



**General Certificate of Secondary Education  
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**Mathematics (Linear)**

**4365**

**Paper 1 Higher Tier 43651H**

**Final Version**

***Mark Scheme***

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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## 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. (QWC)
<b>ft</b>	Follow through marks. Marks awarded following a mistake in an earlier step.
<b>SC</b>	Special case. Marks awarded within the scheme 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.

### General marking principles.

**One error – lose one mark.** If working is clear and one error (arithmetical, miscopy, sign but **not** conceptual) is made then the values stated in the mark scheme will not apply. Work through and if all working correct following the error then award the full marks for the question less one.

**Formulae.** Method marks are only awarded for formulae once numbers are substituted. Quoting formulae is not enough. If a wrong formula is used, say  $2\pi r^2$  for area of a circle it is M0 every time.

**Rounding and accuracy.** As this is a non-calculator paper the answers are always nice-ish numbers. If the student makes an error they may need to calculate a decimal value. Accuracy required is 2dp or better to get the A mark on a follow through.

**Marking the whole page.** This is a new requirement to make sure that work written outside the scanned area is not missed. The way this is designed is not efficient as the scroll bar must be taken down to the very bottom or the marks will not be accepted and you will get a message on screen. Two ways to deal with this are: (1) Use the zoom out button to reduce the page size so that it all appears on screen. This means the working will be unreadable but you will be able to see if there is any working outside the scanned area. The zoom in can then be used until the script is readable, The mark should then be accepted. (2) Turn on the thumbnail. This is very small and may not be sufficiently clear to see any extraneous working.

**Qu 12.** As the overlay cannot be used make a judgement. If the arcs look correct assume they are. If they look wrong assume they are.

## Paper 1 Higher Tier

Q	Answer	Mark	Comments
1(a)	Line from (08 00, 0) to (09 30, 60)	B1	Line need not be straight ± 1 small square
	1 cm horizontal line from their (09 30, 60) <b>or</b> horizontal line ending at 10 00	B1ft	± 1 small square
	Line from (10 00, 60) to meet the time axis between (11 06, 0) and (11 18, 0) inclusive <b>or</b> line from their (10 00, 60) down 6 cm and across 2.4 cm	B1ft	Line need not be straight ± 1 small square
1(b)	Correct ft decision and reference to their graph <b>or</b> correct ft decision and correct ft time (±6 minutes) read from their graph	B1ft	Must be from a line that meets the time axis at at least 6 minutes past their 10 00.
1(b) Alt	Correct ft decision and calculation of home time eg 60 miles at 50 mph = 1.2 hours 11 30 is 1.5 hours after 10 <b>or</b> 10 + 1.2 hours = 11 12	B1ft	ft from their 10 00

### Additional guidance – exemplars

These are B1:

Yes as he gets home at 11 10 (11 10 within one small square of his graph)

Yes he will see the show, I've shown it by my graph (line ends before 11 30)

Yes my graph shows that Dan gets home by 11 30 (line ends at (11 12, 0))

No, see my graph (line ends after 11 30)

Yes as after an hour, he has 10 miles to do at 50 mph which will take less than half an hour

Yes as he gets home at 10 24 B1 ft mark (line ends at (10 24, 0))

No as he gets home at 11 45 (line ends at 11 48 so within 6 minutes)

Yes my graph shows he gets home at 11 30 (line ends at 11 30)

No my graph shows he gets home at 11 30 so he will miss the start (line ends at 11 30).

