AQA Qualifications

GCSE

Linked Pair Pilot

Methods in Mathematics Paper 2 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

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.
ft	Follow through marks. Marks awarded following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme 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.

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.

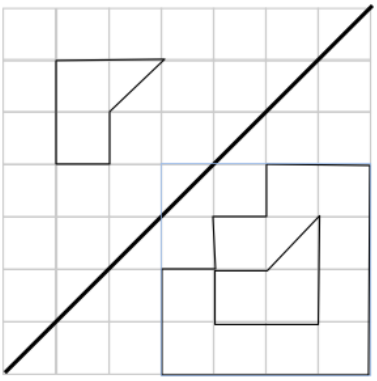
Work replaced

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.

Q	Answer	Mark	Comments
1	Correct working for the area of a 'rectangle' from the cross-section. ie 3×6 (=18), 4×8 (= 32), 4×5 (=20) or 2×3 (= 6) or 5×2 (= 10)	M1	
	Their 4×8 + their 2×3 or Their 3×6 + their 4×5 or 6×8 – their 5×2 or 38	M1dep	
	Their cross-sectional area $\times$ 12	M1dep	NB $12 \times 8 \times 6 - 12 \times 5 \times 2$ or $12 \times 8 \times 4 + 12 \times 3 \times 2$ or $12 \times 3 \times 6 + 12 \times 4 \times 5$ are M3
	456	A1	
2a	Parallelogram and Rhombus	B2	B1 each
2b	Any valid property that distinguishes the kite from the others Only one pair equal angles Diagonals cross at right angles No rotational symmetry Rotational symmetry 1 Opposite sides of rectangle and parallelogram are equal. Opposite sides of a kite are not equal 1 line of symmetry One set of angles same Diagonals do not bisect each other	B1	
2c	diagonals bisect each other	B1	

Q	Answer	Mark	Comments
3a	Correct reflection 	B2	B1 for shape in correct orientation, wholly within the outline
3b	$\begin{pmatrix} 6 \\ -3 \end{pmatrix}$	B2	B1 for $\begin{pmatrix} 6 \\ a \end{pmatrix}$ or $\begin{pmatrix} b \\ -3 \end{pmatrix}$ or '6 right and 3 down' (oe) or (6, –3) or $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ **or** $\begin{pmatrix} -3 \\ 6 \end{pmatrix}$
4	79 13 25 or 79 13 64 or 79 13 04	B3	B2 for 79 (11 or 17 or 19) 16, 25, 36, 49, 64 or 81 B2 for 79 13 (16 or 36 or 49 or 81) B1 for 79 13 (any 2-digit non-square) B1 for 79 (any non-prime number between 10 and 20) (any 2-digit square with different digits to previous 4 numbers) B1 **1325, **1364, **1304, **1764
5	1, 2, 19, 38, 53, 106, 1007, 2014	B3	B2 for any 3 of 38, 106, 1007, (1 or 2014) B1 for any 1 of 38, 106, 1007 –1 each wrong factor Factors must come from an understanding of factors, ie 2 ×1007, followed by 2 × 503.5 then do not allow 1007 for B1 Ignore repeats.

Q	Answer	Mark	Comments
6a	$2x$ or –3	M1	
	$2x = -3$	A1	
	$x = -1\frac{1}{2}$	A1ft	ft their equation if M awarded and no further errors.
6b	$(-1\frac{1}{2}, -2\frac{1}{2})$	B1	
	Alternative method 1		
7	$3 \times 7 = 21$ or $3 \times 5 = 15$	M1	Side of 3 or side of 7 or side of 5 marked on diagram
	Area face = 35	A1	
	$2 \times (21 + 15 +$ their 35)	M1	
	142 and a full method	Q1ft	Strand (iii). ft their sides if both Ms awarded or if a common factor other than 3, such as 1 or 1.5 is chosen as the height.
	Alternative method 2		
7	Height of 1.5 chosen $1.5 \times 14 = 21$ or $1.5 \times 10 = 15$, Area face = 140, $2 \times (21 + 15 + 140)$, 352		M0, A0, M1, Q1
8a	0.64992(3…)	B1	
8b	0.650	B1ft	ft their answer to (a), 0.65 is B0

Q	Answer	Mark	Comments
9a	18	B1	Allow $\frac{18}{23}$
9b	3	B2	B1 for any multiple of 3, ie 6 or 9 or 2 : 1 seen or 10 : 5 seen Multiple of 3 must come after 2 : 1 or equivalent eg $\frac{1}{2}$ seen
9c	3	B1	
10a	$85^2 - 77^2$ (= 1296)	M1	$x^2 + 77^2 = 85^2$ $85^2 + 77^2$ or 13 154
	$\sqrt{1296}$	M1Dep	
	36	A1	SC1 [114.69, 115]
10b	tan used with 19 and 37 (even if wrong)	M1	
	(y =) $\tan^{-1}$ (19 ÷ 37), **or** tan y = 19 ÷ 37 (= 0.51351...)	A1	
	[27, 27.2]	A1	27 with working
11	$\frac{x}{6.3} = \frac{4.2}{4.9}$ **or** $\frac{x}{4.2} = \frac{6.3}{4.9}$ or x : 4.2 = 6.3 : 4.9	M1	
	$\left(x =\right) \frac{6.3 \times 4.2}{4.9}$	M1Dep	
	5.4	A1	

