Mark Scheme (Results)

Summer 2013

GCE Core Mathematics 2 (6664/01R)

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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 $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c$, $q \neq 0$, 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.	$\frac{dy}{dx} = 2 - 16x^{-3}$	M1 A1
	$2 - 16x^{-3} = 0$ so $x^{-3} =$ or $x^3 =$, or $2 - 16x^{-3} = 0$ so $x = 2$	M1
	$x = 2$ only (after correct derivative)	A1
	$y = 2 \times "2" + 3 + \frac{8}{"2^2"}$	M1
	= 9	A1
		(6)
		Total 6
	Notes for Question 1	
	1st M1: At least one term **differentiated (not integrated)** correctly, so $2x \to 2$, or $\frac{8}{x^2} \to -16x^{-3}$, or $3 \to 0$ A1: This answer or equivalent e.g. $2 - \frac{16}{x^3}$ 2nd M1: Sets $\frac{dy}{dx}$ to 0, and solves to give x^3 = value or x^{-3} = value (or states x =2 with no working following correctly stated $2 - 16x^{-3} = 0$) A1: x = 2 cso (if x = -2 is included this is A0 here) 3rd M1: Attempts to substitutes **their positive** x (found from attempt to differentiate) into $y = 2x + 3 + \frac{8}{x^2}$, $x > 0$ Or may be implied by y = 9 or correct follow through from their positive x A1: 9 cao (Does not need to be written as coordinates) (ignore the extra (-2,1) here)	

Question Number	Scheme	Marks
2.(a)	$\{x=1.3\}\quad y=0.8572$ (only)	B1 cao (1)
(b)	$\frac{1}{2}\times 0.1.........$ $\{0.7071+0.9487+2(0.7591+0.8090+"0.8572"+0.9037)\}$ $...\{0.7071+0.9487+2(0.7591+0.8090+"0.8572"+0.9037)\}$ $\{0.05(8.3138)\}=0.41569$ = awrt 0.416	B1 M1 A1ft A1 (4) **Total 5**

	Notes for Question 2
(a) **(b)**	B1: 0.8572 cao B1 for using $\frac{1}{2}\times 0.1$ or 0.05 or equivalent. M1 It needs the first bracket to contain first *y* value **plus** last *y* value and the second bracket to be multiplied by 2 and to be the summation of the remaining *y* values in the table with no additional values. If the only mistake is a copying error or is to omit one value from 2nd bracket this may be regarded as a slip and the M mark can be allowed (An extra repeated term forfeits the M mark however). M0 if values used in brackets are *x* values instead of *y* values A1ft for the correct bracket $\{......\}$ following through candidate's *y* value found in part (a). NB: Separate trapezia may be used : B1 for 0.05, M1 for 1/2 *h*(*a* + *b*) used 4 or 5 times (and A1ft if it is all correct) Then A1 as before. (Equivalent correct formulae may be used) Special case: Bracketing mistake $0.05\times(0.7071+0.9487)+2(0.7591+0.8090+"0.8572"+0.9037)$ scores B1 M1 A0 A0 (usually for 6.74079) unless the final answer implies that the calculation has been done correctly (then full marks can be given).

