AQA

GCSE

Mathematics

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

93702H

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Version V1 Final Mark Scheme

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	$210 \div 6 \times 4$ or $210 \div 3$ or 70 and 210 – their 70	M1	oe
	140	A1	
	Additional guidance		
	Using $\frac{2}{3}$ (or $\frac{4}{6}$) as a decimal		
	$210 \times 0.66 = 138.6$ or $210 \times 0.67 = 140.7$		M1 A0
	$210 \times 0.6666 = 139.986$ or $210 \times 0.6667 = 140.007$ with rounded answer 140		M1 A0
	210×0.6666 with answer 140		M1 A1
	$210 \times 0.6 = 126$		M0 A0
2(a)	$5x = 2x + 12$	B1	
2(b)	4	B2ft	B1ft $3x = 12$ oe ft their equation from (a) for B2 or B1
	Additional guidance		
	If $5x = 2x + 6$ or $2x = 5x - 6$ in part (a) → 2 scores B2 and $3x = 6$ oe scores B1		
	If $5x = x + 12$ in part (a) → 3 scores B2 and $4x = 12$ oe scores B1		
	If 0 marks are scored in (a) The correct solution for **any** equation in (a) can score up to B2		
	If 1 mark is scored in (a) The correct solution for **any** equation other than $5x = 2x + 12$ in (a) can score B1 max		
	Award B1ft for the correct rearrangement of the equation, separating x terms and numbers on opposite sides of the equation, eg $5x - x = 12$ from $5x = x + 12$		
	Answers only Answer 4 only **always** scores B2 Answer 2 only or answer 3 only scores B2 **only** if it is compatible with their answer to 2(a)		

Q	Answer		Mark	Comments
2(c)	**Alternative method 1**			
	54		B1ft	ft $9x + 18$ evaluated correctly for their value of x in (b) Only ft their value of x in (b)
	their 54 and 50 and Yes		Q1ft	Only ft their value of x in (b) Strand (iii) Correct evaluation of $9x + 18$ with correct ft decision made SC1 their 48 and 50 and correct decision
	Alternative method 2			
	54		B1ft	ft $9x + 18$ evaluated correctly for their value of x in (b) Only ft their value of x in (b)
	their 10.8 and Yes or their 54 ÷ 5 = 10 and Yes	their 5.4 and Yes or their 54 ÷ 10 = 5 and Yes	Q1ft	Only ft their value of x in (b) Strand (iii) Correct evaluation of $9x + 18$ and correct evaluation of their 54 ÷ 5 or their 54 ÷ 10 with correct ft decision made SC1 their 9.6 and correct decision or their 48 ÷ 5 = 9 and correct decision or their 4.8 and correct decision or their 48 ÷ 10 = 4 and correct decision
	Additional guidance			
	Alternative method 1 → must see 50 as well as their 54 and correct ft decision for Q1ft			
	Decision may be implied but 54 > 50 does **not** imply yes			
	If the numbers of apples in bags C and D are equal allow either $12x + 6$ or $6x + 30$ for $9x + 18$			
	their 48 is the correct evaluation of $9x + 12$ for their x from (b)			

Q	Answer		Mark	Comments
3	$0.5 \times (1.8 + 1.4) \times (0.)75$ or $0.5 \times (180 + 140) \times (0.)75$ or digits 12		M1	oe
	1.2	12 000	A1	
	m^2	cm^2	B1ft	oe
	Additional guidance			
	M1 Multiplication signs may be missing			
	1.2 m^2 or 12 000 cm^2 M1 A1 B1 even if subsequent incorrect attempt to convert units eg1 12 000 cm^2 (in working) → 120 m^2 (on answer line) M1 A1 B1 eg2 12 000 → 120 m^2 M1 A1 B0			

