AQA

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Mathematics

8300/1H-Paper 1 Higher Tier
Mark scheme

8300

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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	40	B1	
2	$\begin{pmatrix} 2 \\ -3 \end{pmatrix}$	B1	
3	$5a - 4a^2$	B1	
4	500	B1	
5	$5x + 15 < 60$ or $5x < 45$ or $x + 3 < 12$	M1	
	$x < 9$ or $9 > x$	A1	SC1 incorrect sign eg $x \leq 9$ or $x = 9$ or $x > 9$ or $x \geq 9$ or $x =< 9$ or answer of 9
	Additional Guidance		
	Allow use of other inequality signs or = if recovered to answer of $x < 9$		M1A1
	Embedded answer of $5(9 + 3) < 60$		M0A0
	$5x + 3 < 60$ followed by $x + 3 < 12$ followed by $x < 9$ is not a recovery, but is two errors		M0A0

Question	Answer	Mark	Comments
6	$\frac{1.86}{1.6(0)}$	M1	oe $\frac{0.93}{0.8(0)}$ or $1\frac{0.26}{1.6}$
	$\frac{186}{160}$ or $1\frac{26}{160}$	A1	oe with no decimal values
	$\frac{93}{80}$ or $1\frac{13}{80}$	B1ft	ft correct simplification of their fraction using the digits 186 and 16(0) ignore incorrect conversion from $\frac{93}{80}$ to a mixed number

Additional Guidance	
Cannot score B1ft from an incorrect mixed number	
$\frac{160}{186} = \frac{80}{93}$	M0A0B1ft
$\frac{80}{93}$ implies B1ft	M0A0B1ft
$\frac{93}{80} = 1\frac{3}{80}$ (incorrect conversion to mixed number)	M1A1B1
$\frac{186}{160} = \frac{31}{30}$ (incorrect simplification of fraction)	M1A1B0
$\frac{93}{80} = \frac{31}{30}$ (incorrect simplification of fraction)	M1A1B0
$\frac{93}{80} = \frac{0.93}{0.8}$ (incorrect simplification of fraction)	M1A1B0
$\frac{186}{16} = \frac{93}{8}$	M0A0B1ft
$\frac{1.86}{1.6} = \frac{9.3}{8}$	M1A0B0
$\frac{1.86}{1.6} = \frac{186}{16} = \frac{93}{8}$	M1A0B1ft
$\frac{1.86}{1.6} = \frac{86}{60} = \frac{43}{30}$ (simplification does not come from 186 and 16(0))	M1A0B0

Question	Answer	Mark	Comments
7	x-coordinate of C = 12 or y-coordinate of C = 8 or 12 marked on x-axis below C and 8 marked on y-axis left of C or x-coordinate of D = 6 + 6 + 6 or y-coordinate of D = 2 + 3 + 3 + 3 or $\frac{x}{6} = 3$ or $6 = (2 \times 0 + x) \div 3$ or $\frac{y-2}{5-2} = 3$ or $5 = (2 \times 2 + y) \div 3$ or 18 marked on x-axis below D or 11 marked on y-axis left of D	M1	oe sets up a correct equation for x-coordinate of D or y-coordinate of D
	(C is the point) (12, 8) or (D is the point) (18, …) or (…, 11) or 18 marked on x-axis below D and 11 marked on y-axis left of D	A1	condone missing brackets if intention is clear
	18, 11	A1	

Additional Guidance

(12,8 , 18,11) on answer line with previous link to C and D	M1A1A1
(12,8 , 18,11) on answer line with no previous link to C and D	M1A1A0
12, 8 on answer line with no other working	M1A1A0
Accept correct working on diagram and correct answer on diagram if not contradicted by answer line	
11, 18 on answer line does not score the last mark, but may score M1A0 or M1A1	
11, 18 with no working	M0A0A0

