AQA

GCSE
Mathematics
93702H Applications of Mathematics
Unit 2: Higher Tier
Mark scheme

93702H

November 2015

Version 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg, accept 0.5 as well as $\frac{1}{2}$
[*a, b*]	Accept values between *a* and *b* inclusive.
3.14…	Allow answers which begin 3.14 eg 3.14, 3.142, 3.149.
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles

Diagrams
Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods
Whenever there is doubt as to whether a candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

Questions which ask candidates to show working
Instructions on marking will be given but usually marks are not awarded to candidates who show no working.

Questions which do not ask candidates to show working
As a general principle, a correct response is awarded full marks.

Misread or miscopy
Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work
Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice
When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced
Erased or crossed out work that is still legible should be marked.

Work replaced
Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation
Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Q	Answer	Mark	Comments
1(a)	$3.4^2 - 3^2$ or 2.56	M1	
	$\sqrt{\text{their } 2.56}$	M1dep	
	1.6	A1	
	Additional guidance		

Q	Answer	Mark	Comments
1(b)	(3.4 + 3 + their 1.6) ÷ 3.2 or 2.5	M1	
	2 (hours) 30 (minutes)	A1ft	ft their 1.6 rounded or truncated to nearest minute
	Additional guidance		
	ft from $3.4^2 + 3^2$ in 1(a)		
	(3.4 + 3 + 4.5 ÷ 3.2 = 4.5 3 (hours) 24 (minutes)		M1 A1ft

Q	Answer	Mark	Comments
2(a)	40 cm	B1	
	Additional guidance		

Q	Answer	Mark	Comments
2(b)	$2 \times \pi \times$ their 40 or 80π	M1	oe their 40 from (a)
	[251.2, 251.4] or 251 or 252	A1ft	ft their 40 from (a) Do not allow 251 or 252 if value outside [251.2, 251.4] seen
	Additional guidance		
	their (a) is 44 → [276.3, 276.5] or 276 or 277 Do not allow 276 or 277 if value outside [276.3, 276.5] seen		
	their (a) is 48 → [301.4, 301.632] or 301 or 302 Do not allow 301 or 302 if value outside [301.4, 301.632] seen		
	their (a) is 80 → [502.4, 502.72] or 502 or 503 Do not allow 502 or 503 if value outside [502.4, 502.72] seen		

Q	Answer	Mark	Comments
	Alternative method 1		
	$3x + 18 = 52$	M1	oe eg $x + x + x + 2 \times 9 = 52$
	$3x = 52 – 18$ or $3x = 34$	M1	Isolates term in x for their equation of the form $ax + b = \ldots\ldots$
3(a)	$11\dfrac{1}{3}$ or $11.3(3 \ldots)$	A1ft	oe ft from M1 M0 or M0 M1 Do not allow if their equation is of form $(1)x + b = \ldots\ldots$
	Sets up and solves a linear equation	Q1ft	ft their equation Allow one error in the solution of their equation Do not allow if their equation is of form $(1)x + b = \ldots\ldots$
	Alternative method 2		
	$52 – 18$ or 34	M1	
	their $34 \div 3$	M1	
	$11\dfrac{1}{3}$ or $11.3(3\ldots)$	A1ft	oe ft from M1 M0 or M0 M1
		Q0	

Q	Answer	Mark	Comments
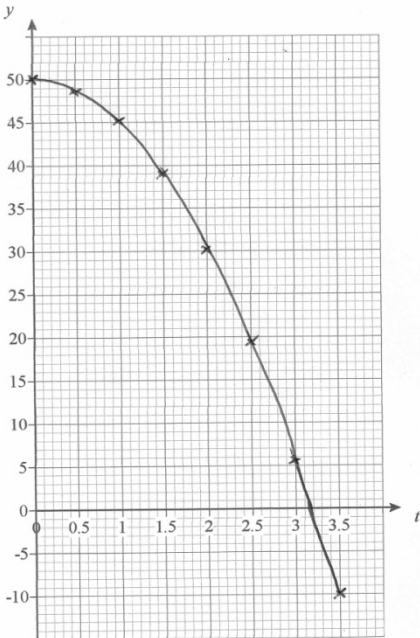
	Additional guidance				
3(a)	Examples				
	$3x + 18 = 52$ $3x = 70$ $x = 26.7$	M1 M0 A1ft Q1ft	$2x + 18 = 52$ $2x = 34$ $x = 17$	M0 M1 A1ft Q1ft	
	$3x + 18 = 52$ $3x = 34$ $x = 102$	M1 M1 A0ft Q1ft	$x + 18 = 52$ $x = 34$	M0 M1 A0ft Q0ft	
	$3x + 9 = 52$ $3x = 61$ $x = 20.33$	M0 M0 A0ft Q1ft	$52 + 18 = 70$ M0 $70 ÷ 3$ M1 26.7 A1ft Q0	M0 M1 A1ft Q0	