Q	Answer	Mark	Comments
4(a)	3×9 has a units digit of 7 or $3 \times 9 = 27$	B1	oe
	Additional guidance		
	Ignore further work if not contradictory Example		
	3 and 9 are both prime and $3 \times 9 = 27$		B1
	Allow equivalent answers Examples		
	$13 \times 19 = 247$		B1
	$27 \div 9 = 3$ or $247 \div 13 = 19$		B1

Q	Answer	Mark	Comments
4(b)	89 and 73	B2	B1 two prime numbers that multiply to give an integer with units digit 7 eg 1 83 and 79 eg 2 31 and 37 eg 3 17 × 11 = 187 eg 4 43 × 19 = 817 or divides 6497 by a prime number other than 2 or 5
	Additional guidance		
	The answer to a multiplication or division need not be shown		
	Award B1 for one correct in a list of responses		
	If 4(b) is blank, check 4(a) and award any available marks		
5(a)	[228, 232]	B1	

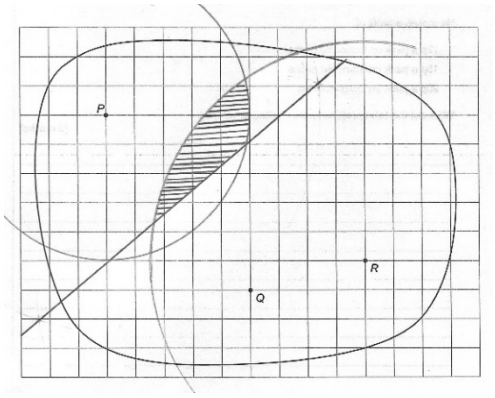
Q	Answer	Mark	Comments
5(b)	36 + 39 or 75	M1	
	their [9.8, 10.2] × 5 or [49, 51]	M1	
	[24, 26]	A1	SC1 16
	Additional guidance		
	2nd M1 their [9.8, 10.2] × 5 or [49, 51] can be *CD* → [5.8, 6.2] × 5 or [29, 31] *BC* or *AD* → [6.4, 6.8] × 5 or [32, 34] *AB* → [8.8, 9.2] × 5 or [44, 46] *BD* → [9.6, 10] × 5 or [48, 50] If a length is measured incorrectly and the incorrect length is stated and linked then their [9.8, 10.2] can be the given incorrect length The link could be on the diagram. Example		
	AC = 10.5 or *AC* drawn with 10.5 next to it on diagram 10.5 × 5 = 52.5 and 36 + 39 = 75 75 – 52.5 = 22.5		M1 M1 A0

Q	Answer	Mark	Comments
6(a)	A $\rightarrow$ 3 and B $\rightarrow$ 2 and C $\rightarrow$ 4 and D $\rightarrow$ 1	B2	B1 Any two or three correct
6(b)	(Graph) 3	B1	Allow A and 3
7(a)	Straight line joining (0, 40) and (100, 70) Allow $\pm\frac{1}{2}$ small square at (0, 40) and at (100, 70)	B2	B1 straight line with positive gradient passing through (0, 40) or straight line with positive gradient passing through (100, 70) or straight line with gradient 0.3 or coordinates of any two points on line identified on graph or in working
	Additional guidance		
	To check gradient use their end points of their line. Allow tolerance [0.28, 0.32]. B2 Line must span 0 cards to 100 cards		

Q	Answer	Mark	Comments
7(b)	**Alternative method 1**		
	56 or their [54, 56]	M1	ft their graph for [54, 56] from 50 cards Allow $\pm\frac{1}{2}$ small square
	[110, 112]	A1ft	ft 56 + their [54, 56] from 50 cards
	Alternative method 2		
	56 or 40 + 0.3 × 50 or 55	M1	oe eg 40 + 3 × 5
	111	A1	
	Additional guidance		
	Alternative method 1 their [54, 56] can be from a horizontal line, a line with negative gradient or a curve		

