AQA

GCSE
Mathematics

43652H Paper 2
Mark scheme

43652H
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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.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

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 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. e.g. accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values a ≤ value < b
3.14 …	Accept answers which begin 3.14 e.g. 3.14, 3.142, 3.1416
Q	Marks awarded for quality of written communication
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.
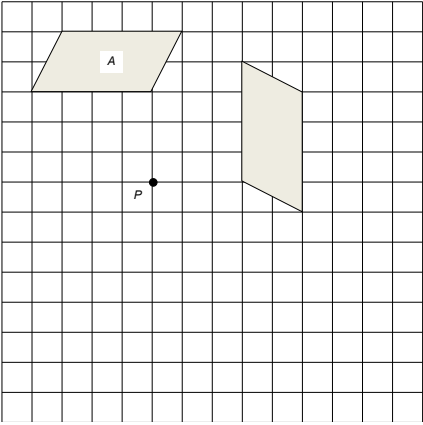
Premature approximation

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

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the candidate intended it to be a decimal point.

Paper 2 Higher Tier

Q	Answer	Mark	Comments
1		B3	B2 for rotation of parallelogram 90° anticlockwise about *P* or correct four vertices plotted but not joined B1 for any rotation of parallelogram 90° or correct four vertices plotted but not joined for rotation of parallelogram 90° anticlockwise about *P*
	Additional Guidance		

Q	Answer	Mark	Comments
2(a)	60 – 24 – 9 or 27	M1	oe
	100 – 42 or 42 + 58 (= 100) or 58 or (100 – 42) ÷ 2 or 29	M1	oe
	29 – 9 or 20 or 29 – 27 or 2	M1dep	dep on 2nd M1 dep on both M marks
	Fully correct table 24 9 **27** 60 18 **20** **2** 40 42 **29** **29** 100	A1	
	Additional Guidance		
	Allow use of a letter in the table with the letter worked out in the working		
	If there are two tables mark their best attempt		
	58 can be implied by total part time and total not working		

	Alternative method 1		
	$\dfrac{24}{60}$ or $24 \div 60$ or 0.4 or $\dfrac{18}{40}$ or $18 \div 40$ or 0.45	M1	oe eg $40(\%)$ or $45(\%)$ $\dfrac{2}{5}$ or $\dfrac{9}{20}$
	$40(\%)$ and $45(\%)$ or 0.4 and 0.45 or $\dfrac{8}{20}$ and $\dfrac{9}{20}$	A1	oe format so comparison can be made eg $\dfrac{4}{10}$ and $\dfrac{4.5}{10}$
	$40(\%)$ and $45(\%)$ and women or 0.4 and 0.45 and women or $\dfrac{8}{20}$ and $\dfrac{9}{20}$ and women	Q1	oe Strand (iii) Correct conclusion with all working correct
2(b)	**Alternative method 2**		
	$60 \div 24$ or 2.5 or $40 \div 18$ or $2.2\ldots$	M1	oe 27 out of 60 (women) or 16 out of 40 (men) or 9 out of 20 (women) or 8 out of 20 (men)
	2.5 and $2.2\ldots$	A1	oe 24 and 27 or 16 and 18 or 8 and 9
	2.5 and $2.2\ldots$ and women	Q1	24 and 27 and women or 16 and 18 and women or 8 and 9 and women Strand (iii) Correct conclusion with all working correct
	Additional Guidance		
	Allow common numerators for comparison		
	Beware of 40 as there are 40 women (40% are women)		

