AQA

GCSE

Methods in Mathematics

93651H: Higher Tier

Mark scheme

9365

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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

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.

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.

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Q	Answer	Mark	Comments
*1	0.2 × 140 or 28 or 1.2 seen or $\frac{1}{4}$ × 220 or 55 or $\frac{3}{4}$ seen	M1	oe
	140 + their 28 or 1.2 × 140 or 168 or 220 – their 55 or $\frac{3}{4}$ × 220 or 165	M1	oe
	168 and 165	A1	
	168 and 165 and (Box) A	Q1ft	Strand (iii) ft their 168 and 165 provided all methods correct
	Additional Guidance		
	28 or 55 will score at least M1		
	168 or 165 will score at least M2		
	168 and 165 will score at least M2 A1		
	168 and 165 and Box A will score all the marks		
	The Qft mark can only be awarded if both methods for increasing 140 by 20% and decreasing 220 by 1/4 are complete and correct		

2(a)	64	B1	

2(b)	21	B1	

Q	Answer	Mark	Comments
*2(c)	**Alternative method 1**		
	$\sqrt[3]{10\,648}$ or 22 or $22^3 = 10\,648$	M1	
	$46^3 = 97\,336$ or $47^3 = 103\,823$	M1	
	22 or 22^3 (= 10 648) and $46^3 = 97\,336$ and $47^3 = 103\,823$ and 46 – 21 = 25 oe or 47 – 22 = 25 oe or shows all correct values from 23^3 to 45^3	Q1	Strand (ii) Correct method and values Evaluation is not necessary but if done must be correct SC1 Any 5 correct cube numbers from 12 167 to 97 336
	Alternative method 2		
	$\sqrt[3]{10\,648}$ or 22	M1	
	$\sqrt[3]{99\,999}$ = 46(….)	M1	
	22 or 22^3 (= 10 648) and $\sqrt[3]{99\,999}$ = 46(….) 46 – 21 = 25 oe or 47 – 22 = 25 oe	Q1	Strand (ii) SC1 Any 5 correct cube numbers from 12 167 to 97 336
	Additional Guidance		

The other cube values are:

23	12 167	29	24 389	35	42 875	41	68 921
24	13 824	30	27 000	36	46 656	42	74 088
25	15 625	31	29 791	37	50 653	43	79 507
26	17 576	32	32 768	38	54 872	44	85 184
27	19 683	33	35 937	39	59 319	45	91 125
28	21 952	34	39 304	40	64 000		

Q	Answer	Mark	Comments
3	$15x + 36$	M1	
	Their $15x - 4x = -8 -$ their 36 or $11x = -44$	M1	Rearranging to give x term(s) on one side and number term(s) on the other
	-4	A1ft	ft M1M0 or M0M1 with one arithmetic or rearrangement error
	Additional Guidance		
	$15x + 12$ $11x = -20$ $x = -\frac{20}{11}$		M0 M1 A1ft
	$15x + 12$ $11x = -8 - 12$ $x = \frac{4}{11}$		M0 M1 A0
	$15x + 36$ $19x = -44$ $x = -\frac{44}{19}$		M1 M0 A1ft

Q	Answer	Mark	Comments
4	Reference to a large number of trials eg roll the dice 60 times	B1	Accept 'lots' or a number of trials ≥ 30
	Reference to theoretical probability or Works out the expected frequency for each number	B1	eg (if it's fair) the probability for each number should be $\frac{1}{6}$ eg (if it's fair) it should be (approximately) the same frequency for each number
	Additional Guidance		
	For second B1, ignore incorrect divisions by 6 if wording attracts the mark		
	Examples of reference to a large number of trials:		
	Roll the dice 60 times	B1	
	Keep on rolling the dice	B1	
	Roll the dice again and again	B1	
	Roll the dice numerous times / multiple times	B1	
	Roll the dice a number of times	B0	
	Reference to theoretical probability or expected frequency:		
	For 60 rolls it should land on 1 (approximately) 10 times	B1	
	It should be about the same (relative) frequency for each number	B1	
	If it keeps on landing on one number (more than others) it is biased	B1	
	It should land on each number (roughly) the same amount	B1	
	Roll it 6 times; each number should come up once	B1	
	Compare the results to see if it landed on one number more than another	B1	
	You can work out the relative frequency to see if it's fair	B0	