	Identifies height of trapezium or parallelogram as 8	B1	
3(b)	$\frac{1}{2}$ × (9 + 5) × their 8 or 56 or (9 + 5) × their 8 or 112 or $\frac{1}{2}$ × (23 + 19) × their 8 or 168	M1	
	224	A1	
	Additional guidance		

Q	Answer	Mark	Comments
	Alternative method 1		
	$\dfrac{75}{5000} \times 100$	M1	oe
	1.5(%)	A1	oe
	Machine Q makes lower proportion of damaged parts	Q1ft	oe Comparison using their 1.5 Must have gained M1
	Alternative method 2		
	0.02×5000	M1	oe
	100	A1	
	Machine Q makes lower proportion of damaged parts	Q1ft	oe Comparison using their 100 Must have gained M1
4	**Alternative method 3**		
	Compares for the same number of parts eg for 1000 0.02×1000 or 20 and $75 \div 5$ or 15	M1	oe
	Works out both calculations correctly eg for 1000 20 and 15	A1	
	Machine Q makes lower proportion of damaged parts	Q1ft	oe Comparison using their values Must have gained M1
	Additional guidance		

Q	Answer	Mark	Comments
5	18 (red) or 6 (blue)	B1	Necklace A
	35 ÷ (3 + 2) or 7	M1	Necklace B
	their 7 × 3 or 21 (red) or their 7 × 2 or 14 (blue) or 39 (red) or 20 (blue)	M1	
	19	A1ft	ft B0 M2
	Additional guidance		

Q	Answer	Mark	Comments
6(a)	$1 \rightarrow 45.1$	B1	
	$2 \rightarrow 30.4$	B1	

6(b)	Smooth decreasing curve passing through (0, 50), (0.5, 48.8), (1, their 45.1), (1.5, 39.0), (2, their 30.4), (2.5, 19.4), (3, 5.9), (3.5, -10.0) $\pm\dfrac{1}{2}$ square 	B2ft	ft decreasing curve only for B2 B1ft 4 points plotted, $\pm\dfrac{1}{2}$ square ft their points

Additional guidance			

6(c)	3.2	B1ft	ft their graph $\pm\dfrac{1}{2}$ square

Q	Answer	Mark	Comments
7(a)	(B) C E A D or (B) E A C D or (B) A E C D or (B) C A E D	B2	Mark diagram if answer line blank B1 Arrangement where first three tiles (including B) fit, eg (B) C D
	Additional guidance		
	Repeated tile can score B1 max		

Q	Answer	Mark	Comments
7(b)	angle *PAQ* = 55 or angle *QPB* = 136 or angle *BAQ* = 110 or angle *QPC* = 44	M1	
	angle *BAP* = 55 or angle *BPA* = 55	M1	This mark implies first M1
	angle *BPA* = 55 and angle *BAP* = 55 and Two equal angles	A1	oe statement
	Additional guidance		
	Angles may be seen on diagram for M marks		
	Must be a clear statement for A1		

Q	Answer	Mark	Comments
8(a)	**Alternative method 1**		
	11×30 or 330 or 5.5×30 or 165 or 12×30 or 360 or 6×30 or 180	M1	Allow $[10.8, 11.2] \times 30$ or $[324, 336]$ or $[5.3, 5.7] \times 30$ or $[324, 336]$ or $[11.8, 12.2] \times 30$ or $[354, 366]$ or $[5.8, 6.2] \times 30$ or $[174, 186]$
	$\pi \times$ their 165^2 or $[85\,486.5, 85\,541]$	M1	their 165 must be a radius eg $\pi \times 180^2$
	their $[85\,486.5, 85\,541] \times 40$ or $[3\,419\,460, 3\,421\,640]$	M1	Units must be compatible
	their $[3\,419\,460, 3\,421\,640] \div 1000$ $\div 1000$ or $[3.41946, 3.42164]$	M1	
	$[3.41946, 3.42164]$ and 3.42	A1	$[3.41946, 3.42164]$ must have > 3 sf
	Additional guidance		

