AQA

GCSE

Mathematics (Linear)

Higher Tier Paper 1

Mark scheme

43651H

November 2015

Version 1.0 Final

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.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

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 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. e.g. accept 0.5 as well as $\frac{1}{2}$
[*a*, *b*]	Accept values between *a* and *b* inclusive.
[a, b)	Accept values a ≤ value < b
3.14 …	Accept answers which begin 3.14 e.g. 3.14, 3.142, 3.1416
Q	Marks awarded for quality of written communication
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.

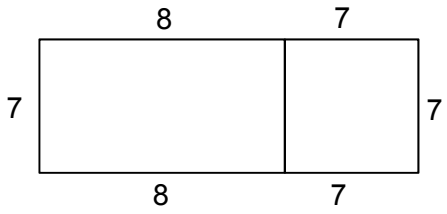
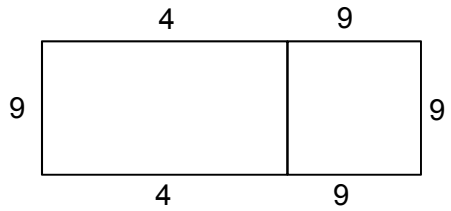
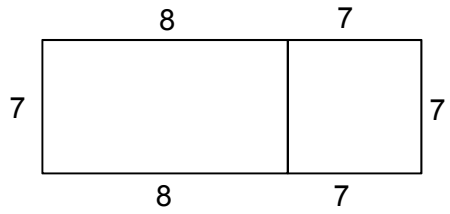
Paper 1 Higher Tier

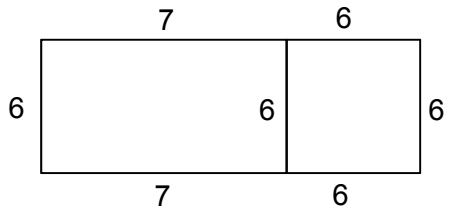
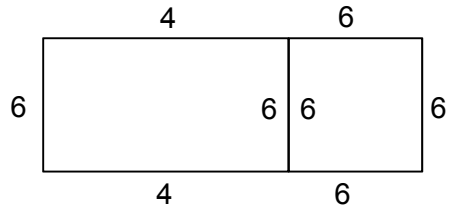
Q	Answer	Mark	Comments
1	270 ÷ (3 + 2 + 1)	M1	
	45	A1	No wrong working seen
	135, 90, 45	A1ft	ft their 45 if all values correctly evaluated Values must be written in order Correct answer only full marks Incorrect answer only with 45 as a part ratio is not M1, A1 **NB** Build up method must be fully correct
	Additional Guidance 1		
	Be careful of correct answers from wrong work.		
	eg 270 ÷ 3 = 90, 270 ÷ 2 = 135, 270 ÷ 1 = 270 135 : 90 : 270		M0
	eg 270 ÷ 3 = 90, 270 ÷ 2 = 135, 90 ÷ 2 = 45, 135 : 90 : 45		M0
	270 ÷ 6 = 35 105 : 70 : 35		M1, A0 A1ft
	270 ÷ 6 = 45 145 : 90 : 45		M1, A1 A0
	270 ÷ 6 = 45 45 : 135 : 90		M1, A1 A0
	270 ÷ 6 = 41.2 123.2 : 82.4 : 41.2		M1, A0 A0ft
	270 ÷ 6 = 41.2 123.6 : 82.4 : 41.2 124 : 82 : 41	Ignore rounding after correct ft	M1, A0 A1ft
	270 ÷ 6 = 41.2 124 : 82 : 41	Answer do not ft. No intermediate values	M1, A0 A0ft
	135 : 45 : 90	No working, not in order	M0

1	**Additional Guidance 2**		
	145 : 90 : 45	No working, not correct	M0
	3 + 2 + 1 = 5 270 ÷ 5 = 54 162 : 108 : 54		M1, A0 A1ft
	270 ÷ 5 = 54 162 : 108 : 54		M0