Q	Answer	Mark	Comments
5	$0 < 2x \leq 9$ or $0 < 2x$ or $0 < x$ or $2x \leq 9$ or $x \leq 4.5$	M1	or embedded answers for any two of $(2 \times 1) - 1 = 1$ $(2 \times 2) - 1 = 3$ $(2 \times 3) - 1 = 5$ $(2 \times 4) - 1 = 7$
	$0 < x \leq 4.5$	M1	or embedded answers for all four correct values only identified
	1, 2, 3, 4	A1	SC2 all 4 correct values with one incorrect or 3 correct values with none incorrect SC1 all 4 correct values with two incorrect or 3 correct values with one incorrect or 2 correct values with none incorrect

Q	Answer	Mark	Comments
6(a)	–4	B1	
6(b)	**Alternative method 1**		
	$\frac{9-1}{6-2}$ or $\frac{8}{4}$ or 2	M1	Could be embedded eg 1 = 2 × 2 – 3
	(20 – 6) × their 2 or 28	M1	
	37	A1	Accept (20, 37)
	Alternative method 2		
	$\frac{9-1}{6-2}$ or $\frac{8}{4}$ or 2	M1	
	(20 – 2) × their 2 or 36	M1	
	37	A1	Accept (20, 37)
	Alternative method 3		
	$\frac{9-1}{6-2}$ or $\frac{8}{4}$ or 2	M1	implied by $y = 2x$ …
	$y = 2x - 3$ or $m = 2$ and $c = -3$	M1	Correct equation or correct intercept for either point and their gradient
	37	A1	Accept (20, 37)
	Alternative method 4		
	$\frac{8}{4} = \frac{a-1}{18}$	M1	
	$36 = a - 1$	M1	
	37	A1	Accept (20, 37)

Q	Answer	Mark	Comments
6(b)	**Alternative method 5**		
	$\frac{8}{4} = \frac{a-9}{14}$	M1	
	$28 = a - 9$	M1	
	37	A1	Accept (20, 37)
7	200 × 0.68(0) or 136 or 400 × 0.74(0) or 296 or 600 × 0.755 or 453 or 885	M1	
	(200 × 0.68(0) + 400 × 0.74(0) + 600 × 0.755) ÷ 1200 or (136 + 296 + 453) ÷ 1200 or 885 ÷ 1200	M1	
	0.7375	A1	Accept 0.738 without working Accept 0.74 with working
	Additional Guidance		
	Be aware that 0.725 is the mean of the three relative frequencies given and does not attract any marks		

Q	Answer	Mark	Comments
8	Plots or identifies at least three points on the graph of $y = x^2 - 5$	M1	Any three from (–5, 20), (–4, 11), (–3, 4), (–2, –1), (–1, –4), (0, –5), (1, –4), (2, –1), (3, 4), (4, 11) and (5, 20),
	Correctly draws the graph of $y = x^2 - 5$ from $x = -5$ to $x = 5$	A1	
	Correctly draws the graph of $y = 4 - x$	B1	from (–5, 9) to (5, –1)
	–3.5 and 2.5	B2ft	Correct x coordinates of the intersections of their graphs B1 one value correctly identified or both correct values given in pairs of coordinates SC2 –3.5 and 2.5 given from non-graphical methods
	Additional Guidance		
	Allow a tolerance of 0.1 for readings from intersections		
	Full marks can be gained from values which are not –3.5 and 2.5 if the graphs have been drawn correctly and readings are within tolerance		
	If their graphs only have one intersection they can only score B1 of the last two marks. If they have more than two intersections they must give them all for B2 or all but one for B1		
	Condone incomplete graphs if the intersections are clear		

