GCSE

Methods in Mathematics (Linked Pair)

Higher Tier   Unit 1   Algebra and Probability
Mark scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

M	Method marks are awarded for a correct method which could lead to a correct answer.
M dep	A method mark dependent on a previous method mark being awarded.
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.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
Q	Marks awarded for quality of written communication.
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.
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.
25.3 …	Allow answers which begin 25.3 e.g. 25.3, 25.31, 25.378.
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.

Q	Answer	Mark	Comments
1	Correct line from (–1, –5) to (3, 3)	B3	B2 correct line drawn but of inadequate length or at least two correct points plotted with no incorrect points B1 any line with gradient 2 or any line through (0, –3) or at least two correct pairs of coordinates
	Additional Guidance		
	The correct line will score 3 marks, irrespective of the points plotted		
	The line must be ruled		
	Ignore extra points plotted if the line is correct		
	For B1, ignore incorrect pairs of coordinates if two correct pairs are seen, unless the x coordinate(s) of the incorrect pairs match those of the correct pairs(s)		

Q	Answer	Mark	Comments
	Alternative method 1		
	$\frac{2}{3}$ × 75 or 50	M1	oe
	0.2 × (300 – 75) or 45	M1	oe
	50 and 45	A1	
	50 > 45 or (50 – 45 =) 5 and Increased	Q1ft	Strand (iii) ft correct decision for their 50 and their 45 with at least M1 awarded and two values given
	Alternative method 2		
	$\frac{5}{3}$ × 75 or 125	M1	oe
	0.8 × (300 – 75) or 180	M1	oe
	125 and 180	A1	
2	125 + 180 = 305 and Increased	Q1ft	Strand (iii) ft correct total and decision for their 125 and their 180 with at least M1 awarded and the total of their two values given
	Additional Guidance		
	The Alt 1 scheme works out and compares the increase/decrease. The alt 2 scheme compares the number of beads after the increase/decrease.		
	The Q mark can only be awarded if M1 has been scored and the other value is given, even from an incorrect method.		
	50 and 45 or 125 and 180 scores at least M2 A1 unless from incorrect working.		
	A candidate may work out 50 and 45 correctly, but then use these to work out the new totals and make a mistake (eg 125 and 190). If the 125 and 190 are being used to arrive at a conclusion, the Q mark will be lost. The same is true if 125 and 180 are worked out first and then used to work out the increase/decrease.	M2 A1 Q0
	For the M marks (and the Q mark if appropriate), accept [0.33, 0.34] for $\frac{1}{3}$ and [0.66, 0.67] for $\frac{2}{3}$. For the A mark, values must be correct.		

Q	Answer	Mark	Comments
3	$10x – 4x$ or $6x$	M1	
	2 + 7 or 9	M1	
	1.5	A1ft	oe ft on M1M0 or M0M1 with only one calculation or rearrangement error
	Additional Guidance		
	$14x = 9$ and $x = \dfrac{9}{14}$		M0M1A1ft
	$6x = -5$ and $x = \dfrac{-5}{6}$		M1M0A1ft
	$14x = -5$ and $x = \dfrac{-5}{14}$		M0M0A0

Q	Answer	Mark	Comments
	Alternative method 1		
4	n even => p odd 5n is even and 3p is odd or n odd => p even 5n is odd and 3p is even	M1	
	n even => p odd 5n is even and 3p is odd and n odd => p even 5n is odd and 3p is even	A1	
	One of 5n and 3p is odd; the other is even and even + odd = odd	Q1	strand (ii) complete and accurate proof SC1 fully correct substitution and evaluation of 5n + 3p, where $p = n + 1$
	Alternative method 2		
	5n + 3(n + 1)	M1	
	8n + 3	A1	
	8n + 3 and 8n must be even and even + odd = odd	Q1	strand (ii) complete and accurate proof SC1 fully correct substitution and evaluation of 5n + 3p, where $p = n + 1$

