 11, (14),iswB11 $a = 5$ and $d = 3$ soiB1 $a = 5$ and $d = 3$ soiB1 $s_{50} = \frac{50}{2}(2\times5 + (50 - 1) \times 3)$ oeM13(i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ 1[4]3(i) $9.8^2 + 6.4^2 - 74.79$ [= 62.2]3(ii) $9.8^2 + 6.4^2 - 74.79$ [= 62.2]7.887 or 7.89 or 7.9A13(ii) $1/2 \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seen3(ii) $1/2 \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = $9.8 \times \sin 53$ then the extra term in x				$2^{\lambda}$ $3^{\lambda}$ $3^{\lambda}$ $3^{\lambda}$ $3^{\lambda}$		B2 for one term correct	before differentiation	
2       (5), 8, 11, (14),isw       B1 B1 B1 B1 S <sub>50</sub> = $\frac{50}{2}(2\times5 + (50 - 1) \times 3)$ oe       B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B					[2]	1gnore + $c$	deduct one mark for extra term in $x$	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					[3]			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2			(5), 8, 11, (14),1sw	BI			
$S_{50} = \frac{50}{2}(2 \times 5 + (50 - 1) \times 3)$ oeM1if M0, SC1 for use of $a = 8$ and obtaining 4075if M0, award B2 if 3925 is obtained from summing individual terms or if unsupported3(i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ $9.8^2 + 6.4^2 - 74.79$ [= 62.2]M1 M1 M1 if M0, B3 for 7.89 or more precise www6.89 implies M0 262.4368 implies M1 (calc in radian mode), (NB $\sqrt{262.436=16.199}$ ) NB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1 M1or sin 53.4 used; may be embeddedmay be split into height = 9.8 \times sin 53 then Area = 16 \times 7.3 \times baight				a = 5 and $d = 3$ sol	BI			
3(i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ $9.8^2 + 6.4^2 - 74.79$ [= 62.2]M1 M1 M1for evidence of correct order of operations used; may be implied by correct answer6.89 implies M0 262.4368 implies M1 (calc in radian mode), (NB $\sqrt{262.436=16.199}$ ) NB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1 M1or sin 53.4 used; may be embeddedmay be split into height = 9.8 × sin 53 then A rea = 16 \times 7.3 \times baight				$S_{50} = \frac{50}{2}(2 \times 5 + (50 - 1) \times 3)$ oe	M1		if M0, award B2 if 3925 is obtained	
$3925$ A1 [4] $4075$ unsupported $3$ (i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ $9.8^2 + 6.4^2 - 74.79$ [= 62.2]M1 M1 M1 for evidence of correct order of operations used; may be implied by correct answer $6.89$ implies M0 $262.4368$ implies M1 (calc in radian mode), (NB $\sqrt{262.4368.=16.199}$ ) NB 9.8sin53.4 = 7.87 $3$ (ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1 M1or sin 53.4 used; may be embeddedmay be split into height = 9.8 \times sin 53 then Area = 16 \times 7.3 \times beight						if M0, SC1 for use of $a = 8$ and obtaining	from summing individual terms or if	
Image: Second stateImage: Second stateImage: Second stateImage: Second stateImage: Second state3(i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ M1M1for evidence of correct order of operations used; may be implied by correct answer $6.89$ implies M0 $9.8^2 + 6.4^2 - 74.79 [= 62.2]M1M1for evidence of correct order of operationsused; may be implied by correct answer6.89 implies M07.887 or 7.89 or 7.9A1if M0, B3 for 7.89 or more precise www8.89 implies M1 (calc in radianmode), (NB \sqrt{262.436=16.199})NB 9.8sin53.4 = 7.873(ii)\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4) oe seenM1or sin 53.4 used; may be embeddedmay be split into height = 9.8 \times \sin 53then Area = \frac{16}{2} \times 7.3 \times height$				3925	A1	4075	unsupported	
3(i) $9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ $9.8^2 + 6.4^2 - 74.79$ [= 62.2]M1 M1for evidence of correct order of operations used; may be implied by correct answer6.89 implies M0 262.4368 implies M1 (calc in radian mode), (NB $\sqrt{262.436=16.199}$ ) NB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be embedded					[4]			
9.8² + 6.4² - 74.79 [= 62.2]M1for evidence of correct order of operations used; may be implied by correct answer6.89 implies M0 262.4368 implies M1 (calc in radian mode), (NB $\sqrt{262.436=16.199}$ ) NB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = 9.8 × sin 53 then Area = 16 × 7.3 × beight	3	(i)		$9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$	M1			
aused; may be implied by correct answer $262.4368$ implies M1 (calc in radian mode), (NB $\sqrt{262.436=16.199}$ )7.887 or 7.89 or 7.9A1 [3]if M0, B3 for 7.89 or more precise wwwNB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = 9.8 × sin 53 then Area = $\frac{1}{2} \times 7.3 \times beight$				$9.8^2 + 6.4^2 - 74.79 = 62.2$	M1	for evidence of correct order of operations	6.89 implies M0	
A1 [3]if M0, B3 for 7.89 or more precise wwwmode), (NB $\sqrt{262.436=16.199}$ ) NB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = 9.8 × sin 53 then Area = $\frac{1}{2} \times 7.3 \times beight$						used; may be implied by correct answer	262.4368 implies M1 (calc in radian	
7.887 or 7.89 or 7.9A1 [3]if M0, B3 for 7.89 or more precise wwwNB 9.8sin53.4 = 7.873(ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = 9.8 × sin 53 then Area = $\frac{1}{2} \times 7.3 \times beight$							mode), (NB √262.436=16.199)	
[3][3]3 (ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seenM1or sin 53.4 used; may be embeddedmay be split into height = $9.8 \times \sin 53$ then $\Delta rea = \frac{1}{2} \times 7.3 \times beight$				7.887 or 7.89 or 7.9	A1	if M0, B3 for 7.89 or more precise www	NB 9.8sin53.4 = 7.87	
3 (ii) $\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seen M1 or sin 53.4 used; may be embedded may be split into height = $9.8 \times \sin 53$					[3]			
then $\Delta reg = 1/2 \vee 7.3 \vee height$	3	<b>(ii)</b>		$\frac{1}{2} \times 9.8 \times 7.3 \times \sin(180 - 53.4)$ oe seen	M1	or sin 53.4 used; may be embedded	may be split into height = $9.8 \times \sin 53.4$	
then Area – 72 × 7.5 × height							then Area = $\frac{1}{2} \times 7.3 \times \text{height}$	
28.716or 28.72 or 28.7 or 29 isw       A1       if M0, B2 for 28.7 or more precise www				28.716or 28.72 or 28.7 or 29 isw	A1	if M0, B2 for 28.7 or more precise www		
					[2]			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	4	(i)		(6, 9)	2	1 for each co-ordinate	SC0 for (6, 3)	
					[2]			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	4	(ii)		(1.5, 3)	2	1 for each co-ordinate	SC0 for (6, 3)	
	L				[2]			
5 $M1$ $45 = \frac{1}{2}r^2 \times 1.6$ oe $M1$ $45 = \pi r^2 \times \frac{91.673}{360}$	5			$45 = \frac{1}{2} r^2 \times 1.6$ oe	M1	$45 = \pi r^2 \times \frac{91.673}{360}$		
$r^2 = 90/1.6$ oe M1				$r^2 = 90/1.6$ oe	M1			
r = 7.5 or exact equivalent cao A1 or B3 www allow recovery to 7.5 if working in				r = 7.5 or exact equivalent cao	A1	or B3 www	allow recovery to 7.5 if working in	
degrees, but A0 for (eg) 7.49							degrees, but A0 for (eg) 7.49	
91.673						91.673		
(their 7.5) × 1.6 M1 $2\pi \times (\text{their } r) \times \frac{360}{360}$ 12 implies M1				(their $7.5$ ) × 1.6	M1	$2\pi \times (\text{then } r) \times \frac{360}{360}$	12 implies M1	
27 A1 or R2 www				27	Δ1	or B2 www		
					[5]			