Q	Answer	Mark	Comments
9	**Alternative method 1**		
	$2n + 3$ or $2n + 5$ or $2n + 7$ or $2(n + 1) + 1$ or $2(n + 2) + 1$ or $2(n + 3) + 1$	M1	or $2n – 1$ or $2n – 3$ or $2n – 5$ or $2(n – 1) + 1$ or $2(n – 2) + 1$ or $2(n – 3) + 1$
	$2n + 1 + 2n + 3 + 2n + 5 + 2n + 7$ or $2n + 2n – 1 + 2n – 3 + 2n – 5$	M1	oe their four different expressions added
	$8n + 16$ or $8n – 8$	A1ft	oe correct simplification of the sum of their four expressions with M0M1 awarded
	$8(n + 2)$ or $8(n – 1)$	Q1	Strand ii Fully correct algebra with factorisation or an explanation that $8n$ and either 16 or 8 are both multiples of 8
	Alternative method 2		
	m and $m + 2$	M1	Accept m and $m – 2$
	$m + m + 2 + m + 4 + m + 6$	M1	oe their four different expressions added
	$4m + 12$	A1ft	oe correct simplification of the sum of their four expressions with M0M1 awarded
	$4(m + 3)$ and $m + 3$ must be even and 4 × an even number is a multiple of 8	Q1	Strand ii Fully correct algebra with correct factorisation and explanation
	Additional Guidance		
	$2n + 1 + 2n + 2 + 2n + 3 + 2n + 4$		M0M1A0Q0
	$2n + 1 + 2n + 2 + 2n + 3 + 2n + 4 = 8n + 10$		M0M1A1Q0
	Allow any letter		
	Numerical example(s) only		M0M0A0Q0

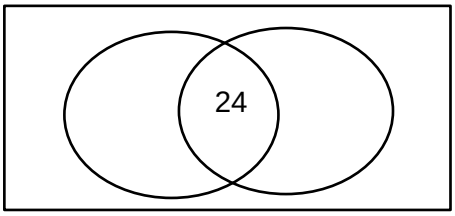
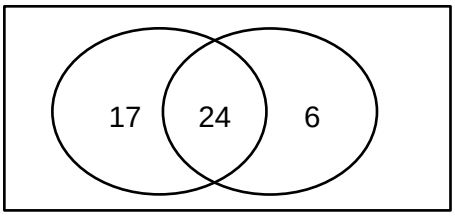
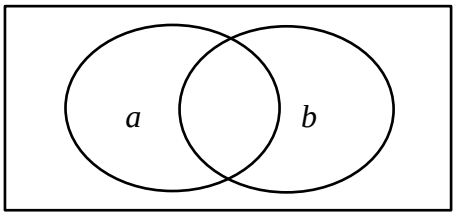
Q	Answer	Mark	Comments
10	**Alternative method 1**		
	P(£1 first + anything) = $\frac{2}{7}$ or $\frac{2}{7} \times \frac{6}{6}$	M1	oe
	$\frac{5}{7} \times \frac{2}{6}$ or $\frac{10}{42}$ or $\frac{2}{7} \times \frac{1}{6}$ or $\frac{2}{42}$	M1	oe Not £1 followed by £1 oe 50p followed by 50p
	their $\frac{2}{7} + (\frac{5}{7} \times \frac{2}{6}) + (\frac{2}{7} \times \frac{1}{6})$	M1	
	$\frac{24}{42}$	A1	oe fraction, decimal or percentage $\frac{4}{7}$ 0.57(1…) 57(.1…)%
	Alternative method 2		
	$\frac{2}{7} \times \frac{3}{6}$ or $\frac{6}{42}$	M1	oe 50p followed by 5p, 10p or 20p
	$\frac{3}{7} \times \frac{4}{6}$ or $\frac{12}{42}$	M1	oe 5p, 10p or 20 followed by anything except £1
	$1 - (\frac{2}{7} \times \frac{3}{6}) - (\frac{3}{7} \times \frac{4}{6})$	M1	
	$\frac{24}{42}$	A1	oe fraction, decimal or percentage $\frac{4}{7}$ 0.57(1…) 57(.1…)%

