AQA

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Mathematics

8300/3H – Paper 3 Higher Tier
Mark scheme

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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.

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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. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq$ value $< b$
3.14…	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
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 student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student 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 student intended it to be a decimal point.

Question	Answer	Mark	Comments
1	0.56	B1	
	Additional Guidance		
2	–1, 0, 1, 2, 3, 4	B1	
	Additional Guidance		
3	$3.2\dot{7}$	B1	
	Additional Guidance		
4	36°	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
5	At least two common factors of 72 and 120 from 2, 3, 4, 6, 8, 12, 24 or 72 = 2 (×) 2 (×) 2 (×) 3 (×) 3 or 120 = 2 (×) 2 (×) 2 (×) 3 (×) 5	M1	May be seen on a diagram, eg factor tree
	At least two common multiples of 6 and 9 from 18, 36, 54…	M1	
	(HCF =) 24 selected from factors or a = 24 or (LCM =) 18 selected from multiples or b = 18	M1	oe eg HCF = 2 (×) 2 (×) 2 (×) 3 24 can be implied from their numerator oe eg LCM = 2 (×) 3 (×) 3 18 can be implied from their denominator oe eg $\frac{2 \times 2 \times 2 \times 3}{2 \times 3 \times 3}$
	$1\frac{1}{3}$ or $\frac{4}{3}$ or 1.33…	A1	oe Accept $\frac{24}{18}$ Ignore further incorrect cancelling
	Additional Guidance		
	HCF = 24 and LCM = 18		M1M1M1
	HCF = 24		M1M0M1
	LCM = 18		M0M1M1

Question	Answer	Mark	Comments
6	54	B1	May be on diagram
	7.5 6	B2	May be on diagram B1 for 1 correct or for answers transposed
	Additional Guidance		
	If answers are in wrong position on answer lines, check working and diagram for clear indication of possible transcription errors eg $w = 9 \div 1.5 = 6$ in working, 9 on answer line $9 \div 1.5 = 6$ in working, 9 on answer line		B1 B0
	Answer line takes precedence over diagram eg $x = 54$ on diagram and $x = 81$ on answer line		B0

Question	Answer	Mark	Comments
7	$2 \times 12 \times 150 \times 1.025$ or $24 \times 150 \times 1.025$ or 3690 or $2 \times 12 \times 150 \times 0.025$ or $24 \times 150 \times 0.025$ or 90	M1	Investment A oe
	1.03×3500 or 3605	M1	Investment B oe eg $0.03 \times 3500 + 3500$ or $105 + 3500$ May be implied from $1.03^2 \times 3500$
	$1.03^2 \times 3500$ or $1.03 \times$ their 3605 or 1.0609×3500 or 3713(.15) or $0.03 \times$ their 3605 or 108(.15)	M1dep	oe Dependent on 2nd M1
	23.15	A1	Condone £23.15p
	Additional Guidance		
	If build up methods are used they must be complete		
	1% = 35 3% = 95 (error without showing method) 95 + 3500 or 3595		M0
	1% = 35 3% = 35 × 3 = 95 (error but correct method shown) 95 + 3500 or 3595		M1
	$1.03^3 \times 3500$ (full method incorrect but implies 1.03×3500)		M0M1M0

Question	Answer	Mark	Comments
8(a)	**Alternative method 1** – Using gradients		
	Gradient of $y = 3x + 7$ is 3 and $y = 3x + 4$ and gradient of $2y – 6x = 8$ is 3 or $6 \div 2$	B3	May come from using points on line eg using (0, 7) and (1, 10) and $\frac{10 – 7}{1 – 0} = 3$ or correct calculation for gradient from points on line $2y – 6x = 8$ eg using (0, 4) and (1, 7) and $\frac{7 – 4}{1 – 0} = 3$ B2 for $y = 3x + 4$ and lines have same gradient or $y = 3x + 4$ and gradient of $2y – 6x = 8$ is 3 or $6 \div 2$ or gradient of $y = 3x + 7$ is 3 and $y = 3x + 4$ B1 for gradient of $y = 3x + 7$ is 3 or $y = 3x + 4$ or gradient of $2y – 6x = 8$ is 3 or $6 \div 2$
	Alternative method 2 – Using coordinates and distances		
	Chooses a value for x and correctly evaluates the y value for both lines	M1	eg (0, 7) and (0, 4)
	Chooses a different value for x and correctly evaluates the y value for both lines	M1dep	eg (1, 10) and (1, 7)
	States that y values are a constant distance apart so parallel	A1	oe