Question	Answer	Mark	Comments
8(a)	$\frac{31}{50}$ or 0.62 or 62%	B1	oe fraction, decimal or percentage
	Additional Guidance		
	31 or 62		B0
	31 : 50		B0
	31 out of 50 or 31 in 50		B0
	Ignore subsequent attempts to simplify $\frac{31}{50}$ or convert it to a decimal or percentage, eg $\frac{31}{50}$ = 0.6		B1
	$\frac{31}{50}$ = 0.5 oe is considered as choice		B0

Question	Answer	Mark	Comments
8(b)	Valid reason	B1ft	eg 31 is more than 19 (12) more heads than tails 31 is more than 25 31 ≠ 25 (6) more than expected it should be 25 times heads and tails should be (roughly) equal it landed on heads more than half the times relative frequency/probability is more than 0.5 ft if their 0.62 > 0.5 0.62 > 0.5 ft if their 0.62 > 0.5
	Additional Guidance		
	ft is only available if comparing their relative frequency to 0.5, and their relative frequency must be greater than 0.5		
	Condone the probability given as 50/50 in otherwise correct reasons eg Probability is 50/50 so there should be 25 heads		B1
	There were only 19 tails		B1
	There weren't enough tails		B1
	Because it landed on heads 31 times and it should be 25/25		B1
	It should be $\frac{1}{2}$		B1
	The probability should be $\frac{1}{2}$ but it lands on heads 31 times		B1
	There were 31 heads		B0
	There were 19 tails		B0
	There were 31 heads and 19 tails		B0
	The coin could be fixed		B0
	Incorrect statement eg 31 is 22 more than 19		B0

Question	Answer	Mark	Comments
9	**Alternative method 1**		
	$-2\frac{7}{8} + 15\frac{1}{4}$ or $15\frac{2}{8}$ or (–)2.875 and 15.25 or (–)$\frac{23}{8}$ and $\frac{61}{4}$	M1	oe common denominator for both fractional parts of the mixed numbers conversion of both numbers to decimals with at least one correct conversion of both numbers to improper fractions with at least one correct
	$-2\frac{7}{8} + 15\frac{2}{8}$ or –2.875 + 15.25 or $-\frac{23}{8} + \frac{122}{8}$	M1dep	oe common denominator correct decimals oe common denominator
	$\frac{99}{8}$ or $12\frac{3}{8}$ or 12.375	A1	oe fraction, mixed number or decimal
	Alternative method 2		
	–2 + 15 and (–)$\frac{7}{8} + \frac{1}{4}$	M1	
	–2 + 15 and (–)$\frac{7}{8} + \frac{2}{8}$ or $13 - \frac{5}{8}$	M1dep	oe common denominator
	$\frac{99}{8}$ or $12\frac{3}{8}$ or 12.375	A1	oe fraction, mixed number or decimal
	Additional Guidance		
	$15\frac{1}{4} - -2\frac{7}{8}$ scores M0, but followed by $15\frac{2}{8} + 2\frac{7}{8}$ scores M1 on Alt 1		
	Values in 2nd mark must be correct; no ft from incorrect conversion		
	$\frac{99}{8}$ incorrectly converted to a decimal or mixed number		M1M1A1
	$13\frac{-5}{8}$		M1M1A0

Question	Answer	Mark	Comments
10	(x =) 3 and (y =) 2 in correct positions	B2	B1 $y = \frac{24}{x}$ or $4 = \frac{k}{6}$ or $k = 24$ oe or (x =) 3 in correct position above 8 or (y =) 2 in correct position below 12
	Additional Guidance		
	$y = \frac{1}{kx}$ or $4 = \frac{1}{6k}$ oe followed by $k = \frac{1}{24}$, with no or incorrect values in table		B1