Question Number	Scheme	Marks
3. Way 1	$\left(2-\frac{1}{2}x\right)^8 = 2^8 + \binom{8}{1}.2^7\left(-\frac{1}{2}x\right)+\binom{8}{2}2^6\left(-\frac{1}{2}x\right)^2+\binom{8}{3}2^5\left(-\frac{1}{2}x\right)^3$	
	First term of 256	B1
	$\left({}^8C_1\times\ldots\times x\right)+\left({}^8C_2\times\ldots\times x^2\right)+\left({}^8C_3\times\ldots\times x^3\right)$	M1
	$=(256)-512x+448x^2-224x^3$	A1, A1
		(4)
		Total 4
Way 2	$\left(2-\frac{1}{2}x\right)^8 = 2^8\left(1-\frac{1}{4}x\right)^8 = 2^8\left(1+\binom{8}{1}.\left(-\frac{1}{4}x\right)+\binom{8}{2}\left(-\frac{1}{4}x\right)^2+\binom{8}{3}\left(-\frac{1}{4}x\right)^3\right)$ Scheme is applied exactly as before except in special case below*	
	Notes for Question 3	
	B1: The first term should be 256 in their expansion M1: Two binomial coefficients must be correct and must be with the correct power of x. Accept ${}^8C_1$ or $\binom{8}{1}$ or 8 **as a coefficient, and** ${}^8C_2$ or $\binom{8}{2}$ or 28 **as another……..** Pascal's triangle may be used to establish coefficients. A1: Any two of the final three terms correct (but allow +- instead of -) A1: All three of the final three terms correct and simplified. (Deduct last mark for +-512*x and* +-224x^3 in the series). Also deduct last mark for the three terms correct but unsimplified. (Accept answers without + signs, can be listed with commas or appear on separate lines) The common error $\left(2-\frac{1}{2}x\right)^8 = 256+\binom{8}{1}.2^7\left(-\frac{1}{2}x\right)+\binom{8}{2}2^6\left(-\frac{1}{2}x^2\right)+\binom{8}{3}2^5\left(-\frac{1}{2}x^3\right)$ would earn B1, M1, A0, A0 **Ignore extra terms** involving higher powers. Condone terms in reverse order i.e. $=-224x^3+448x^2-512x+(256)$ ***In Way 2 the error** $=2\left(1+\binom{8}{1}.\left(-\frac{1}{4}x\right)+\binom{8}{2}\left(-\frac{1}{4}x\right)^2+\binom{8}{3}\left(-\frac{1}{4}x\right)^3\right)$ giving $=2-4x+\frac{7}{2}x^2-\frac{7}{4}x^3$ is a **special case** B0, M1, A1, A0 i.e. 2/4	

Question Number	Scheme		Marks
	Way 1	Way 2	
4.(a)	Attempting f(±1) or f(±3)	Divides by (x-3) and reaches remainder or divides by (x+1) and reaches remainder	M1
	Sets f(3)=55 i.e. $27a-99+3b+4=55$	Sets remainder =55 $27a-99+3b+4=55$	A1
	Sets f(-1)=-9 i.e. $-a-11-b+4=-9$ $a=..../b=....$	Sets remainder = -9 $-a-11-b+4=-9$ $a=..../b=....$	A1 M1
	a = 6 and b = -4		A1cao
			(5)
(b)	$f(x)=(3x+2)(2x^2-5x+2)$ or $(x+\frac{2}{3})(6x^2-15x+6)$		M1 A1
	$=(3x+2)(x-2)(2x-1)$ or $=(3x+2)(2-x)(1-2x)$		M1 A1
			(4) **Total 9**
	Notes for Question 4		
(a)	**Way 1** M1: Attempting f(±1) or f(±3) – with numbers substituted into expression A1: for applying f(3) correctly and setting the result equal to 55 (see correct equation then isw) A1: for applying f(−1) correctly and setting the result equal to -9 (see correct equation then isw) M1: Solve simultaneously to obtain a value for either *a* or *b* (may make slip) A1: Both values correct- this could imply M1 if no working **Or Way 2** M1: Long division by (x – 3) or (x + 1) A1: A1: correct remainders put equal to 55 or -9 respectively M1A1: As in Way 1		
(b)	1st M1: attempting to divide a multiple of their cubic by $(3x+2)$ or $(x+\frac{2}{3})$ leading to a 3TQ beginning with the correct term, usually $\frac{a}{3}x^2$. A1: for either $(2x^2-5x+2)$ after division by (3x+2)or $(6x^2-15x+6)$ after division by $(x+\frac{2}{3})$ 2nd M1: for a ***valid*** attempt to factorise their quadratic 2nd A1 is for any equivalent correct answer and needs all three factors together. As shown in scheme Apply isw if candidate continues to “solve” and give x =..		

