

# GCSE

# Methods in Mathematics

# (Linked Pair Pilot)

93651H  
Unit 1: 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.

Further copies of this Mark Scheme are available from [aqa.org.uk](http://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.

<b>M</b>	Method marks are awarded for a correct method which could lead to a correct answer.
<b>M dep</b>	A method mark dependent on a previous method mark being awarded.
<b>A</b>	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>B</b>	Marks awarded independent of method.
<b>B dep</b>	A mark that can only be awarded if a previous independent mark has been awarded.
<b>Q</b>	Marks awarded for quality of written communication.
<b>ft</b>	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
<b>SC</b>	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
<b>oe</b>	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
<b>[a, b]</b>	Accept values between $a$ and $b$ inclusive.
<b>25.3 ...</b>	Allow answers which begin 25.3 e.g. 25.3, 25.31, 25.378.
<b>Use of brackets</b>	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.

## M1 Higher Tier

Q	Answer	Mark	Comments
1(a)	$30x + 10$	B1	
1(b)	$4(x - 3)$	B1	
1(c)	$x(x + 5)$	B1	
2	$6x - 4x$ or $2x$ or $4x - 6x$ or $-2x$	M1	For M1M1 the rearrangements must be a correct pair: $6x - 4x$ or $2x$ and $7 + 11$ or $18$ or $4x - 6x$ or $-2x$ and $-11 - 7$ or $-18$
	$7 + 11$ or $18$ or $-11 - 7$ or $-18$	M1	
	9	A1ft	
3(a)	$180 \div (4 + 1)$ or $180 \div 5$ or $36$ or $\frac{1}{5} \times 180$ or $\frac{4}{5} \times 180$	M1	
	144	A1	
3(b)	Their $144 \div 180$ or $4 \div 5$ or $0.8$ or $\frac{\text{their } 144}{180}$ or $\frac{4}{5}$	M1	
	80	A1ft	ft their (a)

Q	Answer	Mark	Comments
4	$4 \div 4 + 4 \div 4$ or $4 \times 4 \div (4 + 4)$ or $(-4 - 4) \div 4 + 4$ or $4 \div ((4 + 4) \div 4)$ or $(4 \div (4 + 4)) \times 4$	B1	Any correct calculation
	$(4 + 4 + 4) \div 4$ or $(4 \times 4 - 4) \div 4$	B1	Any correct calculation
5(a)	Correct set of four different prime numbers	B2	B1 all numbers prime and the calculation correct, but with repeated numbers used or all numbers different and three of the four numbers prime and the calculation correct or at least four prime numbers identified with no incorrect numbers or at least five prime numbers identified with one incorrect number
5(b)	2 is the only even prime number, so the sum must be even	Q2	oe Strand (ii) Q1 2 is the only even prime number or (with 2 in) the sum would be even

			or even + odd + odd = even or 2 can't be the answer (as it's the smallest prime number) or one or more correct numerical example(s) using 2, with no incorrect examples
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<b>6</b>	<b>Alternative method 1</b>		
	$x - 5$ or $x - 7$ or $x + 5$ or $x + 7$	M1	Any letter
	$x + x - 5 + x - 7$ or $3x - 12$	A1	
	$3x - 12 = 3(x - 4)$ or $3x + 12 = 3(x + 4)$	Q1	Strand (ii) Correct algebra throughout and showing that their total is a multiple of 3
	<b>Alternative method 2</b>		
	$x + 5$ or $x - 2$ or $x - 5$ or $x + 2$	M1	Any letter
	$x + x + 5 + x - 2$ or $3x + 3$	A1	
	$3x + 3 = 3(x + 1)$ or $3x - 3 = 3(x - 1)$	Q1	Strand (ii) Correct algebra throughout and showing that their total is a multiple of 3
	<b>Alternative method 3</b>		
	$x + 7$ or $x + 2$ or $x - 7$ or $x - 2$	M1	Any letter
	$x + x + 7 + x + 2$ or	A1	
	$3x + 9 = 3(x + 3)$ or $3x + 9$ $3x - 9 = 3(x - 3)$	Q1	Strand (ii) Correct algebra throughout and showing that their total is a multiple of 3

Q	Answer	Mark	Comments
7(a)	usually get a different outcome	B1	
7(b)	more trials	B1	
7(c)	$300 \times 0.38$ or 114	M1	oe
	their 114 + 42 or 156	M1dep	
	0.39 or $\frac{156}{400}$	A1	oe
8(a)	-1	B1	
8(b)	All five points correctly plotted	M1	ft their value in (a) or the four given points correctly plotted if their point cannot be plotted
	Smooth curve through the five points in (a) correctly plotted	A1ft	ft their value in (a) or through the four given points if their point cannot be plotted
9(a)	0.6	B1	oe
	0.75, 0.75, 0.25	B1	oe
9(b)	$0.4 \times$ their 0.75	M1	
	0.3	A1ft	oe ft their tree diagram



