GCSE

Methods in Mathematics (Linked Pair)

Foundation Tier   Unit 1   Algebra and Probability
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.

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
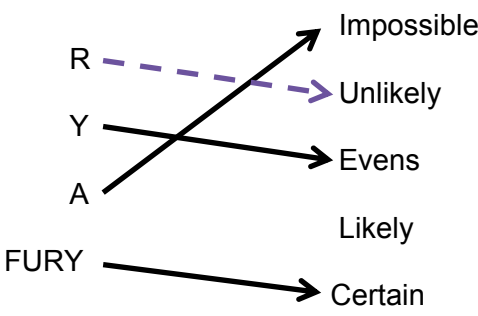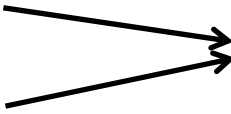
Erased or crossed out work that has been replaced is not awarded marks.
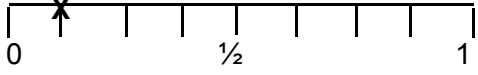
Premature approximation

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 (a)	110 000	B1	
1 (b)	$\dfrac{1}{4}$	B1	
1 (c)	0.8	B1	
1 (d)	0.05	B1	

2 (a)		B3	B1 for each correct answer
	Additional Guidance		
	Two arrows from the same event is choice and scores B0 for that event (though the candidate may still score if other events are correct)		
	Two arrows to the same chance may score a mark if one of the arrows is correct		

Q	Answer	Mark	Comments
2 (b)		B1	

	Additional Guidance	
	Accept any indication: cross, arrow, dot, etc	

Q	Answer	Mark	Comments
2 (c)	4 As, 6 Bs and 2 Cs	B2	B1 4 As or 3 Bs and 1C or 6 Bs and 2 Cs or 9 Bs and 3 Cs

	Additional Guidance	
	B1 can be scored even if other letters are used	

Q	Answer	Mark	Comments
3		B2	B1 2 or 8 or 5 in correct cell or at least one row, one column and one diagonal have the same total

Q	Answer	Mark	Comments
4 (a)	expression	B1	

Q	Answer	Mark	Comments
4 (b)	$4x = 19 - 5$ or $4x = 14$ or $(19 - 5) \div 4$	M1	
	3.5	A1	oe SC1 17.75 or 6 or –0.25 oe

Additional Guidance

17.75 comes from $x + \dfrac{5}{4} = 19$	
6 comes from $4x = 24$	
–0.25 comes from $x + 5 = \dfrac{19}{4}$	

Q	Answer	Mark	Comments
5	(0).138	B1	

Additional Guidance

Accept (0).138 followed by any number of 0s	B1
Accept (0).138 shown and then rounded to 0.1 or 0.14	B1
$\dfrac{138}{1000}$ or $\dfrac{69}{500}$	B0

Q	Answer	Mark	Comments
6 (a)	– 5	B1	

6 (b)	At least 2 points correctly plotted	M1	ft their table in (a)
	Correct line from (–1, –5) to (3, 3)	A1	
	Additional Guidance		
	The correct line scores 2 marks, irrespective of the points plotted or the value given in the table in (a)		
	The line must be ruled		
	Ignore a line drawn through (–1, –4) and (1, 4), which relates to part (c)		
	Ignore extra points plotted if the line is correct		
	There is no ft for the accuracy mark from an incorrect value in (a)		

Q	Answer	Mark	Comments
6 (c)	$4 \times x$ or $x \times 4$ or $4x$ or $\dfrac{y}{4}$ or $y \div 4$ or y is 4 times x or x is y divided by 4 or gradient is 4 or m = 4	M1	oe
	$y = 4x$	Q1	oe (condone multiplication or division signs correctly placed) Strand (i)

Additional Guidance		
$x = \dfrac{y}{4}$		M1 Q1
$\dfrac{y}{x} = 4$		M1 Q1
$x4$ $y = x4$		M0 Q0 M1 Q0

Q	Answer	Mark	Comments
7 (a)	22	B1	

7 (b)	$\sqrt{1000}$ or $\sqrt{999}$ or 31.(…) or $\sqrt{500}$ or $\sqrt{501}$ or 22.3(...) or 22.4 or 529 (= 23²) or at least five square numbers between 500 and 1000 correctly identified	M1	
	9	A1	

Additional Guidance	
List of the nine square numbers: 529 576 625 676 729 784 841 900 961	
With errors in calculations of squares, award a maximum of M1A0	

Q	Answer	Mark	Comments
	Alternative method 1		
	$\dfrac{2}{3}$ × 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		
	$\dfrac{5}{3}$ × 75 or 125	M1	oe
	0.8 × (300 – 75) or 180	M1	oe
	125 and 180	A1	
8	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 $\dfrac{1}{3}$ and [0.66, 0.67] for $\dfrac{2}{3}$. For the A mark, values must be correct.	