Q	Answer		Mark	Comments
7(c)	**Alternative method 1**			
	50 + 0.6 × 150 or 50 + 6 × 15 or 90	(130 – 50) ÷ 0.6	M1	oe eg 110 + 0.6 × 50 or 110 + 6 × 5 90 most likely from evaluating 0.6 × 150 oe
	(150 cards cost) (£)140 and No	(Only) 133 (.3 …) (cards) (can be bought for (£)130) and No	A1	
	Alternative method 2			
	110 + 80 – 50 (from 100 cards → (£)110 and 50 cards → (£)80)		M1	oe eg 2 × 95 – 50 (from 75 cards → (£)95) or 3 × 80 – 2 × 50 (from 50 cards → (£)80)
	(150 cards cost) (£)140 and No		A1	
	Alternative method 3			
	(100 (cards) → (£)110) 110 (cards) → (£)116 120 (cards) → (£)122 130 (cards) → (£)128 (140 (cards) → (£)134) (150 (cards) → (£)140)		M1	oe eg 130 (cards) → (£)128 implies all previous values
	(150 cards cost) (£)140 and No or (140 cards cost) (£)134 and No		A1	or 130 cards → (£)128 and No and £2 is not enough (to buy 20 more cards) oe or 130 cards → (£)128 and No and £2 can only buy 3 more cards oe
	Additional guidance			
	Decision (No) must be seen for A1			

Q	Answer	Mark	Comments
8	30 ÷ 24 or 6 ÷ 24 or 15 (min) or 0.25 or 60 ÷ 24 × 30	M1	oe
	1.25 (h) or 75 (min)	A1	oe
	1 h 15 min	B1ft	ft their time SC2 1 h 25 min
	Additional guidance		
	Do not award B1ft if their time is a whole number of hours if their time is in minutes < 60 min Examples		
	24 ÷ 30 = 0.8 = 80 min = 1 h 20 min		M0 A0 B1ft
	24 ÷ 30 = 0.8 = 1 h 20 min		M0 A0 B0
	24 ÷ 30 = 0.8 (0.8 × 60) = 48 min		M0 A0 B1ft

Q	Answer	Mark	Comments
9	Arc, radius [4.8, 5.2] cm, centre *P* or arc, radius [7.3, 7.7] cm, centre *R*	B1	
	Perpendicular bisector of *PQ*	B1	Must see construction arcs and be within tolerance
	Appropriate region shaded  	B1ft	Only ft if their two arcs enclose a region and their line passes through the region Their line cannot be *PQ*

Q	Answer	Mark	Comments
10	**Alternative method 1**		
	270 ÷ (5 + 3 + 2) or 270 ÷ 10 or 27	M1	oe
	5 × their 27 × (0.)12 or 1620 and 3 × their 27 × (0.)15 or 1215 and 2 × their 27 × (0.)20 or 1080 or 3915	M1	oe
	39.15	A1	
	Alternative method 2		
	5 × 12 + 3 × 15 + 2 × 20 or 60 + 45 + 40 or 145	M1	oe
	their 145 × 270 ÷ (5 + 3 + 2) or their 145 × 27 or 3915	M1	oe
	39.15	A1	
	Additional guidance		
	Accept working in pence or £ for M marks		

Q	Answer	Mark	Comments
11(a)	200 ÷ 37 or $\frac{x}{200} = \frac{1}{37}$	M1	oe
	5.4(05...)	A1	
	5.41	B1ft	
	Additional guidance		
	Further work makes the method incorrect		
	eg1 $\frac{1}{2} \times \frac{1}{37} \times 200$ M0		
	eg2 200 ÷ 37 = 5.405 followed by 5.405 × 200 M0 A0		
	Allow $\frac{1}{37}$ to be 0.027(0...) or 0.03 in working eg 0.03 × 200 M1		
	A1ft Their 5.405... must have at least 4 sf 0.027 × 200 = 5.4 M1 A1 B0		
	200 ÷ 37 = 5.41 M1 A1 (implied) B1		
	B1ft Rounding to 3sf must be required and you may have to check their calculation eg 200 ÷ 0.027 = 7410 M0 A0 B1ft (200 ÷ 0.027 = 7407.4……)		
	B1ft Be careful when following through when their number has end digits 9 eg1 199.99 to 3sf is 200 (do not accept 200.0) eg2 8.50267 to 3sf is 8.50 (do not accept 8.5)		