Q	Answer	Mark	Comments
	Alternative method 2		
8(a)	11×30 or 330 or 5.5×30 or 165 or 12×30 or 360 or 6×30 or 180	M1	Allow $[10.8, 11.2] \times 30$ or [324, 336] or $[5.3, 5.7] \times 30$ or [324, 336] or $[11.8, 12.2] \times 30$ or [354, 366] or $[5.8, 6.2] \times 30$ or [174, 186]
	their $330 \div 100$ or 3.3(0) or their $165 \div 100$ or 1.65 or their $360 \div 100$ or 3.6(0) or their $180 \div 100$ or 1.8(0)	M1	
	$\pi \times$ their 1.65^2 or [8.54865, 8.5541]	M1	their 1.65 must be a radius
	their $[8.54865, 8.5541] \times 40 \div 100$ or [3.41946, 3.42164]	M1	Units must be compatible
	[3.41946, 3.42164] and 3.42	A1	[3.41946, 3.42164] must have > 3 sf
	Additional guidance		

Q	Answer	Mark	Comments
	Alternative method 3		
	$\pi \times 5.5^2$ or [94.98, 95.05]	M1	Allow $\pi \times [5.3, 5.7]^2$ or [88.2, 102.1]
	their [94.98, 95.05] $\times$ 40 or [3799.2, 3802]	M1	
8(a)	their [3799.2, 3802] $\times 30^2$ or [3 419 280, 3 421 800]	M1	
	their [3 419 280, 3 421 800] ÷ 1000 ÷ 1000 or [3.41928, 3.4218]	M1	
	[3.41928, 3.4218] and [3.4, 3.422]	A1	[3.41928, 3.4218] must have > 3sf
	Additional guidance		

Q	Answer		Mark	Comments
8(b)	3.42 × 1000 ÷ 750 or 4.56 or 4.6	750 × 4 or 3000 and 750 × 5 or 3750 and 3.42 × 1000 or 3420	M1	oe
	5		A1	
	Additional guidance			
	Answer 5 with no incorrect working			M1 A1

Q	Answer	Mark	Comments
9(a)	$8000 \times 1.25^0 = 8000$ or $1.25^0 = 1$	B1	oe
	Additional guidance		
	$8000 \times 1 = 8000$		B0

Q	Answer	Mark	Comments
9(b)	Correct curve passing through (0, 8000) (1, 10 000) (2, 12 500) (3, 15 625) (4, 19 531.25) All points $\pm \frac{1}{2}$ sq	B3	B2 Increasing graph passing through any 4 of (0, 8000) (1, 10 000) (2, 12 500) (3, 15 625) (4, 19 531.25) All points $\pm \frac{1}{2}$ sq B1 Any two of (0, 8000) (1, 10 000) (2, 12 500) (3, 15 625) (4, 19 513.25) Seen or plotted $\pm \frac{1}{2}$ sq
	Additional guidance		

Q	Answer	Mark	Comments
9(c)	14 400 seen or implied and 2014	B2ft	ft line on their increasing graph from 14 400 B1 Marking on graph at 14 400 or 14 400 seen or B1ft value of t given for V = 14 400 on their graph
	Additional guidance		
	2014 with no valid working		B0

Q	Answer	Mark	Comments
10(a)	**Alternative method 1**		
	756 ÷ 36 or 21	M1	
	their 21 × 48 ÷ 36 or 28 and their 28 × 48 or 1344	M1dep	Do not allow 1344 with no working or from 756 + 588
	1344 – 756 = 588	A1	Do not allow 1344 with no working or from 756 + 588
	Alternative method 2		
	36 ÷ 48 or 0.75 or 48 ÷ 36 or 1.33(3….)	M1	oe
	756 ÷ (their 0.75)^2 or 756 × their 1.33(3….)^2 or 1344	M1dep	oe Do not allow 1344 with no working or from 756 + 588
	1344 – 756 = 588	A1	Do not allow 1344 with no working or from 756 + 588
	Additional guidance		

Q	Answer	Mark	Comments
10(b)	588 × 4 or 2352	M1	
	their 2352 × 0.0105	M1	their 2352 may be 3024 or 5376
	[24.696, 24.7]	A1	Accept 25 if method seen SC2 [31.75, 31.8] or [56.4, 56.45]
	Additional guidance		

Q	Answer	Mark	Comments
11(a)	5 cm	B1	
	Additional guidance		

Q	Answer	Mark	Comments
11(b)	$\dfrac{17-12}{7-5}$	M1	oe
	2.5 or $2\frac{1}{2}$ or $\dfrac{5}{2}$	A1	oe
	cm/s or cm s^{-1}	B1ft	oe eg centimetres per second SC1 5 cm in 2 seconds
	Additional guidance		
	Allow other units if value also correct 0.025 m/s		M1 A1 B1