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8(a) cont	**Alternative method 3** – Using simultaneous equations		
	$y = 3x + 4$ or $y - 3x = 4$ or $2y = 6x + 14$ or $2y - 6x = 14$	M1	oe Equates coefficients in any form
	Any attempt to eliminate both variables from their equations	M1dep	
	States simultaneous equations have no (real) solution and concludes parallel	A1	
	Additional Guidance		
	To award A mark on Alternative method 2, the working must be seen		
	$y = 3x + 4$ and lines have gradient of $3x$		B2
	$y = 3x + 4$ and $3x$ identified in both equations		B2
	Both lines have gradient $3x$		B1
	$y = 3x + 7$, gradient 3 and $y = 3x + 8$, gradient 3 (error in rearrangement)		B1
	$y = 3x + 8$, gradient 3 (error in rearrangement)		B0
	Parallel as both have same gradient		B0
	$2(3x + 7) - 6x = 8$ $6x + 14 - 6x = 8$ $14 = 8$		M1 M1
	$y = 3x + 7$ and $y = \frac{8 + 6x}{2}$ are equated coefficients, Alternative method 3		M1

Question	Answer	Mark	Comments
8(b)	3 × –5 + 7 or –15 + 7 or –8 or (–5, –8) or (–6 – 7) ÷ 3 or –4.33… or $y = 3x + 9$	M1	Use a point on $y = 3x + 7$ with (–5, –6) to compare gradient to 3 eg Gradient from (–5, –6) to (0, 7) is 2.6
	Above and –8 or Above and –4.33 or Above and $y = 3x + 9$	A1	oe Above and eg Gradient from (–5, –6) to (0, 7) is 2.6
	Additional Guidance		
	Do not ignore incorrect statements eg –6 is less than –8 so above		M1A0
	(0, 7), (–1, 4), (–2, 1), (–3, –2), (–4, –5), (–5, –8) and ticks below		M1A0

9	1.1 seen or 110% = 19.25 seen or 19.25 ÷ 110	M1	oe eg 10% = 1.75 1% = 0.175
	19.25 ÷ 1.1 or 0.175 × 100 or 17.5	M1dep	oe
	17.50	A1	correct money notation
	Additional Guidance		
	Condone £17.50p		M1M1A1
	Answer £17.5		M1M1A0

Question	Answer	Mark	Comments
10	55 and 91	B3	B2 for (7), 19, 31, 43, 55, 67, 79, 91 or 55 identified with 0 or 1 incorrect answer or 91 identified with 0 or 1 incorrect answer or 55 and 91 identified with 1 incorrect answer B1 at least 2 correct two-digit numbers from the sequence seen
	Additional Guidance		
	The correct sequence is (7), 19, 31, 43, 55, 67, 79, 91 Ignore continuation of sequence beyond 91		
	Ignore further working unless contradictory		
	55 and 91 identified and 5th and 8th terms stated (ignore fw)		B3
	55 and 91 identified and answer 2 (or there are 2) (ignore fw)		B3
	55 identified and 5th stated (ignore fw)		B2
	Condone 5 or 5th as final answer provided there is a clear link to 55 eg $12 \times 5 = 60 - 5 = 55$ $55 \div 11 = 5$ 5 on answer line		B2
	Condone 8 or 8th as final answer provided there is a clear link to 91 eg $12 \times 8 = 96 - 5 = 91$ 8 on answer line		B2

11(a)	$\begin{pmatrix} 1 \\ -1 \end{pmatrix}$	B2	B1 for 1 correct value in correct position Condone a divisor line
	Additional Guidance		

Question	Answer	Mark	Comments
11(b)	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen	M1	
	Valid reason	A1	eg $\begin{pmatrix}-2\\4\end{pmatrix} = 2 \times \begin{pmatrix}-1\\2\end{pmatrix}$ $\begin{pmatrix}-2\\4\end{pmatrix} = 2\mathbf{b}$ $\begin{pmatrix}-2\\4\end{pmatrix}$ is a multiple of $\begin{pmatrix}-1\\2\end{pmatrix}$ $\mathbf{a} + 2\mathbf{c}$ is a multiple of $\mathbf{b}$ $2\mathbf{b} = \mathbf{a} + 2\mathbf{c}$
	Additional Guidance		
	Condone vectors written as coordinates, eg (–1, 2) is half of (–2, 4)		
	Must see $\begin{pmatrix}-2\\4\end{pmatrix}$ or (–2, 4) to award the A mark		
	Condone missing brackets and / or divisor lines		
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and both gradient –2		M1A1
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and double so parallel		M1A1
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and half so parallel		M1A1
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and $\mathbf{a} + 2\mathbf{c}$ is $2\mathbf{b}$		M1A1
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and $\mathbf{b} = \frac{1}{2}\mathbf{a} + 2\mathbf{c}$		M1A0
	$\begin{pmatrix}-2\\4\end{pmatrix}$ seen and both have same ratio		M1A0
	$\frac{-2}{4}$ and $\frac{-1}{2}$ both equal –0.5		M1A0