Q	Answer	Mark	Comments
11(b)	**Alternative method 1**		
	tan (a) = $\frac{\text{their } 5.41}{200}$ or sin (a) = $\frac{\text{their } 5.41}{\sqrt{\text{their } 5.41^2 + 200^2}}$ or cos (a) = $\frac{\text{their } 200}{\sqrt{\text{their } 5.41^2 + 200^2}}$	M1	oe eg1 sin (a) = $\frac{\text{their } 5.41}{\sqrt{\text{their } 5.41^2 + 200^2}} \times \sin 90$ eg2 cos (a) = $\frac{\text{their } 5.41^2 + 200^2 + 200^2 - \text{their } 5.41^2}{2 \times \sqrt{\text{their } 5.41^2 + 200^2} \times 200}$
	$\tan^{-1} \frac{\text{their } 5.41}{200}$ or $\sin \frac{\text{their } 5.41}{\sqrt{\text{their } 5.41^2 + 200^2}}$ or $\cos^{-1} \frac{\text{their } 200}{\sqrt{\text{their } 5.41^2 + 200^2}}$	M1dep	oe eg1 $\sin^{-1} \frac{\text{their } 5.41}{\sqrt{\text{their } 5.41^2 + 200^2}} \times \sin 90$ eg2 $\cos^{-1}$ $\frac{\text{their } 5.41^2 + 200^2 + 200^2 - \text{their } 5.41^2}{2 \times \sqrt{\text{their } 5.41^2 + 200^2} \times 200}$ M2 $90 - \tan^{-1} \frac{200}{\text{their } 5.41}$ oe
	[1.5, 1.55]	A1ft	ft their 5.41
	Additional guidance		
	M1 must have tan(a), sin(a) or cos(a) as the subject		
	A1ft Answers need to be rounded correctly to at least 2 sf		
	Scoring 2nd M1 implies M1 M1		
	Note that 90 – 'other' angle scores M2 for complete method (M1 not possible)		
	Allow inv tan or shift tan for $\tan^{-1}$ etc		
	$\sqrt{5.41^2 + 200^2} \rightarrow$ [200.07, 200.1]		

Q	Answer	Mark	Comments
11(b)	**Alternative method 2**		
	tan (a) = $\frac{1}{37}$ or sin (a) = $\frac{1}{\sqrt{1^2+37^2}}$ or cos (a) = $\frac{37}{\sqrt{1^2+37^2}}$	M1	oe eg1 sin (a) = $\frac{1}{\sqrt{1^2+37^2}} \times \sin 90$ eg2 cos (a) = $\frac{1^2+37^2+37^2-1^2}{2\times\sqrt{1^2+37^2}\times 37}$
	$\tan^{-1}\frac{1}{37}$ or $\sin^{-1}\frac{1}{\sqrt{1^2+37^2}}$ or $\cos^{-1}\frac{37}{\sqrt{1^2+37^2}}$	M1dep	oe eg1 $\sin^{-1}\frac{1}{\sqrt{1^2+37^2}} \times \sin 90$ eg2 $\cos^{-1}\frac{1^2+37^2+37^2-1^2}{2\times\sqrt{1^2+37^2}\times 37}$ M2 $90 - \tan^{-1} 37$ oe
	[1.5, 1.55]	A1	
	Additional guidance		
	M1 must have tan(a), sin(a) or cos(a) as the subject		
	M marks Allow $\frac{1}{37}$ = 0.027(0...) or 0.03		
	Scoring 2nd M1 implies M1 M1		
	Note that 90 – 'other' angle scores M2 for complete method (M1 not possible)		
	Allow inv tan or shift tan for $\tan^{-1}$ etc		
	$\sqrt{1^2+37^2} \rightarrow$ [37.01, 37.014]		
	Allow $\frac{1}{37}$ to be 0.027(0...) or 0.03 in working eg tan (a) = 0.02703 M1		