Question	Answer	Mark	Comments
11	**Alternative method 1 – width of small rectangle is x (any letter)**		
	x and $2x$ or $x + 2x + x + 2x$ or $6x$	M1	oe
	$x + 2x + x + 2x = 15$ or $6x = 15$	M1dep	oe
	$(x =)$ 2.5	A1	from correct working or with 5 as the other dimension or with 7.5 as the length of the large rectangle
	25	A1ft	ft 10 × their 2.5 with M1M1 awarded
	Alternative method 2 – length of small rectangle is x (any letter)		
	x and $\frac{x}{2}$ or $x + \frac{x}{2} + x + \frac{x}{2}$ or $3x$	M1	oe
	$x + \frac{x}{2} + x + \frac{x}{2} = 15$ or $3x = 15$	M1dep	oe
	$(x =)$ 5	A1	from correct working or with 2.5 as the other dimension or with 7.5 as the length of the large rectangle
	25	A1ft	ft 5 × their 5 with M1M1 awarded
	Alternative method 3 – **a = width of small rectangle and b = length of small rectangle (any letters)**		
	$b = 2a$ or $10a$ or $5b$	M1	correct expression for perimeter of the large rectangle in one variable
	$6a = 15$ or $3b = 15$	M1dep	correct equation in one variable
	$(a =)$ 2.5 or $(b =)$ 5	A1	from correct working or with both values correct or with one value correct and 7.5 as the length of the large rectangle
	25	A1ft	ft 10 × their a or 5 × their b with M1M1 awarded

11(cont)	**Alternative method 4 – trial and improvement using ratio of sides**			
	length = 2 × width seen or implied	M1		
	Two correctly evaluated trials for perimeter of small rectangle with length = 2 × width	M1dep	eg 8 + 4 + 8 + 4 = 24 and 10 + 5 + 10 + 5 = 30	
	2.5 and 5	A1	implied by 2.5 + 5 + 2.5 + 5 = 15	
	25	A1		
	Additional Guidance			
	Note that there is no ft in method 4			
	In all methods, marks can be awarded for annotation of the diagram, with lengths clearly identified, or working inside or alongside the diagram eg 2.5 and 5 marked correctly as the dimensions of the small rectangle 2.5 marked as the width of the small rectangle and 7.5 marked as the length of the large rectangle			M1M1A1 M1M1A1
	If full marks not awarded, mark both the diagram and working then award the better mark			
	In alt 4, one or more trials may be crossed out to indicate that they do not give the correct perimeter. Do not treat this as the usual crossed out work not to be marked if replaced.			

Question	Answer	Mark	Comments
12	One correct conversion to a comparable form 0.08×10^{-2} or 0.0008 400×10^{-4} or 0.04 0.06×10^{-2} or 0.0006 7×10^{-2} or 700×10^{-4}	M1	
	6×10^{-4} 8×10^{-4} 4×10^{-2} 0.07 with no clearly incorrect working	A1	oe accept in converted form
	Additional Guidance		
	Correct answer from clearly incorrect working	A0	
	Accept numbers with two decimal points if it is clear that the point has been moved to the correct place eg 0.0008.0 with curved lines between each place value between the decimal points		
	If the numbers are converted into fractions, at least two must be given correctly with common denominators to score the first mark		
	eg $\frac{4}{100}$ and $\frac{7}{100}$	M1	
	eg $\frac{6}{1000}$ and $\frac{8}{1000}$ only	M0	
	eg $\frac{6}{10\,000}$ and $\frac{7}{100}$ only	M0	
13	15 000 mm^3	B1	

Question	Answer	Mark	Comments
14(a)	At least 3 correct pairs from 15 and 16 20 and 20 25 and 24 30 and 28 35 and 32 40 and 36 or $9(10 + 5n) = 10(12 + 4n)$ or $9(5n) = 10(4n + 4)$ or $9(5 + 5n) = 10(8 + 4n)$ or 7 rows added to A	M1	oe pairs may be seen as ratios oe equation, where n is the number of new rows (correct answer is 6) oe equation, where n is the total number of rows (correct answer is 8) oe equation, where n is the number of new rows after Pattern A (correct answer is 7) not implied by answer 7
	6	A1	
	Additional Guidance		
	6 with no incorrect working		M1A1
	7 or 8 with no working		M0A0
	Multiplication of ratio with no working worthy of M1 eg 10 : 9 20 : 18 30 : 27 40 : 36		M0A0