Q	Answer	Mark	Comments
3	**Alternative method 1**		
	180 – 152 or 28 or (360 – 152 × 2) ÷ 2	M1	152 – 90 or 62
	their 28 × 2 or (360 – 152 × 2) (÷ 2 × 2)	M1dep	180 – 2 × their 62 or (180 – 90 – their 62) × 2
	56	A1	
	Alternative method 2		
	720 (used for the hexagon)	M1	540 used for a pentagon
	(720 – 4 × 152) ÷ 2 or 112 ÷ 2	M1dep	540 – 152 – 152 – 90 – 90
	56	A1	
	Additional Guidance		
	Angles may be on the diagram but must be in the correct place		
	28 must be for a correct angle If diagram or working shows that 28 is for an incorrect angle then the method is incorrect, eg y = 28 (on diagram in the wrong place) Answer 28 degrees		M0 M0

Q	Answer	Mark	Comments
4(a)	250 ÷ 5 × 4 or 200 or 250 ÷ 5 or 50	M1	oe
	200 and 50	A1	
	Additional Guidance		
	Sand 50 and Cement 200		M1A0
	250 ÷ 5 = 50, 250 ÷ 4 = 62.5, Sand 62.5, Cement 50		M1A0
	Allow transcription error if clear in the working		

Q	Answer	Mark	Comments
	Alternative method 1		
	25 × 3 or 75 or 25 × 4 or 100 or 25 × 5 or 125	M1	Total cement Sand Mix
	25 × 3 × 4 or 300 or 75 × 4 or 300 or 25 × 4 × 3 or 100 × 3 or 300 or 75 × 5 or 25 × 5 × 3 or 125 × 3	M1dep	Total sand Total mix
	375	A1	
	Alternative method 2 (uses part (a))		
4(b)	25 + 50 or 75 or 200 ÷ 2 or 100 or (200 + 50) ÷ 2 or 125	M1	Total cement Sand Mix
	100 + 200 or 300 or 25 + 50 + 100 + 200 or 125 + 250	M1dep	Total sand Total mix Total mix
	375	A1	
	Alternative method 3 (uses part (a))		
	Scale factor 1.5 seen or implied, eg $\frac{75}{50}$ or 50 × 1.5 or 75	M1	
	200 × 1.5 or 300 or 250 × 1.5	M1dep	Total sand Total mix
	375	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
5(a)	–1 –5 –4	B2	B1 for one or two correct in the correct place
	Additional Guidance		

Q	Answer	Mark	Comments
5(b)	6 or 7 of their points plotted correctly	M1	tolerance ± ½ square
	Fully correct smooth curve	A1	tolerance ± ½ square
	Additional Guidance		
	Curve must be U-shaped and must **not** curve back in or have vertical lines		

Q	Answer	Mark	Comments
5(c)	[2.2, 2.3] and [–2.3, –2.2] or their two values read off from the graph	B1	tolerance ± ½ square
	Additional Guidance		
	Do not accept coordinates		

Q	Answer	Mark	Comments
6(a)	$\dfrac{15}{100} \times 20$ or 3 or $\dfrac{12}{100} \times 10$ or 1.2 or $\dfrac{10}{100} \times 10$ or 1	M1	oe 20 × 15 + 10 × 12 or 420
	3 + 1.2 or 4.2 or 3 + 1	M1dep	oe their 420 ÷ 100
	4	Q1	Strand (i) Rounding down
	Additional Guidance		

Q	Answer	Mark	Comments
6(b)	$(85 + 88) \div 2$ or 86.5 or $(0.85 + 0.88) \div 2$	M1	oe
	0.865 or $\dfrac{173}{200}$ or 86.5%	A1	oe Allow 0.87 or $\dfrac{87}{100}$ or 87% if correct method shown
	Additional Guidance		
	Beware of $\dfrac{26}{30}$ leading to 86.6(…)%		M0A0
	0.87 on its own		M0A0

Q	Answer	Mark	Comments
7(a)	$\pi \times 6^2$ or $\pi \times 36$	M1	oe
	$[113, 113.2]$ or 36π	A1	
	Additional Guidance		
	$\pi36$		M1A0