Q	Answer	Mark	Comments
2	$4x - 1 = 14x$ or $4x - 1 = 7 \times 2x$ or $\frac{4x}{7} - 2x = \frac{1}{7}$ or $2 - \frac{1}{2x} = 7$	M1	Allow one error
	$10x = -1$ or $-\frac{10x}{7} = \frac{1}{7}$ or $2x = -\frac{1}{5}$	A1	oe
	$-\frac{1}{10}$	A1ft	ft their equation if M awarded and at most 1 error
	Additional Guidance		
	$\frac{4x}{7} - 1 = 2x, -\frac{10x}{7} = 1, x = -\frac{7}{10}$		M1, A0 A1ft
	$4x - 1 = 9x, -5x = 1, \quad x = -\frac{1}{5}$		M0
	$4x - 1 = 2x + 7$		M0
	$\frac{4x}{7} - 1 = 2x, -\frac{18x}{7} = 1, x = -\frac{7}{18}$		M1, A0, A1ft
	$\frac{4x-1}{2x} = 7, \quad \frac{1}{2x} - 2 = -7, \quad \frac{1}{2x} = -9, x = -\frac{1}{18}$		M1, A0 A0

Q	Answer	Mark	Comments
3	150 + 60 × 6 or 510	M1	oe
	0.2 × 600 or 120 or 0.8 × 600 or 480	M1	oe If a 'build up' method used to work out 20% or 80%, must be a fully correct method
	720 ÷ 4 or 180 or 720 ÷ 4 × 3 or 540	M1	oe If a 'build up' method used to work out 25% or 75%, must be a fully correct method
	510 **and** 480 **and** 540	A1	
	Correct conclusion based on their **three** values with at least 2 of 510, 480 or 540 correct	Q1ft	Strand (iii)
	Additional Guidance		
	150 + 360 = 510 0.2 × 600 = £120 720 ÷ 4 × 3 = £540 Shop B		M1 M1 M1 A0 Q1
	150 + 360 = 410 0.8 × 600 = £480 720 ÷ 4 = £180 Shop C		M1 M1 M1 A0 Q0
	150 + 60 = £210 0.8 × 600 = £480 720 ÷ 4 × 3 = £540 Shop A		M0 M1 M1 A0 Q1
	Examples of build up		
	10% = 60, 2 × 60 = £120		M1
	10% = 600 ÷ 10 = 6, 2 × 6 = £12		M1
	10% = 7.2, 20% = 14.4, 5% = 3.6, 25% = 18		M0

Q	Answer	Mark	Comments
4	Side of square stated or shown as $\sqrt{36}$ or 6 or 6 × 6 = 36	M1	
	(44 – (2 × their 6)) ÷ 2 or (44 ÷ 2) – their 6 or 16 or (44 – 4 × their 6) ÷ 2 or (44 ÷ 2) – 2 × their 6 or 10	M1dep	16 is their total length 10 is their length of R
	their 6 × their 16 or 36 + their 6 × their 10	M1dep	
	96	A1	SC1 correct calculation of area for any large rectangle with perimeter of 44
	Additional Guidance 1		
	$\sqrt{36}$ = 7  Answer …. 105		M1 M1dep M1dep A0
	36 ÷ 4 = 9  Answer = 117		SC1
	 Answer …. 105		SC1

4	**Additional Guidance 2**	
	 Answer ….. 78	M1 M0 M0 A0
	 Answer …. 60	M1 M0 M0 A0
	$7 \times 7 = 36$ $4 \times 7 = 26$ $44 - 26 = 22$ $22 \div 2 = 14$, $14 + 7 = 19$ $7 \times 19 = 79$	M1 M1dep M1dep, A0

Q	Answer	Mark	Comments
5	A point that lies on the circumference, eg (4, 5), (10, 5), (7, 2), (7, 8)	B2	B1 (4, y) or (10, y) or (x, 2) or (x, 8) B1 for 4 or 10 **clearly** shown as min or max horizontal value B1 for 2 or 8 **clearly** shown as min or max vertical value
	Additional Guidance		
	Circle measurement is 2.6 cm so if subtracted or added then rounded can lead to correct answer, but allow as 2.6 rounds to 3, so mark answer line, ignore any other working		
6a	20 or 20 out of 120 or 20 in 120	B1	$\frac{20}{120}$ (oe) is B0
6b	Yes ticked	B1	If boxes blank, yes may be implied by wording
	Valid reason eg 1 should be (about) 20 (but it is much lower) or 6 should be (about) 20 (but it is higher) or 6 is much higher than 1 or frequencies should be all (about) the same	Q1	oe Strand (i) Only award if Yes ticked or implied
	Additional Guidance 1		
	There are 4 ways to score the Q mark Comparing frequency of 1 to 20 Comparing frequency of 6 to 20 Referring to significant difference between frequency of 1 and 6 Referring to the fact that all frequencies should be the same		