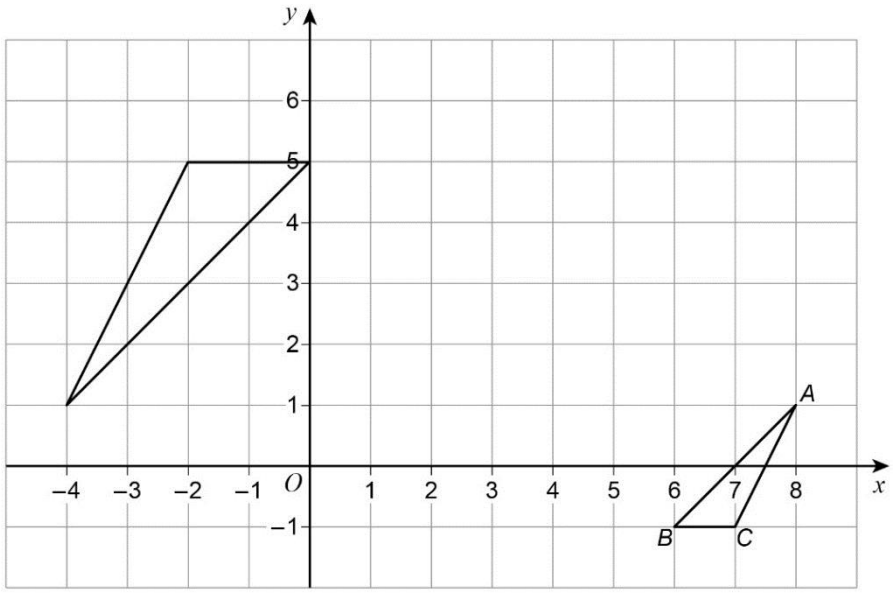
Question	Answer	Mark	Comments
14(b)	**Alternative method 1**		
	12 ÷ 20 or 0.6(0)	M1	oe
	their 0.6(0) × 3 ÷ 2 or 0.9(0) or 14.4(0) or 26.4	M1dep	oe
	26.40	A1	correct money notation
	Alternative method 2		
	12 × 3 ÷ 2 or 18	M1	oe
	their 18 ÷ 20 or 0.9(0) or their 18 ÷ 5 × 4 or 14.4(0) or 26.4	M1dep	oe
	26.40	A1	correct money notation
	Alternative method 3		
	12 ÷ 5 × 4 or 9.6(0)	M1	oe
	their 9.6(0) × 3 ÷ 2 or 14.4(0) or 26.4	M1dep	oe
	26.40	A1	correct money notation
	Alternative method 4		
	16 ÷ 2 × 3 or 24 or 44	M1	oe
	their 24 × 12 ÷ 20 or 14.4(0) or their 44 × 12 ÷ 20 or 26.4	M1dep	oe
	26.40	A1	correct money notation
	Additional Guidance		
	Condone 26.40p		M1M1A1
	20 ÷ 12 or 1.66… or 1.67 with no working that is worthy of M1		M0M0A0
	£18 from using £12 as the cost of one line (may give a total of £528)		M1M0A0

Question	Answer	Mark	Comments
15	**Alternative method 1**		
	0.25 + 0.15 + 0.3 or 0.7	M1	oe eg 1 – 0.05 – 0.05 – 0.2
	their 0.7 × 200	M1dep	oe implied by $\frac{140}{200}$
	140	A1	
	Alternative method 2		
	0.25 × 200 or 50 or 0.15 × 200 or 30 or 0.3 × 200 or 60	M1	oe
	0.25 × 200 + 0.15 × 200 + 0.3 × 200 or 50 + 30 + 60	M1dep	oe implied by $\frac{140}{200}$
	140	A1	
	Alternative method 3		
	(0.05 + 0.05 + 0.2) × 200 or 2 × 0.05 × 200 + 0.2 × 200 or 2 × 10 + 40 or 60	M1	oe
	200 – their 60	M1dep	oe implied by $\frac{140}{200}$
	140	A1	
	Additional Guidance		
	Ignore attempt to simplify $\frac{140}{200}$		M1M1A0
	$\frac{140}{200}$ and 140 both on answer line		M1M1A0
	Do not allow a misread of any probability		
16	5 : 6	B1	
17	$\frac{x}{\sin 42°} = \frac{15}{\sin 104°}$	B1	