Q	Answer	Mark	Comments
12(a)	$7 \rightarrow 6$ $8 \rightarrow [5.26, 5.3]$ or $7 - \sqrt{3}$ $9 \rightarrow 5$ $10 \rightarrow [5.26, 5.3]$ or $7 - \sqrt{3}$ $11 \rightarrow 6$ $12 \rightarrow 7$	B2	B1 Any one correct value
12(b)	Plots their points and joins with smooth curve	B1ft	$\pm \frac{1}{2}$ small square
	Additional guidance		
	Allow curve from $t = 7$ to $t = 12$		
	If any of their values of d are > 11 award B0		
12(c)	5(.00) (am) and 9(.00) (am) or 0500 and 0900	B2	B1 5(.00) (am) or 9(.00) (am) or 0500 or 0900 or 5(.00) pm and 9(.00) pm or 1 and 5
	Additional guidance		
	All times must be in correct positions to score marks		
	Allow use of colons or decimal points		
	If their graph gives more than one time interval allow B2 or B1 for any one correct interval		
	5(.00) (am) and 9(.00) (am) in first answer space and 5(.00) (pm) and 9(.00) (pm) in second answer space scores B2		

Q	Answer	Mark	Comments
13	$\angle BCO = 90 - 15$ or 75 or $\angle BOC = 75$	M1	
	$\angle OBC = (180 - 2 \times$ their $75)$ or 30	M1dep	
	$\angle OBA = (90 -$ their $30)$ or 60	M1dep	dep on M1 M1
	$AB = BC$ and $AB = OB$	M1	oe eg1 $ABCD$ is a square so $AB = OB$ eg2 Single dash on diagram on AB and single dash not on OC
	$(180 - 60) \div 2$ $(= 60)$ and $\angle OAB = \angle AOB = \angle OBA$ $(= 60)$	A1	oe Calculation **and** statement Must score M4 Some equivalences to statement $\angle OAB = \angle AOB = \angle OBA$ $(= 60)$ are shown eg1 three equal angles $(= 60)$ eg2 all angles same $(= 60)$ eg3 $\angle OAB = \angle AOB = 60$
	Additional guidance		
	All M marks can be awarded from working on the diagram		
	A1 can only be awarded from working **and** statement in answer lines		
	If first mark not scored but $\angle OBC = 30$ and/or $\angle OBA = 60$ award M0 M0 M0		
	4th mark could be the only mark gained (eg if no angles attempted)		
	Ignore any reasons given		

Q	Answer	Mark	Comments
14	$\pi \times 2.5^2 \times 2$ or 12.5π or [39.2, 39.3]	M1	oe
	$3 \div 5$ or $\frac{3}{5}$ or 0.6 or $5 \div 3$ or $\frac{5}{3}$ or 1.66... or 1.67	M1	oe 1.2 implies 0.6 or 1.66...
	$\pi \times 1.5^2 \times$ their 0.6×2 or their [39.2, 39.3] $\times$ their 0.6^3 or $\pi \times 1.5^2 \div$ their $1.66... \times 2$ or their [39.2, 39.3] $\div$ their $1.66...^3$ or 2.7π or [8.4, 8.5]	M1	oe Must use their scale factor If multiplying, scale factor must be < 1 If dividing, scale factor must be > 1
	their volume $\times$ 2.6	M1	eg [39.2, 39.3] × 2.6 or [8.4, 8.5] × 2.6 or $(12.5\pi + 2.7\pi) \times 2.6$
	[123.7, 124.3] or $\frac{988}{25}\pi$	A1	oe
	Additional guidance		
	Use of diameter(s) instead of radii should be penalised once, the first time it occurs eg1 $\pi \times 5^2 \times 2$ M0 0.6 M1 $\pi \times 3^2 \times 0.6 \times 2$ M1 (may subsequently score M1 A0 or M0 A0) eg2 $\pi \times 2.5^2 \times 2$ M1 0.6 M1 $\pi \times 3^2 \times 0.6 \times 2$ M0 (may subsequently score M1 A0 or M0 A0)		
	(Additional guidance continues on next page)		