Question Number	Scheme	Marks
5.(a)	$a = 4p,\ ar = (3p+15)$ and $ar^2 = 5p+20$	B1
	(So r =) $\dfrac{5p+20}{3p+15} = \dfrac{3p+15}{4p}$ or $4p(5p+20) = (3p+15)^2$ or equivalent	M1
	See $(3p+15)^2 = 9p^2 + 90p + 225$	M1
	$20p^2 + 80p = 9p^2 + 90p + 225 \rightarrow\ 11p^2 - 10p - 225 = 0$ *	A1 *
		(4)
(b)	$(p-5)(11p+45)$ so p =	M1
	p = 5 only (after rejecting - 45/11)	A1
	<u>N.B. Special case p = 5 can be verified in (b) (1 mark only)</u>	
	$11\times5^2 - 10\times5 - 225 \quad = 275 - 50 - 225 = 0$ M1A0	
		(2)
(c)	$\dfrac{3\times5+15}{4\times5}$ or $\dfrac{5\times5+20}{3\times5+15}$	M1
	$r = \dfrac{3}{2}$	A1
		(2)
(d)	$S_{10} = \dfrac{20\left(1-\left("\frac{3}{2}"\right)^{10}\right)}{\left(1-"\frac{3}{2}"\right)}$	M1A1ft
	(= 2266.601568…) = 2267	A1
		(3)
		Total 11
	Notes for Question 5	
(a)	B1: Correct statement (needs all three terms)**– this may be omitted and implied** by correct statement in p only as candidates may use geometric mean, or may use ratio of terms being equal and give a correct line 2 without line 1. (This would earn the B1M1 immediately) M1: Valid Attempt to eliminate a and r and to obtain equation in p only M1: Correct expansion of $(3p+15)^2 = 9p^2 + 90p + 225$ A1cso: No incorrect work seen. The printed answer is obtained. **NB Those who show p = 5 in part (a) obtain no credit for this**	
(b)	M1: Attempt to solve quadratic by usual methods (factorisation, completion of square or formula) Must appear in part (b) – not part (a) A1: 5 **only and** -45/11 should be seen and rejected or (11p + 45) seen and statement $p > 0$	
(c)	M1: Substitutes p = 5 completely and attempt ratio (correct way up) A1: 1.5 or any equivalent	
(d)	M1: Use of correct formula with n = 10 a and/or r may still be in terms of p A1ft: Correct expression ft on their r only – must have a = 20 and power = 10 here A1 2267 (accept awrt 2267)	

Question Number	Scheme		Marks
6.(a)	Way 1: $\log_3(9x) = \log_3 9 + \log_3 x$	or Way 2: $\log_3(9x) = \log_3 3^{a+2}$	M1
	$= 2 + a$	$= 2 + a$	A1 (2)
(b)	Way 1: $\log_3\left(\frac{x^5}{81}\right) = \log_3 x^5 - \log_3 81$	or Way 2 $= \log_3 \frac{3^{5a}}{3^4}$	M1
	$\log x^5 = 5\log x$ or log81=4log3 or log81=4	$= \log_3 3^{5a-4}$	M1
	$= 5a - 4$		A1 cso (3)
(c)	$\log_3(9x) + \log_3\left(\frac{x^5}{81}\right) = 3$		
	Method 1	Method 2	
	$\Rightarrow 2 + a + 5a - 4 = 3$	$\log_3\left(9x.\frac{x^5}{81}\right)$ = (3 or log27)	M1
	$\Rightarrow a = \frac{5}{6}$	$\log_3\left(\frac{x^6}{9}\right) = 3$ or log 27	A1
	$\Rightarrow x = 3^{\frac{5}{6}}$ or $\log_{10} x = a\log_{10} 3$ so $x =$	$\Rightarrow \frac{x^6}{9} = 3^3 \Rightarrow x^6 = 3^5 \Rightarrow x =$	M1
	$x = 2.498$ **or awrt**	$x = 2.498$ **or awrt**	A1
	If x = -2.498 appears as well or instead this is A0		(4) **Total 9**

Notes for Question 6

(a)	Way 1: M1: Use of log(ab) = log(a) + log(b) A1: must be a + 2 or 2 + a **Way 2: Uses** $x = 3^a$ to give $\log_3(9x) = \log_3 3^{a+2}$, A1 for a + 2 or 2 + a
(b)	Way 1: M1: Use of log(a/b) = log(a) – log(b) M1: Use of nlog(a) = $\log(a)^n$ Way 2: M1 Use of correct powers of 3 in numerator and denominator M1: Subtracts powers A1: No errors seen
(c)	**Method 1**: M1: Uses (a) and (b) results to form an equation in a (may not be linear) A1: a = awrt 0.833 M1: Finds x by use of 3 to a power, or change of base performed correctly A1: x = 2.498 (accept answer which round to this value from 2.498049533…) **Method 2:** M1: Use of log(ab) = log(a) + log(b) in an equation (RHS may be wrong) A1: Equation correct and simplified M1: Tries to undo log by 3 to power correctly, and uses root to obtain x A1: x = 2.498 (accept answer which round to this value from 2.498049533…) Lose this mark if negative answer is given as well as or instead of positive answer.