Question	Answer	Mark	Comments
12	12.5 or $12\frac{1}{2}$ or $\frac{25}{2}$	B1	
	N/m^2 or newtons per square metre or Nm^{-2} or pascals or Pa	B1	oe
	Additional Guidance		
	m^2/N or P		B0
13	The diagonals are lines of symmetry ✓ The diagonals bisect each other ✓ The diagonals are perpendicular ✓ The diagonals are equal in length	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
14	At least 4 of (x = 0) y = 1 (x = 1) y = 0.8 or $\frac{4}{5}$ (x = 2) y = 0.64 or $\frac{16}{25}$ (x = 3) y = [0.51, 0.512] or $\frac{64}{125}$ (x = 4) y = [0.40, 0.41] or $\frac{256}{625}$ (x = 5) y = [0.32, 0.33] or $\frac{1024}{3125}$ (x = 6) y = [0.26, 0.262144] or $\frac{4096}{15\,625}$	M1	oe May be seen in the table or a list or implied from their graph
	6 or 7 correct points plotted	A1	tolerance of $\pm\frac{1}{2}$ small square
	Fully correct smooth curve through all seven correct points	A1	tolerance of $\pm\frac{1}{2}$ small square
	Additional Guidance		
	Ignore extra points plotted		
	Ignore any curve drawn for $x < 0$ or $x > 6$		
	Curve passing through all correct points within tolerance		M1A1A1
	Ruled straight lines		A0

Question	Answer	Mark	Comments
15	$4(x + 3)$	B1	
	Additional Guidance		
16	$(-\frac{3}{4}, 3)$	B1	
	Additional Guidance		
17	7 × 5 (× 9) or (100 – 30) ÷ 2 (× 9) or 35 (× 9) or 99 ÷ 11 or 9 or 4 × 5 × 4 × 5	M1	First two digits of Method A Last two digits of Method A Complete for Method B
	315 or 400	A1	
	315 and 400 with Method B identified	A1	Method B can be implied by choosing 400
	Additional Guidance		
	315 and 400 and B with no working		M1A1A1
	315 and 400 with 400 circled		M1A1A1
	Beware 40 × 10 = 400 (for Method A) is incorrect working		

Question	Answer	Mark	Comments
18	**Alternative method 1**		
	$\frac{2(x+4)}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x(x+4)}{6x^2}$ or $(-)\frac{15x}{6x^2}$ or $\frac{2x^2+8x}{6x^2}$ or $(-)\frac{15x}{6x^2}$	M1	oe A correct fraction using a common denominator for one of the given fractions Accept for this mark only eg $2(3x)$ for $6x$ $3(5)$ for 15 $(2x)(3x)$ for $6x^2$ First fraction can be written as separate fractions eg $\frac{2x}{2(3x)} + \frac{8}{2(3x)}$
	$\frac{2(x+4)}{6x}$ and $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ and $(-)\frac{15}{6x}$ or $\frac{2x(x+4)}{6x^2}$ and $(-)\frac{15x}{6x^2}$ or $\frac{2x^2+8x}{6x^2}$ and $(-)\frac{15x}{6x^2}$	A1	oe A correct fraction using a common denominator for both of the given fractions First fraction can be written as separate fractions eg $\frac{2x}{6x} + \frac{8}{6x}$
	$\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Accept eg $\frac{2x + -7}{6x}$ Do not ignore further working