Q	Answer	Mark	Comments
7(b)	20×50 or 1000	M1	oe
	their 1000 – their $[113, 113.2]$	M1dep	oe
	$[886.8, 887]$ or $1000 - 36\pi$	A1ft	ft their part (a)
	Additional Guidance		
	Do not ignore incorrect further working for the A mark, eg $1000 - 36\pi = 964\pi$		M1M1A0

Q	Answer	Mark	Comments
8 **Alt 1 of 3** **Alt 2 of 3**	**Alternative method 1**		
	53 – 46 or 7 or 53 million – 46 million or 7 million	M1	oe
	$\dfrac{7}{46}$ (× 100) or 0.152(…)	M1dep	oe Accept 0.15 if correct method shown
	15.2(…) (%)	A1	Accept 15(%) if correct method shown
	Alternative method 2		
	$\dfrac{53}{46}$ (× 100) or 1.152… or 115.2(…)	M1	oe Accept 1.15 if correct method shown Accept 115 if correct method shown Accept 0.15 if correct method shown
	1.152… – 1 or 0.152(…) or 115.2(…) – 100	M1dep	
	15.2(…) (%)	A1	Accept 15(%) if correct method shown

Q	Answer	Mark	Comments
	Alternative method 3		
8 cont **Alt 3 of 3**	Any correctly evaluated percentage of 46 (million)	M1	eg 1(%) is 0.46 (million) 5(%) is 2.3 (million) 10(%) is 4.6 (million)
	15(%) (increase) is 52.9 (million) or 15.1(%) (increase) is 52.946 (million) or 15.2(%) (increase) is 52.992 (million) or 15.3(%) (increase) is 53.038 (million) or 15.4(%) (increase) is 53.084 (million) or 15.5(%) (increase) is 53.13 (million)	M1dep	oe 15(%) is 6.9 (million) or 15.1(%) is 6.946 (million) or 15.2(%) is 6.992 (million) or 15.3(%) is 7.038 (million) or 15.4(%) is 7.084 (million) or 15.5(%) is 7.13 (million) and 7 (million)
	15.2(…) (%)	A1	Accept 15(%) with two of the trials listed above (or better), one with an answer below 53 million (or 7 million), the other with an answer above 53 million (or 7 million)
	Additional Guidance		
	Incorrect number of zeros used for millions cannot score A mark		
	15(%) scores at least 2 unless clearly from incorrect working		

Q	Answer	Mark	Comments
9	$8 \times 2x$ or $16x$ or $\frac{1}{2} \times 6 \times (4x + 2)$ or $3(4x + 2)$ or $6(2x + 1)$ or $12x + 6$	B1	oe
	$8 \times 2x = \frac{1}{2} \times 6 \times (4x + 2)$ or $8 \times 2x = 3(4x + 2)$ or $8 \times 2x = 6(2x + 1)$	M1	oe Sets up a correct equation
	$16x = 12x + 6$	M1dep	oe Simplified and bracket expanded
	1.5 or $1\frac{1}{2}$ or $\frac{3}{2}$	A1	

Additional Guidance		
$x = \frac{6}{4}$		B1M1M1A0
Trial and improvement is 0 or 4		

Q	Answer	Mark	Comments
10	31^2 and 8^2 seen or 961 and 64 or 897	M1	oe $\sin^{-1}\left(\dfrac{8}{31}\right) = 14.(9\ldots)$ or 15 and $\tan(14.(9\ldots)) = \dfrac{8}{h}$ or $\sin^{-1}\left(\dfrac{8}{31}\right) = 14.(9\ldots)$ or 15 and $\cos(14.(9\ldots)) = \dfrac{h}{31}$ or $\cos^{-1}\left(\dfrac{8}{31}\right) = 75.(0\ldots)$ or 75 and $\tan(75.(0\ldots)) = \dfrac{h}{8}$ or $\cos^{-1}\left(\dfrac{8}{31}\right) = 75.(0\ldots)$ or 75 and $\sin(75.(0\ldots)) = \dfrac{h}{31}$
	$\sqrt{31^2 - 8^2}$ or $\sqrt{961 - 64}$ or $\sqrt{897}$	M1dep	oe $\dfrac{8}{\tan(14.(9\ldots))}$ or $31\cos(14.(9\ldots))$ or $8\tan(75.(0\ldots))$ or $31\sin(75.(0\ldots))$
	29.9… or 30	A1	
	[5, 5.1]	B1ft	ft their 30 if first M1 scored
	Additional Guidance		
	Note using $31^2 + 8^2$ gives $\sqrt{1025}$ or 32 leading to answer 3		M1M0A0B1