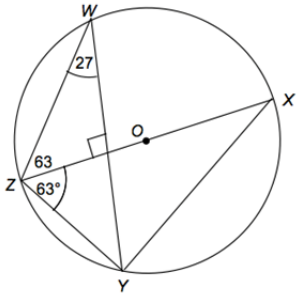
	Additional Guidance 2	
	Yes ticked and:	B1
	6 has above the average which is 20	Q1
	6 more, 1 a lot less	Q1
	Lands more on 6. It should land on each side about the same number	Q1
	The range of results is too large on specific numbers (1,6) showing there is something making it land on a 6 and not a 1	Q1
	The frequency of landing on 6 is over 7 times the frequency of it landing on 1.	Q1
	There is a large range of 33 between the highest and lowest frequency	Q1
6b	Because the frequency is not all the same so it isn`t fair	Q1
	Frequency should be the same for all numbers	Q1
	Lands more on 6	Q0
	6 has appeared as the mode number whereas 1 is the least amount	Q0
	Is heavier on number 6	Q0
	Landed on 6 38 times	Q0
	All number are about average except 1 and 6	Q0
	Answers should be more evenly spaced out	Q0
	Each time the number goes up, the frequency goes up	Q0

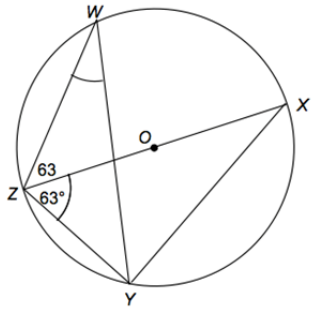
Q	Answer	Mark	Comments
7	$2x + 2 + 3x - 1 = 36$	M1	oe
	$5x = 35$ or $x = 35 \div 5$	A1	
	7	A1ft	ft on $5x = a$ ($a \neq 36$) or $bx = 35$ ($b \neq 2$ or 3)
	$2 \times$ their 7 + 2 **and** $3 \times$ their 7 – 1 **and** $4 \times$ their 7 – 6 **and** $5 \times$ their 7 + 2 If no working shown, at least 3 values must be correct for their 7	M1	their 7 **must** come from the solution (correct or incorrect) of a single equation formed from an expression = 36 If 7 used, three of 16, 20, 22 and 37
	16, 20, 22 and 37 **and** 21 shown as median or all 4 expressions correctly evaluated and median correctly identified	A1ft	SC3 $2x + 2 = 36$, $x = 17$, values 36, 50, 62, 87 and median identified as 56 SC2 $2x + 2 = 36$, $x = 17$, values 36, 50, 62, 87 SC1 $2x + 2 = 36$, $x = 17$ (no other equation seen)
	Additional Guidance		
	As x is positive only the first 3 values are needed to find the median. If the 4th value is worked out it must be evaluated correctly		
	Range is 21 so 37 – 16 = 21 is A0		
	$2x + 2 + 3x - 1 = 36$ $5x = 37$ $x = 7.4$ 16.8, 21.2, 23.6 22.4	Only first 3 values necessary	M1 A0 A1ft M1 A1ft
	$2x + 2 = 36$, $x = 17$	No other equation seen	SC1
	Above and 36, 50, 62, 87		SC2
	Above and 56		SC3
	$3x - 1 = 36$, $x = 12.33$ 26.66, 36, 43.32, 63.65 39.66	Decimals must be to two dp or better	M0, A0, A0 M1 A1ft

	Additional Guidance 2		
7	$2x + 2 = 36$ $2x = 38$ $x = 19$ 36, 56, 70, 96 63	Median correct but as last value evaluated wrongly, follow through mark is lost	M0 A0 A0 M1 A0ft
	$2x + 2 + 3x - 1 = 36$ $3x = 39$ $x = 13$ 28, 38, 46, 67 42	Two errors in solving the equation	M1 A0 A0ft M1 A1ft