Q	Answer	Mark	Comments
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<b>10</b>	<b>Alternative method 1</b>		
	$2x^2 + 5x$	M1	
	$6x^2 + 15x = x + 12$	M1	Multiplying by 3 Allow one error
	$6x^2 + 14x - 12 = 0$ and $3x^2 + 7x - 6 = 0$	Q1	Strand (ii) Fully correct algebra with every step shown
	<b>Alternative method 2</b>		
	$3x(2x + 5) = x + 12$	M1	Multiplying by 3 Allow one error
	$6x^2 + 15x = x + 12$	M1	
	$6x^2 + 14x - 12 = 0$ and $3x^2 + 7x - 6 = 0$	Q1	Strand (ii) Fully correct algebra with every step shown
	<b>Alternative method 3</b>		
	$2x^2 + 5x$	M1	
	$2x^2 + \frac{14x}{3} - 4 = 0$	M1	Combining the $x$ terms Allow one error
	$6x^2 + 14x - 12 = 0$ and $3x^2 + 7x - 6 = 0$	Q1	Strand (ii) Fully correct algebra with every step shown

Q	Answer	Mark	Comments
11(a)	Circle drawn, centre (0, 0), radius 4	B1	
11(b)	$x^2 + y^2 = 16$ or $x^2 + y^2 = 4^2$	B1	oe
12	<b>Alternative method 1</b>		
	$\frac{2}{6}$ or $\frac{1}{3}$ or $\frac{5}{6}$	M1	
	$\frac{7}{9} \times \frac{2}{6}$ or $\frac{14}{54}$ or $\frac{2}{9} \times \frac{5}{6}$ or $\frac{10}{54}$	M1	oe
	Their $\frac{14}{54}$ + their $\frac{10}{54}$	M1dep	dep on M1M1 and a correct method for both probabilities
	$\frac{24}{54}$ or $\frac{4}{9}$	A1	oe 0.4
	<b>Alternative method 2</b>		
	$\frac{4}{6}$ or $\frac{2}{3}$ or $\frac{1}{6}$	M1	oe
	$\frac{7}{9} \times \frac{4}{6}$ or $\frac{28}{54}$ or $\frac{2}{9} \times \frac{1}{6}$ or $\frac{2}{54}$	M1	oe
	$1 - (\text{their } \frac{28}{54} + \text{their } \frac{2}{54})$	M1dep	dep on M1M1 and a correct method for both probabilities
	$\frac{24}{54}$ or $\frac{4}{9}$	A1	oe 0.4

Q	Answer	Mark	Comments
13(a)	15.6 ÷ 4 or 156 ÷ 40 or $\frac{156}{100} \times \frac{100}{40}$	M1	Correctly multiplying both numbers by the same number so that 0.4 becomes an integer
	3.9	A1	oe SC1 digits 39
13(b)	Any decimal greater than 0.6̇3 and less than 0.7̇	B2	B1 Any fraction or percentage between $\frac{7}{11}$ and $\frac{7}{9}$ (eg $\frac{7}{10}$ or 70%) or Correctly evaluates $\frac{7}{11}$ to 0.63... or $\frac{7}{9}$ to 0.77...
13(c)	Any correct fraction	B2	eg $\frac{83}{200}$ , $\frac{415}{1000}$ , $\frac{41}{99}$ , $\frac{41}{98}$ , $\frac{42}{101}$ , $\frac{42}{102}$ B1 $\frac{41.5}{100}$ or any 'correct' fraction with non-integer numerator and/or denominator or any decimal between 41% and 42%
14	Indicates that -10 to -1 = -55 (and that 1 to 10 = 55) or (-55 + 55 +) 11 + 12 + 13 or 91 – 55	M1	
	36	A1	
15	3, 3, 6	B2	B1 any one correct Accept (3, 3, 6) beside M

Q	Answer	Mark	Comments
16	0.2 + 0.4 or 0.6 oe (for bag B) or 0.625 or 62.5(%) (for bag A)	M1	
	0.62(5) or 0.63 and 0.6 and bag A	A1	oe both probabilities correct in the same format and bag A eg $\frac{25}{40}$ and $\frac{24}{40}$ and bag A
17(a)	Shades the area outside the circles	B1	
17(b)	Shades all of A except the intersection with B	B1	
18	<b>Alternative method 1</b>		
	2y = -x + 8 or 2y = 8 - x or -2y = x - 8 or -2y = -8 + x	M1	
	y = $-\frac{1}{2}x + 4$ or y = $4 - \frac{1}{2}x$ or y = $\frac{-x+8}{2}$ or y = $\frac{8-x}{2}$ or y = $\frac{x-8}{-2}$ or y = $\frac{-8+x}{-2}$	A1	
	$-\frac{1}{2}$	B1ft	oe $-\frac{1}{2}$ scores all 3 marks ft their y = mx + c if M1A0 awarded SC2 $-\frac{1}{2}x$
	<b>Alternative method 2</b>		
Identifies at least two correct points	M1	Could be shown on sketch (0, 4) and (8, 0) or 4 and 8 on axes	