Q	Answer	Mark	Comments
11(a)	0.3 or $\frac{3}{10}$ and 0.7 or $\frac{7}{10}$	B1	1st pair of branches fully correct
	0.8 or $\frac{8}{10}$ or $\frac{4}{5}$ and 0.2 or $\frac{2}{10}$ or $\frac{1}{5}$	B2	2nd and 3rd pairs of branches fully correct B1 for 2nd or 3rd pairs of branches fully correct
	Additional Guidance		

Q	Answer	Mark	Comments
11(b)	0.3×0.2 or $\frac{3}{10} \times \frac{2}{10}$ or $\frac{3}{10} \times \frac{1}{5}$ or 3×2 or 6 and 10×10 or 100	M1	oe May be seen in part (a) but must be chosen
	0.06 or $\frac{6}{100}$ or $\frac{3}{50}$ or 6%	A1ft	ft their diagram May be seen in part (a) but must be chosen
	Additional Guidance		

Q	Answer	Mark	Comments	
12(a)	Draws a right-angled triangle to work out gradient using grid lines or $\dfrac{8\ -\ 2}{2\ (-\ 0)}$ or $c = 2$ seen or implied or $2m = 6$	M1	oe	
	Gradient = 3 seen or implied or $m = 3$	M1dep		
	$y =\ 3x + 2$	A1	oe	
	Additional Guidance			
	$3x + 2$			M1M1A0
	$y = 3x - 2$			M1M1A0
	$y = ax + 2$ where $a\ \neq 3$			M1

Q	Answer	Mark	Comments
12(b)	Two correct points plotted or calculated	M1	
	Fully correct straight ruled line	A1	Mark intention
	Additional Guidance		
	For the A mark the line must extend from (0, 9) to (9, 0)		

Q	Answer	Mark	Comments
12(c)	Indication of point of intersection of their lines or $9 - x = \frac{1}{2}x$ or $x + \frac{1}{2}x = 9$ or $y = \frac{1}{2}(9 - y)$	M1	oe Eliminates a variable
	$x = 6$ and $y = 3$ or $(6, 3)$	A1ft	ft their graph
	Additional Guidance		

Q	Answer	Mark	Comments
13(a)	$30x^3y^7$	B2	B1 for two correct terms
	Additional Guidance		
	Do not ignore fw for B2		
	$30 \times x^3 \times y^7$		B1
	$30 \times x^3y^7$		B1
	x^3y^730		B1
	$7x^3 \times 4y^7$		B1
	Do not allow addition sign, eg $10x^3 + 3y^7$		B0

Q	Answer	Mark	Comments
13(b)	$x^2 - 3x + 7x - 21$	M1	Allow one error
	$x^2 + 4x - 21$	A1	

	Additional Guidance	
Do not ignore fw unless attempting to solve the equation		
$x^2 - 3x - 21$ or $x^2 + 7x - 21$ (one error)		M1A0
$x^2 - 21$ (two errors)		M0A0
$x^2 - 4x - 21$ with no other working (two errors)		M0A0

Q	Answer	Mark	Comments
13(c)	8 and –2 or x = 8 and x = –2	B1	Any order

	Additional Guidance	

Q	Answer	Mark	Comments
13(d)	$2xy(4x + 3y)$	B2	B1 for a correct partial factorisation ie $x(8xy + 6y^2)$ $y(8x^2 + 6xy)$ $2(4x^2y + 3xy^2)$ $2x(4xy + 3y^2)$ $2y(4x^2 + 3xy)$ $xy(8x + 6y)$