	Additional guidance
14	4th M1 their volume may be a single volume or from a sum of two volumes
	4th M1 their volume cannot be an area or a length and must include π Do not take their stated units eg cm^3 as indicating a volume eg $\pi \times 2.5 \times 2 = 5\pi$ cm^3 M0 $\pi \times 1.5 \times 1.2 = 1.8\pi$ cm^3 M1 M0 6.8π $cm^3 \times 2.6 = 17.68\pi$ M0 A0
	4^{th} M1 (volume + area) $\times$ 2.6 is acceptable

Q	Answer	Mark	Comments
15	(Monday) 35×200 or 7000 or $\frac{1}{2} \times (200 + 250) \times 25$ or 5625 or 60×200 or $12\,000$ or $\frac{1}{2} \times 25 \times 50$ or 625 or (Wednesday) 20×250 or 5000 or $\frac{1}{2} \times (250 + 150) \times 40$ or 8000 or $\frac{1}{2} \times 40 \times 100$ or 2000 or 40×150 or 6000	M1	oe Correct attempt at any one area section from either graph. May be seen on the graph Allow 1 small square = 10 or 5 by 5 square = 250 oe
	(Monday) $35 \times 200 + \frac{1}{2} \times (200 + 250) \times 25$ or $60 \times 200 + \frac{1}{2} \times 25 \times 50$ or (Wednesday) $20 \times 250 + \frac{1}{2} \times (250 + 150) \times 40$ or $20 \times 250 + \frac{1}{2} \times 40 \times 100 + 40 \times 150$	M1	oe Fully correct attempt for one graph
	(Monday) 12 625 or (Wednesday) 13 000	A1	oe eg 12.625 or 13
	12 625 and 13 000 and Wednesday	A1	oe eg 12.625 and 13 and Wednesday
	Additional guidance		
	Allow Wednesday to be any day other than Monday		

Q	Answer	Mark	Comments
16(a)	$\frac{45}{360}$ or division by 8	M1	oe
	their $\frac{45}{360}$ (×) π (×) 95 (×) 95	M1	oe
	[3542, 3545] or $\frac{9025}{8}\pi$	A1	oe
	Additional guidance		
	π (×) 95 (×) 95 = 9025π = [28 338.5, 28 357]		
	Allow working in centimetres $\frac{45}{360} \times \pi \times 9.5 \times 9.5$ M1 M1 Allow [35.42, 35.45] cm^2 for A1 if cm^2 stated		

Q	Answer	Mark	Comments
16(b)	95 (×) cos 45 = 67.17… or 67.18 or 95 (×) sin 45 = 67.17… or 67.18 or $\sqrt{\frac{95^2}{2}}$ = 67.17… or 67.18 or 95 ÷ 2 cos 45 = 67.17… or 67.18	B2	oe B1 cos 45 = $\frac{OC}{95}$ or 95 (×) cos 45 or sin 45 = $\frac{OC}{95}$ or 95 (×) sin 45 or $\frac{OC}{\sin 45} = \frac{95}{\sin 90}$ oe or $\frac{95^2}{2}$ or 95 ÷ 2 cos 45 or 2 (×) *OC* (×) 95 (×) cos 45 = 95^2 or 67.17… or 67.18 or $\sqrt{95^2 - 67.2^2}$ = 67.15… or $\sqrt{67.2^2 + 67.2^2}$ = 95.03… or 95.04
	Additional guidance		
	B1 Allow any letter for *OC*		
	$\sqrt{95^2 - 67.2^2}$ = 67.2 is B0 unless 67.15… also seen		
	$\sqrt{67.2^2 + 67.2^2}$ = 95 is B0 unless 95.03… or 95.04 also seen		
	If B1 for 67.17… or 67.18 is scored, look back to (a) and award B2 if a B2 response is seen there		
	Ignore further work after B2 response eg using Pythagoras to check the answer		