	Their $\frac{y_2-y_1}{x_2-x_1}$	M1	
	$-\frac{1}{2}$	A1ft	oe ft their two points if M0M1 awarded SC2 $-\frac{1}{2}x$

19	$2 < x$	B1	
	$x \leq 7$	B1	
	3, 4, 5, 6, 7	B1ft	ft their double-sided inequality Correct answer scores all 3 marks SC2 3, 4, 5, 6, 7 with one incorrect answer or any four of 3, 4, 5, 6, 7 with no incorrect answers SC1 any four of 3, 4, 5, 6, 7 with one incorrect answer or any three of 3, 4, 5, 6, 7 with no incorrect answers

20	$x + 2x = 18$ or $3x = 18$ or $2^{3x} = 2^{18}$	M1	
	$(x =) 6$ or $2^6$	A1	
	64	B1ft	ft their $x$ if $x > 6$ 64 scores all 3 marks

21	Draws the line $y = 5$ or draws vertical lines to $x$ axis from points on the curve where $y = 5$ or [-0.79, -0.65] or [2.65, 2.79]	M1	
	$(x =) [-0.79, -0.65]$ and $[2.65, 2.79]$	A1	SC1 [-0.39, -0.35] and [2.35, 2.39]

22(a)	$a^2 - ab - ab + b^2$	B1	Could be in grid
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22(b)	Alternative method 1		
	$a^2 + ab + ab + b^2$ or $a^2 + 2ab + b^2$ or	M1	

	1000		
	$(a + b)^2 - 4ab$ or $1936 - 4 \times 468$ or $1936 - 1872$ or $1000 - 2 \times 468$ or $1000 - 936$	M1	
	64	A1	
<b>Alternative method 2</b>			
	$a = \frac{468}{b}$	M1	$a$ and $b$ are interchangeable
	$(\frac{468}{b} + b)^2 = 1936$ and $468^2 + 936b^2 + b^4 = 1936b^2$ oe	M1	
	64	A1	
<b>Alternative method 3</b>			
	$a + b = 44$	M1	
	$a(44 - a) = 468$ and $a^2 - 44a + 468 = 0$ or 26 and 18	M1	$a$ could be $b$
	64	A1	

<b>23</b>	$\sqrt{36}$ or 6 or $(\sqrt{3} \times) 2\sqrt{3}$	M1	
	$\frac{1}{5^2}$ or $\frac{1}{25}$ or 0.04	M1	$\frac{6}{25}$ is M1M1
	0.24	A1	

Q	Answer	Mark	Comments
24(a)	$y = \tan x$	B1	
24(b)	$y = 2^x$	B1	
25	<b>Alternative method 1</b>		
	$y = -3 - 4x$	B1	
	$x^2 + 2x + 5 = \text{their } -3 - 4x$	M1	
	$x^2 + 6x + 8 = 0$	A1ft	ft their $-3 - 4x$
	$(x + 4)(x + 2) (= 0)$	M1	Correct method to solve their quadratic equation
	$x = -4, -2$	A1ft	ft their quadratic equation
	$y = 13, 5$	A1	SC2 Both pairs of correct values without valid working
	<b>Alternative method 2</b>		
	$x = \frac{-3-y}{4}$	B1	
	$y = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4}) + 5$	M1	
	$y^2 - 18y + 65 = 0$	A1ft	ft their $\frac{-3-y}{4}$ oe may have common denominator 16
	$(y - 5)(y - 13) (= 0)$	M1	Correct method to solve their quadratic equation
	$y = 13, 5$	A1ft	ft their quadratic equation
	$x = -4, -2$	A1	SC2 Both pairs of correct values without valid working
	<b>Alternative method 3</b>		
$4x + x^2 + 2x + 5 = -3$	B1	oe	

	$x^2 + 6x + 5 = -3$	M1	
	$x^2 + 6x + 8 = 0$	A1	
	$(x + 4)(x + 2) (= 0)$	M1	Correct method to solve their quadratic equation
	$x = -4, -2$	A1ft	ft their quadratic equation
	$y = 13, 5$	A1	SC2 Both pairs of correct values with no valid working
<b>Alternative method 4</b>			
	$4x + y = -3$ and $y - x^2 - 2x = 5$ or $4x + y = -3$ and $-2x + y = x^2 + 5$	B1	oe the equations must be used as simultaneous equations
	$4x + x^2 + 2x = -8$ or $x^2 + 6x = -8$ or $6x = -3 - x^2 - 5$	M1	oe
	$x^2 + 6x + 8 = 0$	A1	
	$(x + 4)(x + 2) (= 0)$	M1	Correct method to solve their quadratic equation
	$x = -4, -2$	A1ft	ft their quadratic equation
	$y = 13, 5$	A1	SC2 Both pairs of correct values with no valid working