Q	Answer	Mark	Comments
5 (a)	0.6	B1	oe

Q	Answer	Mark	Comments
5 (b)	**Alternative method 1**		
	0.55 or 0.4(0) and 0.2(0) or 0.6(0)	M1	oe Condone 55 or 40 and 20 or 60
	P(R ∪ F) = 0.55 **and** P(R) + P(F) = 0.6(0)	A1	oe Condone 55 and 60
	Alternative method 2		
	P(R ∪ F) = P(R) + P(F) – P(R ∩ F)	M1	
	Correct values for P(R ∪ F), P(R), P(F) and P(R ∩ F) or reasoning from P(R ∩ F) > 0	A1	
	Alternative method 3		
	P(R ∪ F) = P(R) + P(F) only if R and F are mutually exclusive	M1	
	R and F are not mutually exclusive as there is an intersection	A1	
	Additional Guidance		
	P(R) = 0.4(0) P(F) = 0.2(0) P(R ∪ F) = 0.55 P(R ∩ F) = 0.05		

Q	Answer	Mark	Comments
6	$5x(x - 4)$ or $5x^2 - 20x$	M1	
	$5x(x - 4) + 20x$ or $5x^2 - 20x + 20x$ or $5x^2$	M1	
	$y = \dfrac{5x^2}{3}$	A1	Condone $y = \dfrac{-5x^2}{-3}$ SC2 $\dfrac{5x^2}{3}$ or $\dfrac{-5x^2}{-3}$
	Additional Guidance		
	The SC2 responses are missing '$y =$'		
	Condone '$= y$' after the expression		

7	$72 ÷ (15 – 12)$ or $72 ÷ 3$ or 24	M1	Implied by 960
	312	A1	

8	8, 5, 3	B3	B1 for each coordinate SC1 5, 3, 8 or 3, 8, 5
	Additional Guidance		
	If the answer line is blank, look for coordinates given on the diagram		

Q	Answer	Mark	Comments
9	$\dfrac{2}{5}$ or $\dfrac{3}{5}$ or $\dfrac{1}{5}$ or $\dfrac{4}{5}$	M1	oe 0.4 or 0.6 or 0.2 or 0.8
	$\dfrac{3}{10} \times \dfrac{2}{5}$ or $\dfrac{6}{50}$ or $\dfrac{7}{10} \times \dfrac{1}{5}$ or $\dfrac{7}{50}$	M1	oe 0.12 or 0.14
	$\dfrac{3}{10} \times \dfrac{2}{5} + \dfrac{7}{10} \times \dfrac{1}{5}$ or $\dfrac{6}{50} + \dfrac{7}{50}$	M1	oe Award M3 for $1 - (\dfrac{3}{10} \times \dfrac{3}{5} + \dfrac{7}{10} \times \dfrac{4}{5})$ oe
	$\dfrac{13}{50}$	A1	oe 0.26

	Additional Guidance	
All probabilities may be on a tree diagram		
$1 - (\dfrac{9}{50} + \dfrac{28}{50})$ or $1 - \dfrac{37}{50}$		M3

10 (a)	$x^2 + y^2 = 169$ or $x^2 + y^2 = 13^2$	B1	oe

10 (b)	$\dfrac{5}{13}$	B1	

11 (a)	$y = -x^3$	B1	

11 (b)	$y = \dfrac{1}{x}$	B1	

Q	Answer	Mark	Comments
12	$0.315 \div 0.45$ or 0.7	M1	oe
	(their 0.7)³	M1	oe
	0.343	A1	oe
	Additional Guidance		
	'their 0.7' must come from a calculation involving 0.45 and 0.315 For example, $(0.45 - 0.315)^3$ or 0.135^3 or $0.00246(0375)$		M0 M1 A0