Q	Answer	Mark	Comments
10	**Alternative method 3**		
	P(£1 first + anything) = $\frac{2}{7}$ or $\frac{2}{7} \times \frac{6}{6}$ or $\frac{2}{7} \times \frac{3}{6}$ or $\frac{6}{42}$ or $\frac{3}{7} \times \frac{2}{6}$ or $\frac{6}{42}$	M1	50p first 5p, 10p or 20p first
	P(£1 first + anything) = $\frac{2}{7}$ or $\frac{2}{7} \times \frac{6}{6}$ and $\frac{2}{7} \times \frac{3}{6}$ or $\frac{6}{42}$ and $\frac{3}{7} \times \frac{2}{6}$ or $\frac{6}{42}$	M1	
	$\frac{2}{7} + (\frac{2}{7} \times \frac{3}{6}) + (\frac{3}{7} \times \frac{2}{6})$	M1	
	$\frac{24}{42}$	A1	oe fraction, decimal or percentage $\frac{4}{7}$ 0.57(1…) 57(.1…)%

Q	Answer	Mark	Comments
10	**Alternative method 4**		
	Identifies a total of 21 or 42 outcomes	M1	eg 7×6 or a full list implied by a denominator of 21 or 42
	Identifies all ways of obtaining at least £1 (12 or 24 ways) or Identifies all ways of **not** obtaining at least £1 (9 or 18 ways)	M1	
	Identifies a total of 21 or 42 outcomes and Identifies all ways of obtaining at least £1 (12 or 24 ways) or Identifies all ways of **not** obtaining at least £1 (9 or 18 ways)	M1	21 must be with 12 or 9 42 must be with 24 or 18
	$\frac{24}{42}$	A1	oe fraction, decimal or percentage $\frac{4}{7}$ 0.57(1…) 57(.1…)%
	Additional Guidance		
	The 24 ways of obtaining at least £1 are: £1 £1 £1 50p £1 50p £1 50p £1 50p £1 20p £1 20p £1 10p £1 10p £1 5p £1 5p 50p 50p and their reverses The 18 ways of not getting at least £1 are: 50p 20p 50p 20p 50p 10p 50p 10p 50p 5p 50p 5p 20p 10p 20p 5p 10p 5p and their reverses		
	Ignore incorrect simplification or conversion of a correct answer eg $\frac{24}{42} = \frac{3}{7}$		M1M1M1A1

Q	Answer	Mark	Comments
11	Any two of $(10x + 3)(x – 4)$ and 5 and $(– 2x) \times 5 \times (x – 4)$	M1	oe $10x^2 – 40x + 3x – 12$ 5 $–10x^2 + 40x$
	$\frac{10x^2 – 37x – 12 + 5 – 10x^2 + 40x}{5(x – 4)}$	M1	oe can be separate fractions $\frac{10x^2 – 40x + 3x – 12 + 5 – 10x^2 + 40x}{5(x – 4)}$ Allow one expansion error in their numerator (or denominator if expanded)
	$\frac{3x – 7}{5(x – 4)}$ or $\frac{3x – 7}{5x – 20}$	A1	
12	60 ÷ 400 (× 100) or 0.15 (× 100) or 60 ÷ 4 or $\frac{3}{20}$ or equivalent fraction	M1	$\frac{60}{400}$ or $\frac{30}{200}$ or $\frac{15}{100}$
	15	A1	
13	300 ÷ (1 + 5) or 300 ÷ 6 or 50	M1	
	250	A1	
	Additional Guidance		
	250 : 50 or 50 : 250		M1A0
14(a)	$\frac{16}{22}$ (–) $\frac{11}{22}$	M1	Appropriate common denominator with at least one numerator correct
	$\frac{5}{22}$	A1	oe

Q	Answer	Mark	Comments
14(b)	**Alternative method 1**		
	$\frac{3 \times 8 + 1}{8}$ or $\frac{25}{8}$	M1	Conversion to a fraction
	$\frac{\text{their}25}{2\text{x}8}$ or $\frac{\text{their}25}{16}$ or $\frac{25}{16}$	M1	oe must be a fraction or mixed number, but condone decimal numerators
	$1\frac{9}{16}$	A1	oe mixed number SC2 1.5625
	Alternative method 2		
	$1\frac{1}{2}$ and $\frac{1}{16}$	M1	oe
	$\frac{24}{16} + \frac{1}{16}$ or $\frac{25}{16}$	M1	oe must have a common denominator
	$1\frac{9}{16}$	A1	oe mixed number SC2 1.5625
	Additional Guidance		
	$1.5\frac{1}{16}$	M1	
	$1\frac{4.5}{8}$ or $\frac{12.5}{8}$	M1M1	
	In alt 1, for the 2nd mark a fraction in the form $\frac{m}{n}$ should become $\frac{m}{2n}$ or $\frac{m/2}{n}$ where $m/2$ can be a decimal		