Question Number	Scheme	Marks
7.(a)	$x^2+2x+2=10 \Rightarrow x^2+2x-8=0$ (so $(x+4)(x-2)=0$) $\Rightarrow x=$........	M1
	$x=-4,\ 2$	A1 (2)
(b) Way 1	$\int (x^2+2x+2)\,dx = \frac{x^3}{3}+\frac{2x^2}{2}+2x(+C)$	M1A1A1
	$\left[\frac{x^3}{3}+\frac{2x^2}{2}+2x\right]_{"-4"}^{"2"} = \left(\frac{8}{3}+\frac{8}{2}+4\right)-\left(-\frac{64}{3}+\frac{32}{2}-8\right) \quad (=24)$	M1
	Rectangle: $10\times(2--4)=60$	B1 cao
	$R="60"-"24"$	M1
	$=36$	A1 (7)
		Total 9
(b) Way 2	$\int (8-x^2-2x)\,dx = 8x-\frac{x^3}{3}-\frac{2x^2}{2}(+C)$	M1 A1ft A1
	$\left[8x-\frac{x^3}{3}-\frac{2x^2}{2}\right]_{"-4"}^{"2"} = \left(16-\frac{8}{3}-4\right)-\left(-32+\frac{64}{3}-16\right)$ =(9.3 – (- 26.7))	M1
	Implied by final answer of 36 after correct work	B1
	$10-(x^2+2x+2)=8-x^2-2x,\ =36$	M1, A1
	Notes for Question 7	
(a)	M1 Set the curve equation equal to 10 and collect terms. Solves quadratic to x = ... A1 cao : Both values correct – allow A = -4, B = 2	
(b)	M1: One correct integration A1: Two correct integrations(ft slips subtracting in Way 2) A1: All 3 terms **correct (penalise subtraction errors here in Way 2)** M1: Substitute their limits from (a) into the **integrated** function and subtract (either way round) B1: Way 1:Find area under the line by integration or area of rectangle – should be 60 here (no follow through) Way 2: (implied by final correct answer in second method) M1: Subtract one area from the other (implied by subtraction of functions in second method)- award even after differentiation A1: Must be 36 not –36.	
	Special case 1: Combines both methods. Uses Way 2 integration, but continues after reaching "36"to subtract "36" from rectangle giving answer as "24" This loses final M1 A1 *Special case* 2: Integrates (x^2+2x-8) between limits –4 and 2 to get -36 and then changes sign and obtains 36. Do not award final A mark – so M1A1A1M1B1M1A0 If the answer is left as -36, then M1A1A1M1B0M1A0 N.B. Allow full marks for modulus used earlier in working e.g. $\left\lvert\int_{-4}^{2} x^2+2x-2\,dx-\int_{-4}^{2}10\,dx\right\rvert$	

Question Number	Scheme	Marks
8.(a)	**Way 1**: $10^2 = 7^2 + 13^2 - 2\times 7\times 13\cos\theta$ or $\cos\theta = \frac{7^2+13^2-10^2}{2\times 7\times 13}$	M1
	$\cos\theta = \frac{59}{91}$ or $\cos\theta = \frac{7^2+13^2-10^2}{2\times 7\times 13}$ or $\cos\theta = 0.6483$ or 0.8644	A1 o.e
	(θ = 0.8653789549…) = 0.865 * (to 3 dp)	A1* cso (3)
	Way 2: Uses $\cos\theta = \frac{x}{7}$, where $7^2 - x^2 = 10^2 - (13-x)^2$ and finds x (= 59/13)	M1
	$\cos\theta = \frac{59}{91}$ and (θ = 0.8653789549…) = 0.865 * (to 3 dp) – as in Way 1	A1, A1 (3)
(b)	Area triangle $ABC = \frac{1}{2}\times 13\times 7\sin 0.865$ or $\frac{1}{2}\times 13\times 7\sin 49.6$ or $20\sqrt{3}$	M1
	Area sector $ABD = \frac{1}{2}\times 7^2\times 0.865$ or $\frac{49.6}{360}\times\pi\times 7^2$	M1
	=34.6 (triangle) **or** 21.2 (Sector)	A1
	Area of $S = \frac{1}{2}\times 13\times 7\sin 0.865 - \frac{1}{2}\times 7^2\times 0.865 \quad (=13.4)$	M1 A1
	(Amount of seed =) 13.4 x 50 = 670g or 680g (need one of these two answers)	M1 A1 (7)
		Total 10