Q	Answer	Mark	Comments
16(c)	$\frac{1}{2}$ (×) [67.1, 67.2] (×) [67.1, 67.2] or $\frac{1}{2}$ (×) [67.1, 67.2] (×) 95 (×) sin 45 or [2251, 2258]	M1	
	(their [3542, 3545] – their [2251, 2258]) × 2.5	M1	(their (a) – their triangle area) × 2.5
	[3210, 3235]	A1ft	Only ft their (a)
	Additional guidance		
	1st M1 Allow dimensions to be different in $\frac{1}{2}$ base × height as long as both are [67.1, 67.2] eg $\frac{1}{2}$ (×) 67.1 (×) 67.2 M1		
	2nd M1 Subtraction must be in the order shown		
	A1ft Allow answer rounded to at least 3sf		

Q	Answer	Mark	Comments
17	$28^2 - (\frac{24}{2})^2$ or $784 - 144$ or 640 or $28^2 = OX^2 + (\frac{24}{2})^2$ or $784 = OX^2 + 144$	M1	oe Allow any letter for *OX*
	$\sqrt{28^2 - (\frac{24}{2})^2}$ or $\sqrt{784-144}$	M1dep	M2 $28 \sin(\cos^{-1}\frac{12}{28})$ or $12 \tan(\cos^{-1}\frac{12}{28})$ or $28 \cos(\sin^{-1}\frac{12}{28})$ or $12 \div \tan(\sin^{-1}\frac{12}{28})$
	[25.298, 25.3] or $\sqrt{640}$ or $8\sqrt{10}$	A1	oe SC1 14.4(2...) or $\sqrt{208}$ or $4\sqrt{13}$ oe
	Additional guidance		
	$\sqrt{640}$ or $8\sqrt{10}$ scores M1 M1 A1 even if subsequent attempt to evaluate seen on answer line		
	M2 (M1 not possible) Allow $\cos^{-1}\frac{12}{28}$ to be 64.6… and $\sin^{-1}\frac{12}{28}$ to be [25.37, 25.4] Other angles, eg 64, must have some correct method shown eg1 28 sin 64.6 M2 eg2 $\cos x = \frac{12}{28}$ $x = 64$ 28 sin 64 M2 eg3 28 sin 64 M0		
18(a)	$120x^2$	B1	
18(b)	$40x^3$	B1	

Q	Answer	Mark	Comments
18(c)	**Alternative method 1**		
	their (b) ÷ their (a) linked with 0.5	M1	oe Division in this order only
	1.5	A1ft	ft their (b) and their (a) Allow $x \leq 1.5$
	Alternative method 2		
	120 ÷ 40 × 0.5	M1	oe
	1.5	A1	Allow $x \leq 1.5$
	Alternative method 3		
	60 ÷ 40	M1	oe
	1.5	A1	Allow $x \leq 1.5$
	Additional guidance		
	Alt 1 A1ft answers to at least 2 sf		
	Alt 1 M1 Link may use = or an inequality symbol		
	Alt 1 their (a) is $120x^2$ and their (b) is $24x^3$ $24x^3 \div 120x^2 = 0.5$ M1 $0.5 \times 5 = 2.5$ A1ft		
	Alt 1 their (a) is $120x$ and their (b) is $40x^3$ $\frac{40x^3}{120x} < 0.5$ M1 $x^2 < 1.5$ $x = 1.2$ A1ft		
	Alt 1 If degree of their (a) ≥ degree of their (b) can score a maximum of M1 A0		
	Alt 1 T & I scores 2 or 0		
	Alt 2 oe for M1 $\frac{40}{120} = \frac{1}{3}$ and 0.5×3		
	Alt 3 60 ÷ 120 may also be seen but does not score unless 60 ÷ 40 also seen		