6       gradient = 3 seen       B1       may be embedded $\log_{10} y - 5 = (\text{their 3})(\log_{10} x - 1) \text{ or using}$ M1       or $\log_{10} y = 3 \log_{10} x + c$ and substitution of $(1, 5)$ or $(5, 17)$ for $\log_{10} x$ and $\log_{10} x + 2$ oe $\log_{10} y = 3 \log_{10} x + 2$ oe       A1 $y = 10^{3\log_{10} x+2}$ oe       M1       or $\log_{10} y = \log_{10} x^3 + \log_{10} 100$ $y = 100x^3$ A1         [5]       [5]         7 $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ $4x^{\frac{3}{2}}$ A1 $-5x + c$ B1         B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	ion condone omission of base throughout
Image: 1 to $y - 5 = (\text{their 3})(\log_{10} x - 1) \text{ or using } (5, 17)$ M1       or $\log_{10} y = 3 \log_{10} x + c$ and substitue of $(1, 5)$ or $(5, 17)$ for $\log_{10} x$ and $\log_{10} x + 2$ oe         Image: 1 to $y = 3 \log_{10} x + 2$ oe       A1 $y = 10^{3\log_{10} x + 2}$ oe       M1 $y = 10^{3\log_{10} x + 2}$ oe       M1 $y = 100x^3$ A1         [5]       M1* $y = 100x^3$ M1* $4x^{\frac{3}{2}}$ A1 $-5x + c$ B1         B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	ion condone omission of base throughout
Image: log 10 y = 3 log 10 x + 2 oe       A1         y = 10^{3log_{10} x+2} oe       M1       or log 10 y = log 10 x <sup>3</sup> + log 10         y = 100x <sup>3</sup> A1         [5]       [5]         7 $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ 4x^{\frac{3}{2}}       M1*         -5x + c       B1         B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	ND more recover from as $V = 2V + 2$
y = $10^{3\log_{10} x+2}$ oe       M1       or $\log_{10} y = \log_{10} x^3 + \log_{10} 100$ y = $100x^3$ A1         [5]       [5]         7 $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ $4x^{\frac{3}{2}}$ M1* $-5x + c$ B1         B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	NB may recover from eg $I = 5X + 2$
y = 100x <sup>3</sup> A1 [5]       7 $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ $4x^{\frac{3}{2}}$ M1* A1       a     -5x + c       B1     B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	or $\log_{10} \frac{y}{x^3} = 2$ or $\log_{10} y = \log_{10} 100x^3$
7 $\frac{6x^{\frac{3}{2}}}{3/2}$ M1*       4x^{\frac{3}{2}}     A1     may appear later       -5x + c     B1     B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	
7	
$\begin{vmatrix} 7 & 2 \\ 4x^{\frac{3}{2}} \\ -5x + c \end{vmatrix}$ A1 may appear later B1 B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$	
<b>B1 B0</b> if from $y = (6x^{\frac{1}{2}} - 5)x + c$	
	condone "+ $c$ " not appearing until substitution
substitution of (4, 20) M1dep*	
[ $y = 4x^{1.5} - 5x + 8 \text{ or } c = 8 \text{ isw}$ [5]	
8         0.775397 soi         M1         or 44.427°	
0.388, 1.18, 3.53, 4.32 A4 A1 each value	if any of final answers not given to three sf deduct 1 mark from total A marks
in degrees: 22.2, 67.8, 202, 248*       if A0 then B1 for at least two of 2.366         7.058, 8.649for 2θ or all of 135.5         404.427, 495.57	<ul> <li>,</li> <li>*if final answers in degrees deduct 1 from total A marks ignore extra values outside range if four correct answers in degrees or radians, deduct 1 for extra values in range</li> </ul>