	Additional Guidance	

Q	Answer	Mark	Comments
14	**Alternative method 1**		
	90 is 75%	M1	oe
	90 ÷ 75 × 100	M1dep	oe
	120	A1	
	$\frac{1}{3}$ × 120 or 40	M1	
	120 – 40 = 80 or 120 ÷ 3 × 2 = 80	A1	
	Alternative method 2		
	80 is two-thirds or 80 is 66.6(…)(%)	M1	oe
	80 ÷ 2 × 3	M1dep	oe
	120	A1	
	$\frac{25}{100}$ × 120 or 30 or 75% or $\frac{75}{100}$	M1	oe
	120 – 30 or 90 or $\frac{75}{100}$ × 120 and 90 – 10 = 80	A1	
	Additional Guidance		

Q	Answer	Mark	Comments	
15(a)	10 × 4 or 40 or 5 × 2.8 or 14 or 30 × 1 or 30	M1		
	40 + 14 + 30	M1dep	Allow one error	
	84	A1		
	Additional Guidance			
	Beware of 30 from an incorrect method, eg 10 ÷ 4 = 2.5, 5 ÷ 2.8 = 1.78(…), 30 ÷ 1 = 30, 30 from wrong working or 6 × 5 = 30 (first bar)			M0 M0

Q	Answer	Mark	Comments
15(b)	15 < t ≤ 25	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
16	$\frac{1}{3}$ and $\frac{5}{7}$	B2	B1 for 2 correct and 1 incorrect or for 1 correct and 1 incorrect or for 1 correct
	Additional Guidance		

Q	Answer	Mark	Comments
17(a)	$S - 2\pi r^2 = 2\pi rh$ or $S = 2\pi r (h + r)$ or $\dfrac{S}{2\pi r} = h + \dfrac{2\pi r^2}{2\pi r}$ or $\dfrac{S}{2\pi r} = h + r$	M1	oe
	$h = \dfrac{S - 2\pi r^2}{2\pi r}$ or $h = \dfrac{S}{2\pi r} - r$	A1	oe

Additional Guidance		
$\dfrac{S - 2\pi r^2}{2\pi r}$ or $\dfrac{S}{2\pi r} - r$ implies M1		M1A0
$\dfrac{S - 2\pi r^2}{2} = \pi rh$		M1
$S = 2\pi (rh + r^2)$ (not enough)		M0

Q	Answer	Mark	Comments
17(b)	**Alternative method 1** (uses part (a))		
	$(h =) \dfrac{95\pi - 2\pi r^2}{2\pi r}$ or $(h =) \dfrac{S - 2\pi \times 5.3 \times 5.3}{2\pi \times 5.3}$	M1	oe Correctly substitutes at least one value into their equation
	$(h =) \dfrac{95\pi - 2\pi \times 5.3 \times 5.3}{2\pi \times 5.3}$	M1dep	oe Any unsimplified version of the answer
	3.66…	A1	
	3.7	B1ft	Accept 4 if working shown ft their value rounded to 1 sf or 2 sf
	Alternative method 2 (uses the original equation)		
	$95\pi = 2\pi h \times 5.3 + 2\pi \times 5.3 \times 5.3$	M1	oe Correctly substitutes both values into the original equation
	$(h =) \dfrac{95\pi - 2\pi \times 5.3 \times 5.3}{2\pi \times 5.3}$	M1dep	oe Any unsimplified version of the answer
	3.66…	A1	
	3.7	B1ft	Accept 4 if working shown ft their value rounded to 1 sf or 2 sf
	Additional Guidance		
	It a student is following through from an incorrect part (a) they can score the first M1 and the B1ft only		M1M0A0B1ft
	Some useful values 5.3 × 5.3 = 28.09 2π × 5.3 × 5.3 = 176.49… 95π = 298.45… 95π − 2π × 5.3 × 5.3 = 121.95… 2π × 5.3 = 33.30…		