Question	Answer	Mark	Comments
18	$\pi \times 10^2 - \pi \times 7^2$ or $100\pi - 49\pi$ or 51π or $\frac{1}{2} \times \pi \times 10^2 - \frac{1}{2} \times \pi \times 7^2$ or $\frac{1}{2} \times 100\pi - \frac{1}{2} \times 49\pi$ or $\frac{1}{2} \times 51\pi$ or 25.5π	M1	oe implied by 102π method to work out front and/or back faces – must not be part of a method to work out volume (× 30) may be taken to be full circles
	$2 \times \pi \times 10 \times 30$ or 600π or $\frac{1}{2} \times 2 \times \pi \times 10 \times 30$ or 300π or $2 \times \pi \times 7 \times 30$ or 420π or $\frac{1}{2} \times 2 \times \pi \times 7 \times 30$ or 210π or 1020π or 510π	M1	oe method to work out outer and/or inner curved surfaces may be taken to be full circles 1122π implies M1M1
	$\left(\frac{1}{2} \times \pi \times 10^2 - \frac{1}{2} \times \pi \times 7^2\right) \times 2$ $+ \frac{1}{2} \times 2 \times \pi \times 10 \times 30$ $+ \frac{1}{2} \times 2 \times \pi \times 7 \times 30$ or $2 \times 25.5\pi + 300\pi + 210\pi$ or 561π	M1dep	oe dep on M1M1 correct method to work out total of front, back, outer curved and inner curved surfaces
	$2 \times 30 \times 3$ or 180	M1	implied by an answer of $n\pi + 180$ do not award if 180 is used as 180π
	$561\pi + 180$	A1	
	Additional Guidance		
	150π and 105π implies use of radius for curved surface areas		max M1M0M0M1A0
	Condone use of [3.14, 3.142] for π up to M1M1M0M1A0		

Question	Answer	Mark	Comments
19(a)	300	B2	B1 1100 or 1400 seen
19(b)	4	B1	
	Additional Guidance		
	Ignore incorrect 'units' eg 4 people		B1
19(c)	Ticks type B and gives valid reason	B2	eg valid reasons (median for A is) 1260 and (median for B is) 1300 median for B is 40 more (than A) B1 no or incorrect decision and (median for A is) 1260 and (median for B is) 1300 or no or incorrect decision and median for B is 40 more (than A) or ticks type B and (median for B is) 1300 and (median for A is) 1230 or 1280 or ticks type B and B has a larger median (than A) (if one median given it must be correct)
	Additional Guidance		
	If median values are not given in the wording, look for values on the graph and box plot		
	Ticks type B but gives no valid reason		B0
	Allow use of average or middle for median, or a correct description eg 'top 50%'. Do not accept 'mean' or 'mode' or other statistical measures for median		
	Ignore comments about measures other than the median		
	Ignore units given in explanation		

Question	Answer	Mark	Comments
20	**Alternative method 1**		
	(5^{th} term =) $a + 10b + 4b + 4b$ or (5^{th} term =) $a + 18b$	M1	oe
	$a + 6b = 8$ and $a + 18b = 44$	M1dep	oe correct simultaneous equations eg $3a + 18b = 24$ and $a + 18b = 44$ implied by $12b = 36$ or $2a = –20$
	$b = 3$ or $a = –10$	A1	
	$a = –10$ and $b = 3$	A1	
	Alternative method 2		
	$(d =) \frac{44 – 8}{3}$ or $(d =) \frac{36}{3}$ or $(d =) 12$	M1	any letter
	$4b = 12$	M1dep	oe
	$b = 3$	A1	
	$a = –10$ and $b = 3$	A1	
	Additional Guidance		
	Correct substitution without writing simultaneous equations scores the first two marks on alt 1 eg ($a = 8 – 6b$ and) $8 – 6b + 18b = 44$		M1M1