Q	Answer	Mark	Comments
12	120 marked **or** stated as the interior angle of hexagon	B1	
	360 – (120 + 90) or 150	M1	
	Interior angle = 150 or exterior angle = 30	A1	Must be identified
	12	A1	
13a	$(x \pm a)(x \pm b)$	M1	$ab = 12$. $\frac{1 \pm \sqrt{49}}{2}$
	$(x - 4)(x + 3)$	A1	$\frac{1 \pm 7}{2}$
	4 and –3	A1ft	ft if M awarded
13b	$2xy(3x - 4y)$	B2	B1 for $xy(6x - 8y)$ **or** $2x(3xy - 4y^2)$ **or** $2y(3x^2 - 4xy)$

Q	Answer	Mark	Comments
	Alternative method 1		
14	$4x + 3 + 5x - 11 + 4x - 7 + 3x + 7 = 360$	M1	Allow 1 missing term **or** 1 error
	$16x - 8 = 360$	M1	Collecting their terms (allow one error?)
	$x = 23$	A1ft	ft on M1, M0 or M0, M1
	Substitution of their 23 into either pair of co-interior angles ($A = 95$ and $D = 85$, $B = 104$ and $C = 76$)	M1dep	
	Clear explanation that as the co-interior angles add up to 180 then *AB* and *DC* are parallel, so *ABCD* is a trapezium	Q1	Strand (ii)
	Alternative method 2		
14	$4x + 3 + 4x - 7 = 180$ or $5x - 11 + 3x + 7 = 180$	M1	
	$8x - 4 = 180$	M1	Collecting terms
	$x = 23$	A1ft	Follow through on 1 error
	Substitution into the other pair of co-interior angles ($A = 95$ and $D = 85$, $B = 104$ and $C = 76$)	M1	
	This mark cannot be scored as the starting point was the assumption that *ABCD* was a trapezium, so not a proof.	Q0	Strand (ii) Q1 if $4x + 3 + 4x - 7 = 180$ and $5x - 11 + 3x + 7 = 180$ solved independently and pairs of angles then shown to be $A = 95$ and $D = 85$, $B = 104$ and $C = 76$

Q	Answer	Mark	Comments
	Alternative method 3		
14	A + B + D + C = 360	M1	
	A + D = 8x – 4 or B + C = 8x - 4	M1	Collecting terms
	A + D = 8x – 4 and B + C = 8x - 4	M1	Follow through on 1 error
	Hence A + D = B + C = 360 ÷ 2 = 180	M1	
	Clear explanation that as the co-interior angles add up to 180 then *AB* and *DC* are parallel, so *ABCD* is a trapezium	Q1	Strand (ii)
15	$\frac{80}{360} \times 2 \times \pi \times 15$	M1	oe
	$\frac{20}{3}\pi$ or [20.9, 21]	A1	
	30 + $\frac{20}{3}\pi$ or [50.9, 51]	A1ft	ft their answer + 30 if M1 awarded
16a	56	B1	
	Angle at centre is twice the angle at the circumference	Q1	Strand (i). Must state circumference and centre
16b	*YZX* = 25° because angle in an isosceles triangle	B1	(180 – 130)/2
	XWY = 25° because angles on same chord or in same segment	B1	oe SC1 25 with no reasons SC1 25 in *YZX* or *YXZ* with no other working of credit
17	$\frac{1}{2} \times 12 \times 15 \times \sin 35$	M1	
	[51.6, 52]	A1	

Q	Answer	Mark	Comments
18	$\frac{1}{2} \times \frac{4}{3} \times \pi \times 10^3$	M1	
	$\frac{1}{3} \times \pi \times 8^2 \times 8$	M1	
	[2093, 2095] **or** [535, 536.3]	A1	$\frac{2000\pi}{3}$ or $\frac{512\pi}{3}$
	[1557, 1560] or $\frac{1488\pi}{3}$	A1	Answer must be in this range or exact
19	Shows second difference of 1	M1	
	Shows $\frac{1}{2}n^2$	M1Dep	Working table backwards to get the 'zero' term and identifying difference as $2a$
	Subtracts $\frac{1}{2}n^2$ from at least first two terms of sequence, 4 $\frac{1}{2}$, 6, …	A1	Showing difference between 0th and 1st term is $a + b$ and 0th term is c or Showing difference between 1st and 2nd term is $3a + b$ and first term is $a + b + c$
	$\frac{1}{2}n^2 + 1\frac{1}{2}n + 3$	A1	
	Alternative method 1		
20	$(x) = \frac{-8 \pm \sqrt{8^2 - 4 \times 1 \times 3}}{2}$	M1	Allow one error but not partial division
	$(x) = \frac{-8 \pm \sqrt{52}}{2}$	M1Dep	
	$a = -4$	A1	SC2 –4 stated as a
	$b = 13$	A1	SC2 13 stated as b then award 2 marks

Q	Answer	Mark	Comments
	Alternative method 2		
20	$(x + 4)^2$	M1	
	$x + 4 = \pm\sqrt{}$ their 13	M1dep	Do not award if their 13 is negative
	–4	A1	
	13	A1	
	Alternative method 1		
21	$x(12 + x) = 16 \times 10$	M1	Allow invisible brackets
	$x^2 + 12x – 160 = 0$	A1	ft their equation if M1 awarded
	$(x – 8)(x + 20)$	M1	Attempt to solve by factorising or formula or cts. Allow 1 error in formula. Must get to $(x + 6)^2 – 64$ if using cts.
	8	A1	Do not award if –20 also stated. Answer only zero marks s it can come from wrong work
	Alternative method 2		
21	Value chosen for x and 16×10 and $x \times (12 + x)$ calculated	M1	
	8	A3	T&I only gets M1 unless it leads to correct answer.