Q	Answer	Mark	Comments
14 (a)	$x^2 + 15x + 17 = 3x - 18$	M1	
14 (a)	$x^2 + 12x + 35 = 0$	A1	
14 (a)	$(x + 5)(x + 7)\ (= 0)$	B1	
13	or $(x =) \dfrac{-12 \pm \sqrt{12^2 - 4 \times (1\times)35}}{2(\times 1)}$ or $(x + 6)^2 = 1$	M1	$\dfrac{-12 \pm \sqrt{12^2 - 4 \times (1\times)35}}{2(\times 1)}$ correct factorisation or use of the quadratic formula or completing the square for their quadratic of the form $ax^2 + bx + c = 0$
	$(x =)$ –5 and –7 or $x = -5$ and $y = -33$ or $x = -7$ and $y = -39$	A1	
	$x = -5$ and $y = -33$ and $x = -7$ and $y = -39$	A1	

Q	Answer	Mark	Comments
14 (a)	2.232	B1	
14 (b)	7200	B1	
14 (c)	4.464	B1	

Q	Answer	Mark	Comments
15 (a)	0.1 or 10% or $\dfrac{1}{10}$	B1	
	Additional Guidance		
	1 : 10 or 10 : 1 or 1 : 9 or 9 : 1		B0

Q	Answer	Mark	Comments
15 (b)	No and reason indicating that there were not enough trials	B1	

Q	Answer	Mark	Comments
15 (c)	The results will probably be different from the first 10	B1	

Q	Answer	Mark	Comments
16	$3x + 12 + 10x – 5$	M1	Allow one sign or arithmetic error
	$13x + 7$	A1	
	Additional Guidance		
	Following the correct answer, ignore attempts to 'solve' $13x + 7 = 0$		

Q	Answer	Mark	Comments
			14 of 20

Q	Answer	Mark	Comments
17	Any three pairs from $a = 2$ $b = 6$ $a = 4$ $b = 3$ $a = 8$ $b = 2$ $a = 64$ $b = 1$	B2	Condone $a = -2$ $b = 6$ or $a = -8$ $b = 2$ B1 Any correct pair

Q	Answer	Mark	Comments
18	**Alternative Method 1**		
	100 × 101 or 10 100 or 5050	M1	
	their 10 100 ÷ 2 – 1275 or 5050 – 1275	M1dep	
	3775	A1	
	Alternative Method 2		
	50 × 50 or 2500	M1	
	their 2500 + 1275	M1dep	
	3775	A1	

Q	Answer	Mark	Comments
19	**Alternative method 1**		
	$\frac{3}{12}$ (+) $\frac{8}{12}$ or $\frac{11}{12}$	M1	Common denominator with at least one numerator correct
	1 – their $\frac{11}{12}$ or $\frac{1}{12}$	M1dep	
	7 × their 12 or 84	M1dep	dep on M1M1
	their 84 ÷ 3 × 2	M1dep	dep on M1M1M1
	56	A1	
	Alternative method 2		
	$\frac{3}{12}$ (+) $\frac{8}{12}$ or $\frac{11}{12}$	M1	Common denominator with at least one numerator correct
	1 – their $\frac{11}{12}$ or $\frac{1}{12}$	M1dep	
	$\frac{8}{12}$ ÷ their $\frac{1}{12}$ or 8	M1dep	dep on M1M1
	their 8 × 7	M1dep	dep on M1M1M1
	56	A1	

Q	Answer	Mark	Comments
20	**Alternative method 1**		
	763 000 or 48 200	M1	
	811 200	A1	
	8.112×10^5	B1ft	ft their total correctly converted to standard form with M1 awarded
	Alternative method 2		
	$(76.3 + 4.82) \times 10^4$	M1	oe
	81.12×10^4	A1	
	8.112×10^5	B1ft	ft their 81.12×10^4 correctly converted to standard form with M1 awarded