Question	Answer	Mark	Comments
21	Triangle with vertices (–4, 1) and (0, 5) and (–2, 5)	B2	B1 one of (–4, 1) (0, 5) (–2, 5) or triangle correct size and orientation in wrong position
	Additional Guidance		
	Triangle must be drawn for B2		
	Ignore labelling of vertices on enlarged triangle		
			B2
22	A U B′	B1	

Question	Answer	Mark	Comments
23	**Alternative method 1**		
	$\frac{6}{5}$ or $\frac{3}{4}$	M1	oe fractions, decimals or percentages, but not $\frac{6}{5}$ as a mixed number
	$\frac{6}{5} \times \frac{3}{4}$ or $\frac{18}{20}$ or $\frac{9}{10}$ or 0.9 or 90% or 0.1 or 10%	M1dep	oe fractions or decimals, but not $\frac{6}{5}$ as a mixed number
	$\frac{1}{10}$	A1	oe fraction
	Alternative method 2		
	Chooses value for price and increases by $\frac{1}{5}$ or chooses number of laptops and decreases by $\frac{1}{4}$	M1	correct method or value for either eg (£)5 and (£)6 or 20 (laptops) and 15 (laptops)
	Chooses value for price and increases by $\frac{1}{5}$ and chooses number of laptops and decreases by $\frac{1}{4}$ and $\frac{\text{reduced income}}{\text{original income}}$ (× 100) or $\frac{\text{reduction}}{\text{original}}$ (× 100)	M1dep	correct method or values eg $\frac{6 \times 15}{5 \times 20}$ (× 100) or $\frac{5 \times 20 - 6 \times 15}{5 \times 20}$ (× 100)
	$\frac{1}{10}$	A1	oe fraction
	Additional Guidance		
	For full marks, accept a fraction equivalent to $\frac{1}{10}$ incorrectly simplified, but not converted to a decimal or percentage		M1M1A1 M1M1A0
	If both methods tried and answer incorrect, award better method mark		
	Accept variables in any working for M1M1		

Question	Answer	Mark	Comments
24(a)	$\frac{1}{16}$	B3	B2 2^{-4} or $\frac{1}{2^4}$ or 4^{-2} or $\frac{1}{4^2}$ or 16^{-1} or 0.5^4 or $\frac{16\,384}{262\,144}$ oe fraction B1 2^{18} or $2^5 \div 2^9$ or $(2^2)^{-2}$ or $4^7 \div 4^9$
24(b)	$25 \times 25^{\frac{1}{2}}$ or $(25^{\frac{1}{2}})^3$ or $(25^3)^{\frac{1}{2}}$ or $25\ (\times)\sqrt{25}$ or 25×5 or 5^3 or $\sqrt{25^3}$ or $(\sqrt{25})^3$ or $\sqrt{15\,625}$ or $15\,625^{\frac{1}{2}}$ or $\sqrt{25 \times 25^2}$ or $\sqrt{25 \times 625}$	M1	oe condone ± on any $\sqrt{\ }$
	125	A1	
	Additional Guidance		
	± 125		M1A0
25(a)	300	B1	
25(b)	240	B1	