Q	Answer	Mark	Comments
18(a)	$y \, \alpha \, \dfrac{1}{x^2}$ or $y = \dfrac{k}{x^2}$	M1	oe
	$20 = \dfrac{k}{2^2}$ or $(k =) 2^2 \times 20$ or $(k =)\ 80$ or $\left(\dfrac{1}{k} = \right) \dfrac{1}{80}$	M1dep	oe
	$y = \dfrac{80}{x^2}$	A1	oe

	Additional Guidance		
	$y \, \alpha \, \dfrac{k}{x^2}$		M1

Q	Answer	Mark	Comments
18(b)	$5 = \dfrac{80}{x^2}$ or $x^2 = 16$	M1	oe ft their equation from part (a)
	4	A1	Condone 4 and –4

	Additional Guidance		

Q	Answer	Mark	Comments
19(a)	$\dfrac{x}{\sin 19} = \dfrac{8}{\sin 123}$	M1	oe $\dfrac{x}{0.325...} = \dfrac{8}{0.838...}$
	$\dfrac{8 \sin 19}{\sin 123}$	M1dep	$\dfrac{8 \times 0.325...}{0.838...}$
	3.1…	A1	Accept 3 with working shown

	Additional Guidance		
	For the method marks accept rounded or truncated values		

Q	Answer	Mark	Comments
19(b)	sin 123° = sin 57° and cos 123° = –cos 57°	B2	B1 for 2 correct and 1 incorrect or for 1 correct and 1 incorrect or for 1 correct and 0 incorrect

Q	Answer	Mark	Comments
19(c)	3.1…	B1ft	ft their answer to part (a)
	Additional Guidance		

Q	Answer	Mark	Comments

Alternative Method 1

	Tube A			Tube B	

Q	Radius	Diameter	Mark	Radius	Diameter
20 **Alt 1 of 2**	$20 = 2\pi r$ or $(r =) 20 \div 2\pi$ or $(r =) \dfrac{10}{\pi}$ or $(r =) [3.18, 3.2]$	or $20 = \pi d$ or $d = \dfrac{20}{\pi}$ or $d = [6.36, 6.4]$	M1	or $10 = 2\pi r$ or $(r =) 10 \div 2\pi$ or $(r =) \dfrac{5}{\pi}$ or $(r =) [1.59, 1.6]$	or $10 = \pi d$ or $d = \dfrac{10}{\pi}$ or $d = [3.18, 3.2]$
	their $\left(\dfrac{10}{\pi}\right)^2 \times \pi \times 10$ or $[317, 322]$ or $\dfrac{1000}{\pi}$		M1dep	oe or their $\left(\dfrac{5}{\pi}\right)^2 \times \pi \times 20$ or $[158, 161]$ or $\dfrac{500}{\pi}$	
	$[317, 322]$ or $\dfrac{1000}{\pi}$ and $[158, 161]$ or $\dfrac{500}{\pi}$		A1		
	Tube A and $[317, 322]$ and $[158, 161]$ or Tube A and $\dfrac{1000}{\pi}$ and $\dfrac{500}{\pi}$		Q1ft	oe Strand (ii) ft conclusion from their volumes provided M1M1 awarded	