These are B0:

Correct graph in (a) then Yes he does get home by 11 30 (no reference to graph made)

Yes 50mph = 50 miles every hour. After 1 hour, 10 miles from home which equals 11 00 (incomplete)

He gets home at 11 12 (no decision made)

Yes he gets home at 11.2 (incomplete eg needs to compare 11.2 with 11.5 or convert 11.2 correctly)

Q	Answer	Mark	Comments
2(a)	Fully correct diagram with vertices within 1mm	B2	B1 2 or 3 sides correct from a full hexagon. B1 for symmetrical diagram (about vertical line) with bottom vertex correct. Ignore any internal lines.
2(b)	( $\times$ ) 3 ( $\times$ ) or 1 : 3	B1	Accept – 3 or both
3	$5x - 3x$ or $11 + 9$	M1	Implied by $2x$ or 20
	$2x = 20$	A1	
	10	A1ft	ft on one error only

**Exemplars**

$2x = 2, x = 1$  M1, A0, A1ft

$2x = -2, x = -1$  M1, A0, A1ft

$8x = 20, x = 2.5$  (oe) M1, A0, A1ft

$8x = 2, x = 0.25$  (oe), M0

4(a)	$75 \div 3$	M1	$75 \div 60 \times 20$ or 1.25 km per minute
	25	A1	
4(b)	Any correct conversion between miles and km seen, eg 5 miles = 8 km or 1 mile = 1.6 km or 1km = $\frac{5}{8}$ mile	M1	$75 \times \frac{5}{8}$
	Slower as limit is 80 km	A1	Slower as $46.875 < 50$
5(a)	27	B1	
	81	B1ft	ft their $27 \times 3$ Answers must be evaluated
5(b)	$3^{13}$ or 13	B1	
5(c)	$3^5$ or 5	B1	

Q	Answer	Mark	Comments						
6	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>4</td> <td>12</td> <td>10</td> </tr> <tr> <td>15</td> <td>5</td> <td>6</td> </tr> </table>	4	12	10	15	5	6	B3	<p>B2 12 and/or 10 in correct position <b>and</b> any product that makes 60 in first column (not using 5 or 6)</p> <p>B1 12 and/or 10 in correct position <b>or</b> any product that makes 60 in first column (not using 5 or 6)</p>
4	12	10							
15	5	6							

**Additional guidance**

Condone missing or incorrect 26s and 60s

**Exemplars**

20	10	12	scores B1
3	5	6	

$2\frac{1}{2}$	12	10	scores B2
24	5	6	

7(a)	$(27 - 5) \div 2$	M1	Condone omission of brackets
	11	A1	
	3	B1ft	ft (their $11 - 5) \div 2$ if A0 awarded SC1 -0.75 SC1 24.5 <b>and</b> 22

**Additional guidance**

$(27 \div 2 - 5 = 8.5, 8.5 \div 2 - 5 =)$  -0.75 scores SC1

$27 - (5 \div 2) = 24.5, 24.5 - (5 \div 2) = 22$  scores SC1, but 22 alone does not score SC1

If 11 is wrong then check for follow through eg  $27 \rightarrow 12 \rightarrow 3.5$  scores M0A0B1ft

$(27 - 5) \div 2 = 12$  and 3.5 scores M1A0B1ft

Ignore further working and award full marks if an attempt at further terms is made after term of 3 seen

If 3 is embedded, award M1A1B0

7(a) Alt 1	$2x + 5 = 27$	M1	
	11 or $2(2x + 5) + 5 = 27$ oe or $(27 - 15) \div 4$	A1	
	3	A1	

Q	Answer	Mark	Comments
<b>7(a) Alt 2</b>	Two fully correct trials eg any two of $u_1 = 1, u_2 = 7, u_3 = 19$ $u_1 = 2, u_2 = 9, u_3 = 23$ $u_1 = 4, u_2 = 13, u_3 = 31$ $u_1 = 5, u_2 = 15, u_3 = 35$	M1	
	Fully correct trial with first term 3 ie $u_1 = 3, u_2 = 11, u_3 = 27$	M1Dep	
	3	A1	3, 11, 27 on answer line is full marks.
<b>7(b)</b>	$4n$	M1	Accept $4 \times n$ or $n \times 4$ but not $n4$
	$4n + 2$	A1	oe eg $4 \times n + 2$ $3n + n + 2$ $2(2n + 1)$ SC1 $n4 + 2$
<b>8</b>	$\pi \times 6 \times 6 \div 2$	M1	oe Accept a numerical value for $\pi$
	$18\pi$ or a numerical value [55.8, 56.57]	A1	Accept $\pi \times 18$ or $\pi 18$
<b>*9a</b>	Open circle at $-2$ with line going right to at least 4 or with arrow (of any length) to the right	Q1	Strand (i) If line is marked with any sort of circle at the RHS this is Q0
<b>9b</b>	$3x \leq 11 - 5$ or $3x \leq 6$ or $x - 2 \leq 0$	M1	Working with = sign must be recovered to $\leq$ to gain any credit
	$x \leq 2$	A1	Must have $x \leq$ on answer line SC1 $x < 2$ Any slight error in notation, eg $x \leq 2$ or $x =$ less than 2 is M1, A0