Question	Answer	Mark	Comments
26	**Alternative method 1**		
	$\frac{4}{5} : \frac{2}{3} : 1$	M1	
	$\frac{12}{15} : \frac{10}{15} : \frac{15}{15}$	M1dep	oe common denominator implied by correct unsimplified ratio eg 24 : 20 : 30
	12 : 10 : 15	A1	
	Alternative method 2		
	$a : c = 4 : 5$ or $b : c = 2 : 3$	M1	oe may be seen as part of a ratio with three values
	$a : c = 12 : 15$ and $b : c = 10 : 15$	M1dep	oe with c values equal
	12 : 10 : 15	A1	
	Alternative method 3		
	$(5a =) \ 6b = 4c$ or $1 : \frac{5}{6} : \frac{5}{4}$ or $\frac{6}{5} : 1 : \frac{6}{4}$	M1	oe ratio
	$\frac{12}{12} : \frac{10}{12} : \frac{15}{12}$ or $\frac{24}{20} : \frac{20}{20} : \frac{30}{20}$	M1dep	oe common denominator implied by correct unsimplified ratio eg 24 : 20 : 30
	12 : 10 : 15	A1	
	Alternative method 4		
	Picks values so that a is four fifths of c and b is two thirds of c	M1	eg $(a =) \ 60$, $(b =) \ 50$, $(c =) \ 75$ $(a =) \ 4$, $(b =) \ \frac{10}{3}$, $(c =) \ 5$
	Correct ratio for their values as integers or fractions with a common denominator	M1dep	eg 60 : 50 : 75 or $\frac{12}{3} : \frac{10}{3} : \frac{15}{3}$
	12 : 10 : 15	A1	

Question	Answer	Mark	Comments
27(a)	Ticks No and gives valid reason	B1	eg valid reasons could use formula could complete the square could use $\frac{-3 \pm \sqrt{29}}{2}$
	Additional Guidance		
	Any working or solutions shown must be correct		
	If the quadratic formula is written down it must be correct		
	Ignore irrelevant non-contradictory statements		
	Ticks No and 'There are other methods'	B1	
	Ticks No and 'a and b could be decimals'	B1	
	Ticks No and 'She could draw a graph'	B1	
	Ticks No and 'All quadratic equations can be solved (even if the solutions aren't real numbers)'	B1	
	Ticks No and 'The discriminant is positive'	B1	
	Ticks No and 'Not all quadratics factorise'	B0	
	Ticks No and 'It does factorise'	B0	
	Ticks Yes	B0	

Question	Answer	Mark	Comments
27(b)	$(x + 3)^2 = \frac{4}{9}$ or $\sqrt{9}(x + 3) = (\pm)\sqrt{4}$ or $3(x + 3) = (\pm)2$ or $\left((x+3)+\frac{2}{3}\right)\left((x+3)-\frac{2}{3}\right)$	M1	oe
	$x + 3 = \pm\sqrt{\frac{4}{9}}$ or $3x = \pm 2 - 9$ or $x + 3 = \pm\frac{2}{3}$	M1dep	oe eg $(x =) -3 \pm \sqrt{\frac{4}{9}}$ $(x =) \frac{2}{3} - 3$ and $(x =) -\frac{2}{3} - 3$
	$-\frac{7}{3}$ and $-\frac{11}{3}$ with correct working for M1M1	A1	allow equivalent fractions or recurring decimals or mixed numbers
	Additional Guidance		
	For up to M1M1, allow 0.66… or 0.67 for $\frac{2}{3}$ and –2.33… for $-\frac{7}{3}$ and –3.66… or –3.67 for $-\frac{11}{3}$		
	Answers –2.33… and –3.66… or –3.67 with correct working		M1M1A0
	$(x =) -\frac{7}{3}$ and $(x =) -\frac{11}{3}$ with no correct working		M0M0A0
	Do not allow incorrect conversion of correct solutions		M1M1A0
	Allow $3(x + 3) = (\pm)\ 2$ followed by $3x + 9 = (\pm)\ 2$ etc as a correct method even though it includes a bracket expansion		

Question	Answer	Mark	Comments
28	$\frac{14\sqrt{5}}{3}$	B3	oe eg $\frac{28\sqrt{5}}{6}$ B2 $(\sqrt{2\frac{2}{9}} =) \frac{2\sqrt{5}}{3}$ or $(\sqrt{80} =) 4\sqrt{5}$ and $(\sqrt{2\frac{2}{9}} =) \frac{\sqrt{20}}{3}$ or $(\sqrt{2\frac{2}{9}} =) \frac{2\sqrt{5}}{\sqrt{9}}$ B1 $(\sqrt{80} =) 4\sqrt{5}$ or $(\sqrt{2\frac{2}{9}} =) \frac{\sqrt{20}}{3}$ or $(\sqrt{2\frac{2}{9}} =) \frac{2\sqrt{5}}{\sqrt{9}}$