Q	Answer	Mark	Comments
19	**Alternative method 1**		
	Draws tangent at 9.20	M1	
	Attempt at vertical ÷ horizontal for their tangent	M1	At least one component must be correct $\pm\frac{1}{2}$ small square
	[1.6, 2.4] or [96, 144]	A1	Ignore any units seen
	their [1.6, 2.4] × 60 ÷ [1.6, 1.61] or their [1.6, 2.4] × 60 × [0.62, 0.63] or their [96, 144] ÷ [1.6, 1.61] or their [96, 144] × [0.62, 0.63]	M1	Correct method to convert their speed from km/min or km/h to miles per h oe
	[59.5, 91] and correct decision	Q1ft	Strand (iii) ft if tangent drawn and 2nd and 3rd M marks gained
	Additional guidance		
	2nd M1 If only one component is correct a triangle must be seen A correct component is a correct value or a correct $y_2 - y_1$ or a correct $x_2 - x_1$		
	2nd M1 Can be implied by the 1st M1 and a correct answer for A1		
	No tangent attempted can score a maximum of M0 M0 A0 M1 Q0		

Q	Answer	Mark	Comments
19	**Alternative method 2**		
	Draws tangent at 9.20	M1	
	Attempt at vertical ÷ horizontal for their tangent	M1	At least one component must be correct $\pm \frac{1}{2}$ small square
	[1.6, 2.4] or [96, 144]	A1	Ignore any units seen
	70 × [1.6, 1.61] ÷ 60 or 70 ÷ [0.62, 0.63] ÷ 60 or [1.8, 1.9] or 70 × [1.6, 1.61] or 70 ÷ [0.62, 0.63] or [111, 113]	M1	Correct method to convert 70 miles per h to km/min or km/h oe
	their [1.6, 2.4] and [1.8, 1.9] and correct decision or their [96, 144] and [111, 113] and correct decision	Q1ft	Strand (iii) ft if tangent drawn and 2nd and 3rd M marks gained
	Additional guidance		
	2nd M1 If only one component is correct a triangle must be seen A correct component is a correct value or a correct $y_2 - y_1$ or a correct $x_2 - x_1$		
	2nd M1 Can be implied by the 1st M1 and a correct answer for A1		
	No tangent attempted can score a maximum of M0 M0 A0 M1 Q0		
	Q1ft Must be comparing like for like eg two speeds both in km/h		

Q	Answer	Mark	Comments
19	**Alternative method 3**		
	Draws tangent at 9.20	M1	
	their vertical ÷ [1.6, 1.61] or their vertical × [0.62, 0.63]	M1	Correct method to convert their vertical (distance in km) to miles oe
	Attempt at vertical ÷ horizontal for their tangent	M1	At least one component must be correct $\pm\frac{1}{2}$ small square
	[59.5, 91]	A1	Ignore any units seen
	their [59.5, 91] and correct decision	Q1ft	Strand (iii) ft if tangent drawn and 2nd and 3rd M marks gained
	Additional guidance		
	3rd M1 If only one component is correct a triangle must be seen A correct component is a correct value or a correct $y_2 - y_1$ or a correct $x_2 - x_1$		
	3rd M1 Can be implied by the 1st M1 and a correct answer for A1		
	No tangent attempted can score a maximum of M0 M1 M0 A0 Q0		