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18 cont	**Alternative method 2**		
	$\frac{2(x+4)}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x(x+4)}{6x^2}$ or $(-)\frac{15x}{6x^2}$ or $\frac{2x^2+8x}{6x^2}$ or $(-)\frac{15x}{6x^2}$	M1	oe A correct fraction using a common denominator for one of the given fractions Accept for this mark only eg $2(3x)$ for $6x$ $3(5)$ for 15 $(2x)(3x)$ for $6x^2$ First fraction can be written as separate fractions eg $\frac{2x}{2(3x)}+\frac{8}{2(3x)}$
	$\frac{2x+8-15}{6x}$ or $\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Allow one error in numerator Accept eg $\frac{2x+-7}{6x}$ Must be $6x$ or a multiple of $6x$
	$\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Accept eg $\frac{2x+-7}{6x}$ Do not ignore further working
	Additional Guidance		
	Use the method that gives the greater mark		
	$\frac{2x^2-7x}{6x^2}$		M1A1
	$\frac{2x-7}{6x}=\frac{-5}{6x}$		M1A1A0
	$\frac{15x}{6x^2}-\frac{2x^2+8x}{6x^2}$ (order of fractions reversed)		M1A0A0

Question	Answer	Mark	Comments
19	(8, 0)	B1	
	Additional Guidance		
20	$x^2 + (7x)^2 = (10y)^2$ or $x^2 + 49x^2 = 100y^2$	M1	oe
	$50x^2 = 100y^2$ or 1.41(…)	A1	oe equation with terms collected eg $\frac{x^2}{y^2} = \frac{100}{50}$ or $x^2 = 2y^2$ or $x = 1.41y$
	$\sqrt{2}$ or $\frac{2}{\sqrt{2}}$	A1	Do not accept further working
	Additional Guidance		
	$x^2 + 7x^2 = 10y^2$		M0
	$\sqrt{2} = 1.41$		M1A1A0
	$x^2 + (7x)^2 = (10y)^2$ $x^2 + 14x^2 = 20y^2$		M1 A0

Question	Answer	Mark	Comments
21(a)	$m \propto h^3$ or $m = k \times h^3$ or $1600 = k \times 8^3$ or $c \times m = h^3$ or $c \times 1600 = 8^3$	M1	oe eg $h = km^{1/3}$
	(k =) $1600 \div 8^3$ or 3.125 or (c =) $8^3 \div 1600$ or 0.32	M1dep	oe eg $\frac{1600}{512}$ or $\frac{25}{8}$ $\frac{512}{1600}$ or $\frac{8}{25}$
	$m = 3.125 \times h^3$ or $0.32 \times m = h^3$	A1	oe equation
	Additional Guidance		
	$m \propto 3.125 \times h^3$ or $0.32m \propto h^3$		M1M1A0
	(k =) 3.125 or (c =) 0.32		M1M1
	$3.125h^3$ or $0.32h^3$		M1M1

Question	Answer	Mark	Comments
21(b)	their 3.125×12^3 their 3.125×1728 or $1600 \times \left(\frac{12}{8}\right)^3$ or $12^3 \div$ their 0.32 or $1728 \div 0.32$ or $1600 \div \left(\frac{8}{12}\right)^3$	M1	oe
	5400	A1ft	oe ft their 3.125 provided using m = their $3.125 \times h^3$
	Additional Guidance		
	Must use $\times 12^3$ or $\times 1728$ or $\times \left(\frac{12}{8}\right)^3$ for M1		
	If in part (a) $m = k \times h$ $1600 = k \times 8$ $m = 200h$ and in part (b) $m = 200 \times 12$, $m = 2400$		M0 part (a) M0 part (b)
	If in part (a) $m = k \times h$ $1600 = k \times 8$ $m = 200h$ and in part (b) $m = 200 \times 12^3$, $m = 345\,600$		M0 part (a) M1A1ft part (b)

Question	Answer	Mark	Comments
22	Alternate segment or Reason on first line of working is incorrect	B1	oe Any incorrect statement B0
	Additional Guidance		
	Incorrect theorem stated in first line		B1
	First line is incorrect. It should say alt segment		B1
	Angles not in same segment		B1
	Angles in same segment are not equal		B0
	Opposite segments (are not equal)		B0
	First line is incorrect. It should say opposite segment		B0
	The angle between the chord and the tangent is equal to the angle in the opposite segment		B0
	Angle *ACB* is not in the same segment, it is alternate		B0
	Angles are not in the same segment, they are alternate		B0
23	$u_2 = 0.6$ or $\frac{3}{5}$ $u_3 = 1.875$ or $\frac{15}{8}$	B2	oe B1 for 1 correct or for u_2 incorrect but their value of u_3 correctly follows through rounded or truncated to 4 dp
	Additional Guidance		
	$u_1 = 0.6$, $u_2 = 1.875$, $u_3 = 1.0434\ldots$ or $u_3 = 1.0435$		B1