Additional Guidance	
For B1 or B2, allow $\frac{6\sqrt{5}}{9}$ for $\frac{2\sqrt{5}}{3}$ and $\frac{\sqrt{180}}{9}$ for $\frac{\sqrt{20}}{3}$	
$\frac{14}{3}\sqrt{5}$	B3
$16\sqrt{5} + \frac{2\sqrt{5}}{3} = \frac{50\sqrt{5}}{3}$	B2
$4\sqrt{5} + \frac{2\sqrt{5}}{3} = 4\frac{2}{3}\sqrt{5}$	B2
$4\sqrt{5} + \frac{2\sqrt{5}}{9} = \frac{38\sqrt{5}}{9}$	B1
$2\sqrt{20} + \frac{\sqrt{20}}{3} = \frac{7\sqrt{20}}{3}$	B1

Question	Answer	Mark	Comments
29(a)	**Alternative method 1**		
	$(x + 3)^2 - 1$	M1	
	$x^2 + 3x + 3x + 9 - 1$ or $x^2 + 6x + 8$	M1	oe
	$b = 6$ and $c = 8$	A1	SC1 $b = 6$ or $c = 8$
	Alternative method 2		
	$(x - 3)^2 + b(x - 3) + c = x^2 - 1$	M1	
	$x^2 - 6x + 9 + bx - 3b + c = x^2 - 1$	M1	
	$b = 6$ and $c = 8$	A1	SC1 $b = 6$ or $c = 8$
	Alternative method 3		
	$(x + 3 + 1)(x + 3 - 1)$ or $(x - -4)(x - -2)$ or $(x + 4)(x + 2)$	M1	difference of two squares from the original roots
	$x^2 + 4x + 2x + 8$ or $x^2 + 6x + 8$	M1	
	$b = 6$ and $c = 8$	A1	SC1 $b = 6$ or $c = 8$
	Additional Guidance		
	Working out the roots of the original curve or the translated curve is not enough for M1 in alt 3		

Question	Answer	Mark	Comments

29(b)	$y = 1 - x^2$ or $y = -x^2 + 1$	B1	oe equation
	Additional Guidance		
	$-y = x^2 - 1$		B1
	$y = -(x^2 - 1)$		B1
	$y = -(x - 1)(x + 1)$		B1
	$y = 1 - (-x)^2$		B1
	($y = 1 - x^2$ in working with answer) $1 - x^2$		B0
	$y = (-x)^2 + 1$		B0
	f(x) = $1 - x^2$		B0

30	$\frac{\sqrt{3}}{2} \times \sqrt{3} + \frac{1}{2}$ $= \frac{3}{2} + \frac{1}{2}$ $= 2$	B3	B2 $\frac{\sqrt{3}}{2} \times \sqrt{3} + \frac{1}{2}$ B1 $\cos 30° = \frac{\sqrt{3}}{2}$ or $\tan 60° = \sqrt{3}$ or $\sin 30° = \frac{1}{2}$
	Additional Guidance		
	For B3 all steps must be shown		
	Allow $\frac{\sqrt{3}}{2} \times \sqrt{3} + \frac{1}{2}$ given as $\frac{\sqrt{3}}{2} \times \sqrt{3}$, followed by their $\frac{3}{2} + \frac{1}{2}$		
	Allow equivalent expressions for all trig values eg $\cos 30° = \sqrt{\frac{3}{4}}$ $\sin 30° = \frac{\sqrt{1}}{2}$ $\tan 60° = \frac{\sqrt{3}}{\sqrt{1}}$		
	For B1 allow the trig value(s) given in a table unless contradicted in working		