Question		on	Answer	Marks	Guidance	
9	(i)		$\frac{1}{2} \times 0.2 (0 + 0 + 2(0.5 + 0.7 + 0.75 + 0.7 + 0.5))$ [=0.63]	M3	M2 if one error, M1 if two errors condone omission of zeros or M3 for 0.05 + 0.12 + 0.145 + 0.145 + 0.12 + 0.05 may be unsimplified, must be summed	basic shape of formula must be correct must be 6 strips M0 if brackets omitted, but allow recovery M0 if $h = 1$ or 1.2 Area = 6.3 and 0.53 imply M0
			(their 0.63) × 50 31.5	M1 A1 [5]		
9	(ii)	(A)	$3.8 \times 0.2^4 - 6.8 \times 0.2^3 + 7.7 \times 0.2^2 - 4.2 \times 0.2$	M1	±0.58032 implies M1	condone one sign error
			0.01968 cao isw	A1 [2]	or B2 if unsupported	allow – 0.01968
9	(ii)	(B)	$\frac{3.8x^5}{5} - \frac{6.8x^4}{4} + \frac{7.7x^3}{3} - \frac{4.2x^2}{2} + c$	M2	M1 for two terms correct excluding $c$ condone omission of $c$	accept 2.56 to 2.57 for coefficient of $x^3$ allow M1 if all signs reversed
			F(0.9) [-F(0)] 50 × their ±F(0.9) 24.8 to 24.9 cao	M1* M1dep* A1 [5]	as long as at least M1 awarded	NB $F(0.9) = -0.496$