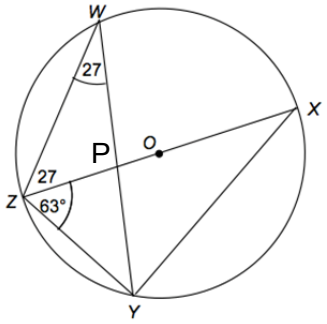
Q	Answer	Mark	Comments
8a	$4x – 8 – 6 + 10x$	M1	Four terms. Three terms correct.
	$4x – 8 – 6 + 10x$	A1	Fully correct
	$14x – 14$ or $14(x – 1)$	A1ft	ft on M awarded and at most one error
	Additional Guidance		
	$4x – 8 – 6 – 10x$, $–6x – 14$		M1, A0 A1ft
	$4x – 8 – 6 – 10x$, $–6x – 2$		M1, A0 A0ft
	$4x – 6 – 6 – 10x$		M0
8b	$2a(4a + 5b)$	M1	
	$3(4a + 5b)$	M1	
	$\frac{2a}{3}$	A1	Answer only full marks
	Additional Guidance		
	Answer can come from wrong work, eg $\frac{8a^2 + 10ab}{12a + 15b} = \frac{18a}{27} = \frac{2a}{3}$		

Q	Answer	Mark	Comments
9a	Total 100 so median 50(th) value or 50.5(th) value	M1	Check diagram for indication of 50 or cumulative totals
	Cumulative total their 18 + their 24 (evaluated) or 42 up to 5 or their 18 + their 24 + their 32 (evaluated) or 74 up to 6	M1	18, 42, 74, 94, 100
	5.25	A1	oe accept 5.25 – 5.27
9b	20 in 6 to 7 bar so 6.8 is $\frac{4}{5}$ of 20 = 16 or $\frac{1}{5}$ of 20 = 4	M1	May need to check diagram in (a)
	4 + 6 or 10	A1	
	35	A1ft	ft their value for men plus 25 SC1 25 for number of Women > 6.8

Q	Answer	Mark	Comments
10a	170	B1	
	Angle at centre twice angle at circumference (or perimeter) (on same arc)	B1	Must mention centre and circumference
10b	54	B1	
	Opposite angles in cyclic quadrilateral (add up to 180)	B1	Must mention opposite and cyclic
10c	*ZXY* stated or shown to be 90 – 63 or 27	M1	
	27	A1	Answer only M0A0
	Additional Guidance 1		
	Correct answer is common from wrong work. Correct working must be seen. Any indication of wrong working or wrong angles marked is M0		
		Assumes *ZX* bisects *WZY* and intersection of chords is a right angle	M0

<table>
<tr><td rowspan="3">10c</td><td colspan="3">Additional Guidance 2</td></tr>
<tr><td> 

180 – 126 = 54

54 ÷ 2 = 27</td><td>Assumes ZX bisects WZY and triangle WZY is isosceles</td><td>M0</td></tr>
<tr><td> 
</td><td>Assumes WZY is a right angle and ZWP is isosceles.</td><td>M0</td></tr>
</table>

Q	Answer	Mark	Comments
11	**Alternative method 1**		
	$14x + 6 < 4x - 1$	M1	
	$10x < -7$	A1	oe
	$x < -0.7$	A1ft	ft on one rearrangement error Must have $x <$ Do not award if wrong inequality ≤, ≥ or > SC1 for $x < -0.4$ from $14x + 3 < 4x - 1$
	Alternative method 2		
	$7x + 3 < 2x - 0.5$	M1	
	$5x < -3.5$	A1	
	$x < -0.7$	A1ft	ft on one rearrangement error Must have $x <$ Do not award if wrong inequality ≤, ≥ or > SC1 for $x < -0.8$ from $7x + 3 < 2x - 1$

	Additional Guidance 1	
11	$14x + 6 = 4x - 1$ $10x = -7$ $x = -0.7$ $x < -0.7$	M0 until recovered then full marks
	$14x + 6 < 4x - 1$ $10x < -7$ < -0.7	M1 A1 A0
	$14x + 3 < 4x - 1$ $10x < -4$ $x < -0.4$	SC1