Q	Answer	Mark	Comments
9 (a)	8 × 4 or 32 or (–)2 × 7 or (–)14	M1	
	18	A1	
	Additional Guidance		
	84 – 27		M0

Q	Answer	Mark	Comments
9 (b)	**Alternative method 1**		
	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
10	2016 ÷ (1 + 8) or 2016 ÷ 9 or 224	M1	
	1792	A1	

Q	Answer	Mark	Comments
11	$2d = C - 5$ or $-2d = -C + 5$ or $\dfrac{C}{2} = d + \dfrac{5}{2}$ or $\dfrac{C}{2} = \dfrac{2d + 5}{2}$	M1	
	$d = \dfrac{C - 5}{2}$ or $d = \dfrac{-C + 5}{-2}$ or $d = \dfrac{C}{2} - \dfrac{5}{2}$	A1	oe for example $d = \tfrac{1}{2}(C - 5)$ SC1 $\dfrac{C - 5}{2}$ or $\dfrac{-C + 5}{-2}$ or $\dfrac{C}{2} - \dfrac{5}{2}$

Additional Guidance

$d = (C - 5) \div 2$	M1 A1
$d = C - 5 \div 2$	M1 A0
Condone the subject given on the right hand side, eg $\dfrac{C - 5}{2} = d$	M1 A1
Accept 2.5 or $2\dfrac{1}{2}$ for $\dfrac{5}{2}$	
The SC is for a correct expression not given as a formula. If the correct formula is given in working, however, award M1A1	

Q	Answer	Mark	Comments
12 (a)	0.6	B1	oe

Q	Answer	Mark	Comments
12 (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
13 (a)	3240	B1	

Q	Answer	Mark	Comments
13 (b)	648	B1	

Q	Answer	Mark	Comments
14 (a)	536	B1	

Q	Answer	Mark	Comments
14 (b)	1036	B1	

Q	Answer	Mark	Comments
14 (c)	143	B1	

Q	Answer	Mark	Comments
14 (d)	13 × 5 or 65	M1	
	81	A1	SC1 145
	Additional Guidance		
	SC1 is for (16 + 13) × 5 correctly evaluated		

Q	Answer	Mark	Comments
15 (a)	46	B1	

Q	Answer	Mark	Comments
15 (b)	3, 6, 9 and 18	B2	Any order B1 any 2 or 3 correct answers with no incorrect answers or any 3 correct answers with one incorrect answer or all 4 correct answers with one or two incorrect answers
	Additional Guidance		
	1 2 3 6 9 18		B1
	2 3 6 9		B1
	3 18		B1

Q	Answer	Mark	Comments
16	*D* or *E* correctly plotted	M1	Points do not need to be labelled
	One correct position of *F* for their *D* and *E* or one correct pair of coordinates for *F* for their *D* and *E* or one of (0, 2) (4, 0) (4, –2) (2, –4) (0, –4) (–2, –2) (–2, 0)	M1	
	Any three of (0, 2) (4, 0) (4, –2) (2, –4) (0, –4) (–2, –2) (–2, 0)	A1	

17 (a)	Cannot tell and valid reason eg don't know how many people there are in each room	B1	

17 (b)	**Alternative method 1**		
	300 ÷ 100 × 70 or 3 × 70	M1	oe
	210	A1	
	Alternative method 2		
	70 ÷ 100 × 300 or 0.7 × 300	M1	oe
	210	A1	

Q	Answer	Mark	Comments
18 (a)	$\dfrac{4}{15}$	B1	oe

18 (a)	**Additional Guidance**	
	Ignore words such as likely, unlikely, etc	
	4 : 15	B0

Q	Answer	Mark	Comments
18 (b)	**Alternative method 1**		
	20 × 2 or 40	M1	
	their 40 – (13 + 20) or 7	M1dep	oe
	$\dfrac{7}{40}$	A1	oe
	Alternative method 2		
	20 × 2 or 40	M1	
	20 – 13 or 7	M1	
	$\dfrac{7}{40}$	A1	oe
	Alternative method 3		
	20 – 13 or 7	M1	
	20 + 13 + their 7 or 40	M1dep	
	$\dfrac{7}{40}$	A1	oe

Additional Guidance	
Ignore any attempt to simplify a correct fraction	
In the Alt 2 scheme the method marks are independent and the steps can be performed either way round	

Q	Answer	Mark	Comments
19 (a)	$y + 2y + 3y$	B1	

Q	Answer		Mark	Comments	
19 (b)	$2 \times 4x$ or $8x$ or 2×3 or 6		M1		
	their $8x - 5x$ or $3x$ or their $6 - 13$ or -7		M1		
	$3x - 7$ or $-7 + 3x$		A1	oe	
	Additional Guidance				
	$3x + 7$				M2
	$3x + -7$				M2 A1
	$3x \; 7$				M2
	There are infinitely many possible correct answers – check apparently incorrect answers as they may simplify to the correct answer eg $8x - 5x + 6 - 13$				M2A1

Q	Answer		Mark	Comments	
20 (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
20 (b)	No and reason indicating that there were not enough trials	B1	

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

Q	Answer	Mark	Comments
21 (a)	16	B1	

Q	Answer	Mark	Comments
21 (b)	Any three pairs from $a = 2 \qquad b = 6$ $a = 4 \qquad b = 3$ $a = 8 \qquad b = 2$ $a = 64 \qquad b = 1$	B2	Condone $a = -2 \quad b = 6$ or $a = -8 \quad b = 2$ B1 Any correct pair

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

Q	Answer	Mark	Comments
23 (a)	30 × 31 (÷ 2) or 930 (÷ 2)	M1	
	465	A1	
	Additional Guidance		
	465 from any legitimate method		M1 A1
	An attempt to add all the integers scores 0 or 2		

Q	Answer	Mark	Comments
23 (b)	**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	