Question	Answer	Mark	Comments
24(a)	**Alternative method 1**		
	$\frac{1}{2} \times 10 \times 20$ or 100	M1	oe Area of triangle on left
	$\frac{1}{2} \times (20 + 30) \times 10$ or 250 or 20×10 or 200 and $\frac{1}{2} \times 10 \times 10$ or 50	M1	oe Area of trapezium on right
	350	A1	
	Alternative method 2		
	$\frac{1}{2} \times 10 \times 10$ or 50	M1	oe Area of triangle on top right
	$\frac{1}{2} \times (20 + 10) \times 20$ or 300 or 10×20 or 200 and $\frac{1}{2} \times 10 \times 20$ or 100	M1	oe Area of trapezium across bottom
	350	A1	
	Additional Guidance		
	$\frac{1}{2} \times (0 + 2 \times 20 + 30) \times 10$ (using Trapezium rule)		M1M1
	Beware of 300 from incorrect working		
	Beware $(30 – 20) \times (20 – 10) = 100$ is incorrect working		

Question	Answer	Mark	Comments
24(b)	☐ It works out an overestimate of the distance ☑ It works out an underestimate of the distance ☐ It could be an overestimate or an underestimate of the distance	B1	
	Additional Guidance		
25(a)	tan 6 = $\frac{CD}{500}$ or 500 × tan 6	M1	oe any letter $\frac{CD}{\sin 6} = \frac{500}{\sin 84}$
	[52.5, 52.6] or 53	A1	May be on diagram
	Additional Guidance		
	Check diagram for angle		

Question	Answer	Mark	Comments
25(b)	**Alternative method 1**		
	$500^2 + 400^2$ or 250 000 + 160 000 or 410 000	M1	oe
	$\sqrt{\text{their } 410\,000}$ or $\sqrt{500^2 + 400^2}$ or 640.(3…)	M1dep	*AC*
	$\tan x = \frac{[52.5, 52.6] \text{ or } 53}{\text{their } 640.(3..)}$	M1dep	oe any letter
	[4.6, 4.75] from correct working	A1	accept 5 with correct working seen
	Alternative method 2		
	$\frac{500}{\cos 6}$ or [502.7, 502.8]	M1	oe *BD*
	$\sqrt{\left(\frac{500}{\cos 6}\right)^2 + 400^2}$ or [642.4, 642.5]	M1dep	*AD*
	$\sin x = \frac{[52.5, 52.6] \text{ or } 53}{\text{their } [642.4, 642.5]}$	M1dep	oe any letter
	[4.6, 4.75] from correct working	A1	accept 5 with correct working seen

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25(b) cont	**Alternative method 3**		
	$500^2 + 400^2$ or 250 000 + 160 000 or 410 000 or $\frac{500}{\cos 6}$ or [502.7, 502.8]	M1	oe *BD*
	$\sqrt{\text{their } 410\,000}$ or $\sqrt{500^2 + 400^2}$ or 640.(3…) or $\sqrt{\left(\frac{500}{\cos 6}\right)^2 + 400^2}$ or [642.4, 642.5]	M1dep	*AC* *AD*
	$\cos x = \frac{\text{their } 640.(3...)}{\text{their } [642.4, 642.5]}$	M1dep	oe any letter
	[4.6, 4.75] from correct working	A1	accept 5 with correct working seen
	Additional Guidance		
	Check diagram for lengths		
	Beware $\sin x = \frac{52.6}{640.(3...)}$ leads to [4.6, 4.75]		M1M1M0A0

Question	Answer	Mark	Comments
26(a)	**Alternative method 1** – Counting squares		
	15 or 6.6 or 2.4 (cm squares)	M1	375 or 165 or 60 (small squares)
	their 15 + their 6.6 + their 2.4 or 24 (total cm squares)	M1dep	allow one error their 375 + their 165 + their 60 or 600 (total small squares)
	$\frac{\text{their } 15}{\text{their } 24}$ or $\frac{\text{their } 375}{\text{their } 600}$ or 0.625 or $\frac{480}{\text{their } 600}$ or 0.8 (cars per small square) or $\frac{480}{\text{their } 24}$ or 20 (cars per cm square)	M1dep	oe $\frac{\text{their } 600}{480}$ or 1.25 (small squares per car) $\frac{\text{their } 24}{480}$ or 0.05 (cm square per car)
	300	A1	
	Alternative method 2 – Using f.d. scale of x per unit		
	$5x \times 15$ or $75x$ or $6.6x \times 5$ or $33x$ or $0.8x \times 15$ or $12x$ (x per cm)	M1	$25x \times 15$ or $375x$ or $33x \times 5$ or $165x$ or $4x \times 15$ or $60x$ (x per small square)
	$5x \times 15 + 6.6x \times 5 + 0.8x \times 15$ or $75x + 33x + 12x$ or $120x$ (x per cm)	M1dep	allow one error $25x \times 15 + 33x \times 5 + 4x \times 15$ or $375x + 165x + 60x$ or $600x$ (x per small square)
	their $120x = 480$ or $x = 4$	M1dep	oe $\frac{480}{\text{their } 120}$ or 4
	300	A1	