11	**Additional Guidance 2**	
	$14x + 3 < 4x - 1$ $18x < -4$ $x < -\frac{2}{9}$	M0
	$14x + 6 < 4x - 1$ $18x < -7$ $x < -\frac{7}{18}$	M1 A0 A1ft
	$7x + 3 < 2x - 1$ $5x < -4$ $x < -0.8$	SC1

Q	Answer	Mark	Comments
12a	$10^2 - 3^2$ or 91 or 100 – 9 or $y^2 + 3^2 = 10^2$	M1	Accept any letter
	$\sqrt{91}$	A1	Ignore any attempt to evaluate SC1 $\sqrt{109}$
12b	$\frac{3}{\sqrt{91}}$	B1ft	ft their length y ignore any misuse of tan, eg $\tan(\frac{3}{\sqrt{91}})$ or $\tan^{-1}(\frac{3}{\sqrt{91}})$

Q	Answer	Mark	Comments
13	n and $n + 1$ seen	M1	Two consecutive integers expressed algebraically, eg $n – 1$ and n
	$(n + 1)^2 – n^2$	M1dep	Subtraction of their consecutive integers squared
	$n^2 + 2n + 1 – n^2$	A1	Correct expansion
	$2n + 1$ and explanation why this expression must be odd	Q1	Strand (i). Explanation why their expression must be odd
14a	$2\mathbf{b} – 2\mathbf{a}$ or $–2\mathbf{a} + 2\mathbf{b}$ or $2(\mathbf{b} – \mathbf{a})$ or $2(–\mathbf{a} + \mathbf{b})$	B1	
14b	**Alternative method 1**		
	$MA + AN$ or $\frac{1}{2}OA + \frac{1}{2}AB$ or $\mathbf{a} + \frac{1}{2}$their$(2\mathbf{b} – 2\mathbf{a})$	M1	oe
	$\mathbf{a} + \mathbf{b} – \mathbf{a}$	A1	
	Alternative method 2		
	(M is midpoint of OA and N is midpoint of AB) (hence) $MN = \frac{1}{2} OB$	M1	
	$MN = \frac{1}{2} \times 2\mathbf{b}$	A1	By midpoint theorem, triangle AOB is an enlargement sf 2 of triangle AMN is M1, A1

Q	Answer	Mark	Comments
14c	**Alternative method 1**		
	Common angle *MAN* or (Angle) *AMN* = (Angle) *AOB* because corresponding or (Angle) *ANM* = (Angle) *ABO* because corresponding	B1	Must be a specific angle shown to be common and if not *MAN* then reason ie corresponding must be stated Check diagram if reference to say, 'x is a common angle'
	Sides in ratio 1 : 2	B1	oe eg scale factor 2
	Alternative method 2		
	$\overrightarrow{OB} = 2\overrightarrow{MN}$ and $\overrightarrow{OA} = 2\overrightarrow{OM}$	B2	Any two sides shown to be parallel vectors oe eg $\overrightarrow{OB} = 2\mathbf{b}$, $\overrightarrow{MN} = \mathbf{b}$ and $\overrightarrow{AB} = 2\mathbf{b} - 2\mathbf{a}$, $\overrightarrow{AN} = \mathbf{b} - \mathbf{a}$
15a	75	B1	
15b	$8x^3y^9$	B3	B2 for 2 terms correct B1 for one term correct SC1 for $2xy^3$
16a	Graph of $y = x^3$	B1	Must be in 1st and 3rd quadrants.
16b	Graph of $y = x^2 + 3$	B1	3 need not be marked as long as graph is roughly symmetrical and crosses y–axis above origin
16c	Graph of $y = \frac{1}{x}$	B1	Must be in 1st and 3rd quadrants

Q	Answer	Mark	Comments
17	$y \propto \frac{1}{x}$ or $y = \frac{k}{x}$	M1	oe $xy = k$ 2 $\propto \frac{1}{5}$ or $2 = \frac{k}{5}$
	$k = 10$	A1	oe $2 = \frac{10}{5}$
	$xy = 10$ or $y = \frac{10}{x}$ or $x = \frac{10}{y}$	A1	oe
18a	2	B1	
18b	170	B1	