Q	Answer	Mark	Comments
12(a)	*AE* = *AD* radii (of circle centre *A*) and *AD* = *ED* radii (of circle centre *D*) and *AE* = *AD* = *ED*	B2	B1 *AE* = *AD* radii (of circle centre *A*) or *AD* = *ED* radii (of circle centre *D*)
	Additional guidance		

Q	Answer	Mark	Comments
12(b)	$\pi \times 1.8 \times 2$ or 3.6π or [11.3, 11.3112]	M1	
	$\dfrac{60}{360} \times$ their [11.3, 11.3112] or [1.88, 1.89]	M1	May multiply by 2 at this stage which leads to [3.76, 3.78]
	$2 \times$ their [1.88, 1.89] + 3×1.8	M1dep	dep on M1 M1 oe eg [3.76, 3.78] + 3×1.8
	[9.16, 9.1704] or 9.2	A1	
	Additional guidance		

Q	Answer	Mark	Comments
13(a)	Any correct attempt at an area during the first 40 seconds eg1 $\dfrac{1}{2}$ × 15 × 26 eg2 $\dfrac{1}{2}$ × 25 × 26 eg3 $\dfrac{1}{2}$ × 40 × 26	M1	May be seen on the diagram
	195 or 325 or (325 – 195 =) 130	A1	
	195 and 325 and Yes or 130 and Yes	A1	
	Additional guidance		

Q	Answer	Mark	Comments
13(b)	Draws tangent at 65 seconds	B1	
	$\dfrac{\text{difference in velocities}}{\text{difference in times}}$ for their tangent with at least one component correct	M1	
	[0.5, 0.9]	A1ft	Must have drawn a tangent ft B0 M1 with a tangent drawn and both components correct
	Additional guidance		

Q	Answer	Mark	Comments
	Alternative method 1		
	sin a = 5.4 ÷ 5.5	M1	
	a = sin^{-1} (5.4 ÷ 5.5)	M1dep	
	[79, 79.1]	A1	
	[79, 79.1] and No	Q1ft	ft decision for their angle with M2 scored SC2 [56, 56.2] and No SC1 [56, 56.2]
	Alternative method 2		
	sin a = 5.4 ÷ x	M1	74 $\leq a \leq$ 76
	x = 5.4 ÷ sin a	M1	
14	[5.56, 5.57] or [5.6, 5.62]	A1ft	ft their 74 $\leq a \leq$ 76 Use of a = 75 → [5.59, 5.6]
	[5.56, 5.57] and No or [5.6, 5.62] and [5.56, 5.57] and No	Q1	Use of a = 76 only or Use of a = 74 and 76 SC2 [56, 56.2] and No SC1 [56, 56.2]
	Additional guidance		
	An angle of 74 gives the longest possible length. As this is too long they need to then try 76 to see if the shortest length is OK As an angle of 76 gives the shortest possible length and this is too long, they don't need to go on to try 74		
	Candidates who work throughout with 76 can score 4 marks Candidates who use 75 can score a maximum of M2 A1 Q0		
	74 $\leq a \leq$ 76 means they can use any angle in this range for the first 3 marks.		

Q	Answer	Mark	Comments
15	$\dfrac{2}{3} \times \pi \times r^3$	B1	oe Must use correct formula Allow $\dfrac{4}{3} \times \pi \times r^3 \div 2$ oe
	$\dfrac{1}{3} \times \pi \times r^2 \times 25$	B1	oe Must use correct formula
	their $\dfrac{2}{3} \times \pi \times r^3 =$ their $\dfrac{1}{3} \times \pi \times r^2 \times 25$	M1	Must equate two volumes and have used $h = 25$ Do not allow if an incorrect value for r has been substituted eg Allow $\dfrac{4}{3} \times \pi \times r^3 = \pi \times r^2 \times 25$
	Simplification to $2r^3 = 25r^2$ or $r^3 = 12.5r^2$ or $r^3 =$ their $\dfrac{1}{3} \times \pi \times r^2 \times 25 \div$ their $\dfrac{2}{3} \times \pi$ or $r = 12.5$	M1	oe Must have an expression in r^3 and r^2
	37.5	A1	
	Additional guidance		
	For B marks condone substitution of a value for r		

Q	Answer	Mark	Comments
16	$BC^2 + 7.5^2 = 12.5^2$ or $12.5^2 - 7.5^2$	M1	oe
	$\sqrt{12.5^2 - 7.5^2}$ or 10	M1dep	
	$\tan(ACB =) \dfrac{8.3}{\text{their } BC}$	M1dep	
	[39.69, 39.7]	A1	Accept 40 with correct working SC2 [29.6, 29.7]
	Additional guidance		