Q	Answer	Mark	Comments
15	30 ÷ 5 × 4 or 24	M1	
	Their 24 + 23 or 47 or sum of two outer parts of circles is 23	M1	  $a + b = 23$
	50 – their 47 or 50 – their 17 – their 24 – their 6 or 3	M1dep	dep on M1M1
	$\frac{3}{50}$	A1	oe fraction, decimal or percentage 0.06 6%

Q	Answer	Mark	Comments
16	$54x^8$	B2	B1 54 or x^8
	Additional Guidance		
	Ignore a multiplication sign between 54 and x^8 but not any other sign		
	$54 \times x^8$ or $x^8 \times 54$		B2
	Condone $x^8 54$		B2
	$54x^{15}$ or $15x^8$ or $15 \times x^8$		B1
	$54 + x^8$ or $54 + x^{15}$ or $15 + x^8$ or 54^8		B0
17	**Alternative method 1**		
	$4x + 4y$ (= $6y - 7$)	B1	
	$4x = 2y - 7$	M1	Isolates x term after their expansion
	$x = \frac{2y-7}{4}$ or $x = \frac{y}{2} - \frac{7}{4}$	A1ft	ft their expansion into $ax + by$ SC2 $\frac{2y-7}{4}$ or $\frac{y}{2} - \frac{7}{4}$
	Alternative method 2		
	$x + y = \frac{6y-7}{4}$	B1	
	$x = \frac{6y-7}{4} - y$	M1	
	$x = \frac{2y-7}{4}$ or $x = \frac{y}{2} - \frac{7}{4}$	A1ft	ft their division into $\frac{6y-7}{a}$ SC2 $\frac{2y-7}{4}$ or $\frac{y}{2} - \frac{7}{4}$
	Additional Guidance		
	Accept $\frac{2y-7}{4} = x$		B1M1A1

Q	Answer	Mark	Comments
18	**Alternative method 1**		
	0.5 or 10^7	M1	
	0.5×10^7	A1	
	5×10^6	A1ft	ft their 0.5×10^7 correctly converted into standard form with M1 scored SC1 5×10^n, where n is an integer
	Alternative method 2		
	1300 or 0.00026	M1	
	5 000 000	A1	
	5×10^6	A1ft	ft their 5 000 000 correctly converted into standard form with M1 scored SC1 5×10^n, where n is an integer
	Additional Guidance		
	In alternative method 1 their 0.5 must be less than 1 or more than 10 to access A1ft		

Q	Answer	Mark	Comments
19	**Alternative method 1**		
	0.3 × 0.2 or 0.06 or 0.7 × 0.8 or 0.56	M1	oe
	0.3 × 0.2 + 0.7 × 0.8 or 0.06 + 0.56	M1	oe
	0.62	A1	oe fraction, decimal or percentage
	Alternative method 2		
	0.3 × 0.8 or 0.24 or 0.7 × 0.2 or 0.14	M1	oe An answer of 0.86 implies 0.14
	1 – 0.3 × 0.8 – 0.7 × 0.2 or 1 – 0.24 – 0.14 or 1 – 0.38	M1	oe
	0.62	A1	oe fraction, decimal or percentage

Q	Answer	Mark	Comments
20	**Alternative method 1**		
	$Q = \frac{4}{400}$	M1	oe $Q = \frac{1}{100}$
	$P = 5 \times \frac{2}{20}$ or $P = 5\sqrt{\frac{4}{400}}$ or $P = 5\sqrt{0.01}$	M1	oe $P = 5 \times \frac{1}{10}$
	$P = \frac{10}{20}$ and $P = \frac{1}{2}$	A1	with fully correct working shown oe $P = \frac{5}{10}$ and $P = \frac{1}{2}$
	Alternative method 2		
	$P = 5 \times \sqrt{\frac{4}{R^2}}$	M1	
	$P = 5 \times \frac{2}{R}$	M1	
	$P = 5 \times \frac{2}{20}$ and $P = \frac{10}{20}$ and $P = \frac{1}{2}$	A1	with fully correct working shown