Q	Answer	Mark	Comments
21	$3n > -27$ or $27 > -3n$ or $9 > -n$	M1	
	$n > -9$	A1	

Q	Answer	Mark	Comments
22	**Alternative method 1**		
	$0.76 \div 8$ (× 100) or (0.0)95	M1	
	9.5	A1	
	Alternative method 2		
	0.8 is 10% and 0.08 is 1% or 0.08 is 1% and build up to 0.72 is 9% or 0.08 is 1% and 0.04 is 0.5%	M1	
	9.5	A1	

Q	Answer	Mark	Comments
23	$y = 2x \dots$ or gradient = 2	M1	
	-10 = their 2 × (–3) + c or $c = -4$ or $y + 10 = 2(x + 3)$	M1	ft their gradient
	$y = 2x - 4$	A1	

Q	Answer	Mark	Comments
24	$\dfrac{8}{11}$ (×) $\dfrac{7}{10}$ or $\dfrac{56}{110}$	M1	May be seen on a tree diagram
	1 – their $\dfrac{56}{110}$	M1 dep	
	$\dfrac{54}{110}$	A1	oe $\dfrac{28}{55}$
	Alternative method 2		
	$\dfrac{3}{11}$ (×) $\dfrac{2}{10}$ or $\dfrac{6}{110}$ or $\dfrac{3}{11}$ (×) $\dfrac{8}{10}$ or $\dfrac{24}{110}$ or $\dfrac{8}{11}$ (×) $\dfrac{3}{10}$ or $\dfrac{24}{110}$	M1	May be seen on a tree diagram
	$\dfrac{3}{11}$ (×) $\dfrac{2}{10}$ or $\dfrac{6}{110}$ and $\dfrac{3}{11}$ (×) $\dfrac{8}{10}$ or $\dfrac{24}{110}$ and $\dfrac{8}{11}$ (×) $\dfrac{3}{10}$ or $\dfrac{24}{110}$	M1 dep	May be seen on a tree diagram
	$\dfrac{54}{110}$	A1	oe $\dfrac{27}{55}$

Q	Answer	Mark	Comments
	Alternative method 1		
	$\sqrt{25}\sqrt{2}$ or $5\sqrt{2}$ or $\sqrt{49}\sqrt{2}$ or $7\sqrt{2}$ or $\sqrt{9}\sqrt{2}$ or $3\sqrt{2}$	M1	
	$\dfrac{\sqrt{25}\sqrt{2} + \sqrt{49}\sqrt{2}}{\sqrt{9}\sqrt{2}}$	M1	
	$\dfrac{5\sqrt{2} + 7\sqrt{2}}{3\sqrt{2}}$ or $\dfrac{12\sqrt{2}}{3\sqrt{2}}$	M1	
25	$(a =)\ 4$	Q1	strand ii correct working throughout
	Alternative method 2		
	$\dfrac{\sqrt{50} + \sqrt{98}}{\sqrt{18}} \times \dfrac{\sqrt{18}}{\sqrt{18}}$	M1	
	$\dfrac{\sqrt{50}\sqrt{18} + \sqrt{98}\sqrt{18}}{18}$	M1	oe
	$\dfrac{5\sqrt{2} \times 3\sqrt{2} + 7\sqrt{2} \times 3\sqrt{2}}{18}$	M1	oe
	4	Q1	strand ii correct working throughout

Q	Answer	Mark	Comments
26	$(3a - 2b)x^2 + (7a + 2b)x + 5b + a$ $(\equiv 13x^2 + 57x + c)$	M1	collects coefficients
	$3a - 2b = 13$ and $7a + 2b = 57$	M1	Allow multiples of these equations with one pair or equal coefficients
	$10a = 70$ or $21a - 14b = 91$ and $21a + 6b = 171$ and $20b = 80$	M1	
	$a = 7$ and $b = 4$	A1	
	27	A1ft	ft their a + 5 × their b with M2 scored
	Additional Guidance		
	27 with no working		0