Q	Answer	Mark	Comments
20 **Alt 2 of 2**	**Alternative Method 2**		
	radius$_A$ = r and radius$_B$ = $\frac{1}{2}$ r	M1	oe
	$V_A = \pi r^2(10)$ or $V_A = \pi r^2$h or $V_B = \pi(\frac{1}{2}$r$)^2(20)$ or $V_B = \pi(\frac{1}{2}$r$)^2(2h)$	M1dep	oe
	$V_A = \pi r^2(10)$ and $V_B = \pi(\frac{1}{2}$r$)^2(20)$ or $V_A = \pi r^2$h and $V_B = \pi(\frac{1}{2}$r$)^2(2h)$	A1	oe
	Tube A and $10\pi r^2$ and $5\pi r^2$ or Tube A and πr^2h and $\frac{1}{2}\pi r^2$h	Q1ft	oe Strand (ii) ft conclusion from their volumes provided M1M1 awarded
	Additional Guidance		

Q	Answer	Mark	Comments
21	$3x^2 = 4x + 2$	M1	Equation must be correct
	$3x^2 - 4x - 2 \ (= 0)$	A1	
	$\dfrac{--4 \pm \sqrt{(-4)^2 - 4 \times 3 \times -2}}{2 \times 3}$ or $\dfrac{4 \pm \sqrt{16 + 24}}{6}$ or $\dfrac{4 \pm \sqrt{40}}{6}$	M1	Allow one error
	$\dfrac{--4 \pm \sqrt{(-4)^2 - 4 \times 3 \times -2}}{2 \times 3}$ or $\dfrac{4 \pm \sqrt{16 + 24}}{6}$ or $\dfrac{4 \pm \sqrt{40}}{6}$	A1ft	Fully correct for their equation
	$x = 1.7$ and $x = -0.4$	A1ft	ft their equation
	Additional Guidance		
	One correct answer with no working, eg $x = 1.7…$ implies 3 marks		M1A1M1

Q	Answer	Mark	Comments
	Alternative method 1		
	$10^2 = 12^2 + 15^2 - 2 \times 12 \times 15 \cos A$	M1	
	$\dfrac{12^2 + 15^2 - 10^2}{2 \times 12 \times 15}$ or 0.74(7…) or 0.75	M1dep	
	$(A =)$ [41.4, 42]	A1	sin [41.4, 42] or [0.66, 0.67]
	sin (their 41.64) = $\dfrac{h}{12}$	M1dep	
22	[7.9, 8]	A1ft	ft their angle A
Alt 1 of 4	**Alternative method 2**		
Alt 2 of 4	$12^2 = 10^2 + 15^2 - 2 \times 10 \times 15 \cos B$	M1	
	$\dfrac{10^2 + 15^2 - 12^2}{2 \times 10 \times 15}$ or 0.60…	M1dep	
	$(B =)$ [52.8, 53.2]	A1	sin [52.8, 53.2] or [0.79, 0.8]
	sin (their 52.89) = $\dfrac{h}{10}$	M1dep	
	[7.9, 8]	A1ft	ft their angle B

Q	Answer	Mark	Comments
22 cont **Alt 3 of 4** **Alt 4 of 4**	**Alternative method 3**		
	$12^2 - x^2 = 10^2 - (15 - x)^2$	M1	oe $h^2 = 12^2 - x^2$ and $h^2 = 10^2 - (15 - x)^2$
	$144 - x^2 = 100 - (225 - 15x - 15x + x^2)$	M1dep	oe
	$30x = 225 + 144 - 100$ or $30x = 269$	M1dep	oe
	$(x =) \dfrac{269}{30}$ or $(x =)$ 8.97 or 9	A1	
	[7.9, 8]	A1ft	ft their x, dependent on M1M1M1
	Alternative method 4		
	$10^2 - y^2 = 12^2 - (15 - y)^2$	M1	oe $h^2 = 10^2 - y^2$ and $h^2 = 12^2 - (15 - y)^2$
	$100 - y^2 = 144 - (225 - 15y - 15y + y^2)$	M1dep	oe
	$30y = 225 + 100 - 144$ or $30y = 181$	M1dep	oe
	$(y =) \dfrac{181}{30}$ or $(y =)$ 6.03… or 6	A1	
	[7.9, 8]	A1ft	ft their y, dependent on M1M1M1
	Additional Guidance		