Q	Answer	Mark	Comments
20	**Alternative method 3**		
	$Q = \frac{P^2}{25}$	M1	
	$\frac{\frac{1}{4}}{25} = \frac{4}{R^2}$	M1	
	$R^2 = 4 \times 25 \div \frac{1}{4}$ and $R^2 = 400$ and $R = 20$	A1	with fully correct working shown
21	$\sqrt{(6-(-2))^2+(-3-1)^2}$ or $\sqrt{8^2+4^2}$ or $\sqrt{64+16}$	M1	oe
	$\sqrt{80}$ or $\sqrt{4}\sqrt{20}$ or $\sqrt{16}\sqrt{5}$	A1	
	$2\sqrt{20}$ or $4\sqrt{5}$	A1ft	ft simplification of their surd if possible and M1 scored

Q	Answer	Mark	Comments
22	**Alternative method 1**		
	$2x + 12y = –16$	M1	oe equates one coefficient Allow one error
	$7y = –21$	M1	Correctly subtracts their equations to eliminate one unknown
	$y = –3$	A1	
	$x = 10$	A1	
	Alternative method 2		
	($x + 6y = –8$ and) $5x + 30y = –40$ and $12x + 30y = 30$	M1	oe equates one coefficient Allow one error
	$7x = 70$	M1	Correctly subtracts their equations to eliminate one unknown
	$x = 10$	A1	
	$y = –3$	A1	
	Alternative method 3		
	($x + 6y = –8$ and) $x = – 6y – 8$	M1	Multiplies to give a coefficient of 1 Allow one error
	$2(– 6y – 8) + 5y = 5$ and $– 7y = 21$ or $7y = –21$	M1	Substitutes their expression to eliminate one variable
	$y = –3$	A1	
	$x = 10$	A1	

Q	Answer	Mark	Comments
23	**Alternative method 1**		
	$(x – 3)(x – 4)$	M1	
	$(x – 3)(x – 4)$ and If x is negative, both terms are negative and the product of two negatives is positive	A1	oe
	Alternative method 2		
	$(x – 3)(x – 4)$	M1	
	$(x – 3)(x – 4)$ and sketches the graph of $y = x^2 – 7x + 12$ or explains that $x^2 – 7x + 12$ is positive for all values of x less than 3	A1	
	Alternative method 3		
	x^2 must be positive or $–7x$ must be positive	M1	
	x^2 must be positive and $–7x$ must be positive and all three terms are positive or positive (+) positive (+) positive = positive	A1	
	Additional Guidance		
	Numerical example(s) only		M0A0
	Ignore general statements such as ‘A negative times a negative is always a positive’ unless applied to these terms		

Q	Answer	Mark	Comments
23	**Alternative method 4**		
	$(x - \frac{7}{2})^2 - \frac{49}{4} (+ 12)$	M1	
	$(x - \frac{7}{2})^2 - \frac{1}{4}$ and $(x - \frac{7}{2})^2$ must be greater than $\frac{49}{4}$ so total must be positive	A1	
	Additional Guidance		
	A sketch of the graph should indicate the roots at $x = 3$ and $x = 4$		
24	**Alternative method 1**		
	2^2 or $(\sqrt[3]{8})^2$ or $\sqrt[3]{64}$ or $\sqrt[3]{8^2}$ or 4	M1	
	$\frac{1}{2^2}$ or $\frac{1}{4}$	M1	
	$(4^x =)$ 1	M1	Accept $\frac{4}{4}$
	0	A1	SC1 0 without appropriate working
	Alternative method 2		
	$\left(4^{1.5}\right)^{⅔}$ or $\left(4^{0.5}\right)^{-2}$	M1	
	4^1 or 4^{-1}	M1	
	$4^1 \times 4^{-1}$ $(= 4^x)$	M1	
	0	A1	SC1 0 without appropriate working