	Notes for Question 8
(a)	M1: use correct cosine **formula in any form** A1: give a value for $\cos\theta$ NB $\cos\theta = \frac{7^2+13^2-10^2}{2\times 7\times 13}$ earns M1A1 A1: deduce and state the printed answer θ = 0.865
(b)	M1: Uses Correct method for area of the correct triangle i.e. *ABC* M1: Uses Correct method for the area of the sector A1: This is earned for one of the correct answers. May be implied if these answers are not calculated but the final answer is correct with no errors (or shaded area is 13.4 or13.5) M1: Their area of Triangle *ABC*– **Area** of Sector (may have $kr^2\theta$ but not $k\theta$) A1: **Correct expression** or awrt 13.4 or 13.5 (may be implied by final answer) M1: Multiply their previous answer by 50 A1: 670g or 680 g (There is an argument for rounding answer up to provide enough seed)

N.B. $(\frac{1}{2}\times 13\times 7\sin 0.865 - \frac{1}{2}\times 7^2\times 0.865)\times 50$ =670 or 680 earns full marks

$(\frac{1}{2}\times 13\times 7\sin 0.865 - \frac{1}{2}\times 7^2\times 0.865)\times 50$ = **awrt** 670 or 680 just loses last mark

$(\frac{1}{2}\times 13\times 7\sin 0.865 - \frac{1}{2}\times 7^2\times 0.865)\times 50$ = wrong answer M1M1A0M1A1M1A0

Question Number	Scheme	Marks
9.(a)	$\sin(2\theta - 30) = -0.6$ or $2\theta - 30 = -36.9$ or implied by 216.9	B1
	$2\theta - 30 = 216.87$ = (180 + 36.9)	M1
	$\theta = \dfrac{216.87+30}{2} = 123.4$ or 123.5	A1
	$2\theta - 30 = 360 - 36.9$ or 323.1	M1
	$\theta = \dfrac{323.1+30}{2} = 176.6$	A1 (5)
(b)	$9\cos^2 x - 11\cos x + 3(1-\cos^2 x) = 0$ or $6\cos^2 x - 11\cos x + 3(\sin^2 x + \cos^2 x) = 0$	M1
	$6\cos^2 x - 11\cos x + 3 = 0$ {as $(\sin^2 x + \cos^2 x) = 1$}	A1
	$(3\cos x - 1)(2\cos x - 3) = 0$ implies $\cos x =$	M1
	$\cos x = \frac{1}{3}, \left(\frac{3}{2}\right)$	A1
	$x = 70.5$	B1
	$x = 360 - "70.5"$ $x = 289.5$	M1 A1cao (7) **Total 12**
	Notes for Question 9	
(a)	B1: This statement seen and must contain no errors or may implied by – 36.9 M1: Uses 180 – arcsin (-0.6) i.e. 180 + 36.9 (or $\pi + \arcsin(0.6)$ in radians) (in 3rd quadrant) A1: allow answers which round to 123.4 or 123.5 must be in degrees M1: Uses 360 + arcsin (-0.6) i.e. 360 – 36.9 (or $2\pi + \arcsin(-0.6)$ in radians) (in 4th quadrant) A1: allow answers which round to 176.6 must be in degrees (A1 implies M1) Ignore extra answers outside range but lose final A1 for extra answers in the range if both B and A marks have been earned) Working in radians may earn B1M1A0M1A0	
(b)	M1: **Use** of $\sin^2 x = (1-\cos^2 x)$ or $(\sin^2 x + \cos^2 x) = 1$ in the given equation A1: Correct three term quadratic in any equivalent form M1: Uses standard method to solve quadratic and obtains cos*x* = A1: A1 for $\frac{1}{3}$ with $\frac{3}{2}$ ignored but A0 if $\frac{3}{2}$ is incorrect B1: 70.5 or answers which round to this value M1: 360 –arcos(*their1*/3) (or $2\pi - \arccos(their 1/3)$ in radians) A1: Second answer Working in radians in (b) may earn M1A1M1A1B0M1A0 Extra values in the range coming from arcos (1/3) – deduct final A mark - so A0	

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