Question		on	Answer	Marks	Guidance		
10	(i)		$y' = 3x^2 - 5$	M1			
			their $y' = 0$	M1			
			(1.3, -4.3) cao	A1	or A1 for $x = \pm \sqrt{\frac{5}{3}}$ oe soi		
			(- 1.3, 4.3) cao	A1	allow if not written as co-ordinates if pairing is clear	ignore any work relating to second derivative	
10	(••)		(0.0)	[4]			
10	(11)		crosses axes at (0, 0)	BI	condone x and y intercepts not written as	See examples in Appendix	
			and $(\pm\sqrt{5}, 0)$	B1	$\pm$ (2.23 to 2.24) implies $\pm \sqrt{5}$		
			sketch of cubic with turning points in correct	B1		must meet the <i>x</i> -axis three times	
			quadrants and of correct orientation and			B0 eg if more than 1 point of inflection	
			passing through origin	D1	(122)		
			x-intercepts $\pm$ v5 marked	БI [4]	may be in decimal form $(\pm 2.2)$		
10	(iii)		1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 =	 M1		sight of $-2$ does not necessarily imply	
10	(111)		substitution of $x = 1 \text{ in } 1$ $(x) = 3x - 5$			Sight of 2 does not necessarily imply M1: check $f'(x) = 2x^2$ 5 is correct	
						$\begin{array}{l} \text{M1. check 1} (x) = 5x - 5 \text{ is context} \\ \vdots \\ $	
				A 1		in part (1)	
			-2	AI M1*			
			$y - 4 = (\text{their f}(1)) \times (x - 1) \text{ oe}$		or $-4 = -2 \times (1) + c$		
			$-2x - 2 = x^3 - 5x$ and completion to given result www	MIdep*			
			use of Factor theorem in $x^3 - 3x + 2$ with $-1$ or $\pm 2$	M1	or any other valid method; must be shown	eg long division or comparing coefficients to find $(x - 1)(x^2 + x - 2)$ or $(x + 2)(x^2 - 2x + 1)$ is enough for M1	
			x = -2 obtained correctly	A1		with both factors correct NB M0A0 for $x(x^2 - 3) = -2$ so $x = -2$ or $x^2 - 3 = -2$ oe	
				[6]			

Question		on	Answer	Marks	Guidance	
11	(i)		ar = 6 oe $\frac{a}{1-r} = 25$ oe	B1 B1	must be in <i>a</i> and <i>r</i> must be in <i>a</i> and <i>r</i>	
			$25 = \frac{a}{1 - \frac{6}{a}}$	M1	or $\frac{6}{r} = 25(1-r)$	NB assuming $a = 10$ earns M0
			$a^{2} - 25a + 150 = 0$ a = 10 obtained from formula, factorising, Factor theorem or completing the square	A1 A1	or $25r^2 - 25r + 6$ [= 0] r = 0.4 and r = 0.6	All signs may be reversed
			<i>a</i> = 15	A1	a = 15	if M0, B1 for $r = 0.4$ and 0.6 and B1 for $a = 15$ by trial and improvement mark to benefit of candidate
			r = 0.4 and 0.6	A1 [ <b>7</b> ]	$a = \frac{1}{0.6} = 10$ oe	
11	( <b>ii</b> )		$10 \times (3/5)^{n-1}$ and $15 \times (2/5)^{n-1}$ seen	M1		
			15 × 2 <sup><i>n</i>-1</sup> : 10 × 3 <sup><i>n</i>-1</sup> or 3 × $\frac{2^{n-1}}{5^{n-1}}$ : 2 × $\frac{3^{n-1}}{5^{n-1}}$	M1	may be implied by $3 \times 2^{n-1} : 2 \times 3^{n-1}$	condone ratio reversed
			$3 \times 2^{n-1} : 2 \times 3^{n-1}$	A1	and completion to given answer www	condone ratio reversed
				[3]		

**Appendix: examples for Question 10(ii)** 





Mark Scheme

June 2012

 $4^{\text{th}} B1$ 

4752