Continues on next page

26(a) cont	**Alternative method 3 –** Using a number scale of f.d. axis		
	5 × 15 or 75 or 6.6 × 5 or 33 or 0.8 × 15 or 12	M1	25 × 15 or 375 or 33 × 5 or 165 or 4 × 15 or 60
	5 × 15 + 6.6 × 5 + 0.8 × 15 or 75 + 33 + 12 or 120 (1 per cm)	M1dep	allow one error 25 × 15 + 33 × 5 + 4 × 15 or 375 + 165 + 60 or 600 (1 per small square)
	$\frac{\text{their 15}}{\text{their 24}}$ or $\frac{\text{their 375}}{\text{their 600}}$ or 0.625 or $\frac{480}{\text{their 600}}$ or 0.8 (cars per small square) or $\frac{480}{\text{their 24}}$ or 20 (cars per cm square)	M1dep	oe $\frac{\text{their 600}}{480}$ or 1.25 (small squares per car) $\frac{\text{their 24}}{480}$ or 0.05 (cm square per car)
	300	A1	
	Additional Guidance		
	Check diagram for working		
	Alternative method 1 Total squares must be the sum of three numbers		
	Alternative method 2 Must be the sum of three expressions		
	The correct f.d. labels for the heights of the bars are 20, 26.4 and 3.2		
	A correct frequency density scale using 1 cm = 4 units eg 4 seen on vertical scale at 1 cm 20 seen on vertical scale at 5 cm		 M1M1M1 M1M1M1

Question	Answer	Mark	Comments
26(b)	$\frac{2}{3} \times 2.4$ or 1.6 or $\frac{2}{3} \times 60$ or 40 or $\frac{2}{3} \times 48$ or $10 \times 0.8 \times 4$	M1	oe
	32	A1	
	Additional Guidance		
27	$\frac{10}{30}$ and $\frac{9}{31}$ seen or $\frac{1}{3}$ and $\frac{9}{31}$ seen	M1	oe accept 0.33… and 0.29…
	$\frac{10}{30} \times \frac{9}{31} \times \frac{8}{32}$ or $\frac{1}{3} \times \frac{9}{31} \times \frac{1}{4}$	M1dep	oe accept 0.33… and 0.29… and 0.25
	$\frac{3}{124}$ or [0.0239, 0.0242]	A1	oe eg $\frac{720}{29\,760}$
	Additional Guidance		
	Fractions do not have to be in simplest form		
	$\frac{10}{30} \times \frac{9}{31} \times \frac{8}{32} \times \frac{7}{33}$		M1M0
	$\frac{10}{30} + \frac{9}{31} + \frac{8}{32}$		M1M0

Question	Answer	Mark	Comments
28	$4^2 + y^2 = 80$ or $y = \sqrt{64}$	M1	oe May be implied from 8 on diagram
	$y = -8$	A1	Accept (4, –8)
	$\frac{\text{their } -8}{4}$ or –2	M1	oe gradient of radius *OP*
	–1 ÷ their –2 or $\frac{1}{2}$ or –1 ÷ their gradient	M1	gradient of tangent at *P*
	$y = \frac{1}{2}x - 10$ or $y + 8 = \frac{1}{2}(x - 4)$	A1	oe Ignore further working
	Additional Guidance		
	$y + 8 = \frac{1}{2}(x - 4)$ followed by error expanding and/or collecting terms		M1A1M1M1A1
	$y = \frac{1}{2}x - 10$ in working and $\frac{1}{2}x - 10$ only on answer		M1A1M1M1A1
	$\frac{1}{2}x - 10$		M1A1M1M1A0
	($y = \sqrt{64}$) $y = 8$ Gradient *OP* = 2 Perpendicular gradient = $-\frac{1}{2}$		M1 A0 M1 M1 A0