**Additional guidance**Just  $\leq 2$  scores M1A0 $x \leq 2$  seen in working, then incorrect answer is M1A0Any inequality that is one step away from the correct answer is M1 eg  $x + 1 \leq 3$ Embedded answer  $3 \times 2 + 5 \leq 11$  is M0 unless further creditworthy work

Q	Answer	Mark	Comments
10	8 and 10	B3	B2 for any whole number combo that satisfies the median equal to the mean. There are an infinite number Common ones are (1, 12), (2, 11), (3, 10), (4, 9), (5, 8), (2, 6), (6, 7), (9, 14), (10, 18), (11, 22) (11 + n, 22 + 4n), (15, 18), (16, 17), (any pair greater than 11 that total 33) B1 for any decimal combo that satisfies the median equal to the mean. There are an infinite number Common ones are (7.5, 8), (8.5,12), (8.5 + n, 12 + 4n).

10 Alt1	$22 + x + y = 5x$	M1	oe
	$4x - y = 22$	M1	oe
	8 and 10	A1	

10 Alt2	Chooses values for $x$ and $y$ (which may be the same) where both are between 7 and 11 inclusive and calculates mean correctly or compares total to $5x$ . Eg 8 and 9 chosen, Mean = $39 \div 5 = 7.8$ or total = $39 \neq 40$ NB an attempt at another pair of values implies rejection of first pair	M1	
	Chooses two further values for $x$ and $y$ where both are between 7 and 11 inclusive and calculates mean correctly or compares total to $5x$ . Eg 9 and 10 chosen, Mean = $41 \div 5 = 8.2$ or total = $41 > 40$	M1	
	8 and 10	A1	



Q	Answer	Mark	Comments
11	$\pi \times 10^2 \times 4$	M1	
	$\pi \times 100 \times 4$ or $3.1 \times 100 \times 4$ or $31 \times 40$ or $124 \times 10$	A1	Any of these products or better Condone use of 3.14 or 3.142 or $\frac{22}{7}$
	1240	A1	Accept 1256 or 1256.8 or 1257.(...) or 1260

**Additional guidance**

To get the first A1 the student must show that  $10^2 = 100$ , which may be done as two products using 10.  
Further working eg  $\div 10$  or  $\div 2$  means an incorrect method has been used so M0

12	Intersecting arcs on both sides of line joining sockets, of same radius centred on each socket	M1	
	Perpendicular bisector of sockets within tolerance (at least 3 cm long)	A1	Tolerance is $\pm 1$ mm through their intersecting arcs.
	Point marked on wall 2 cm from fireplace on either side	B1	
	Socket marked on bottom wall where their perpendicular bisector does intersect the wall.	A1	This mark is for showing that the socket can only be fitted on the bottom wall. If both positions marked then A0

**Additional guidance**

Mark in 4 parts

If intersecting arcs, centred on aerial sockets, same radii give M1

Perp bisector in tolerance at least 3 cm long give A1

Point marked (could be dot, or end of a circular arc) on top wall 2 cm from either end of fireplace give B1

Socket marked on bottom wall where perp bisector intersects (as long as M awarded) give A1 but not if a socket shown on both top and bottom wall.

Q	Answer	Mark	Comments
*13	$6x - 4$	B1	
	LHS = $xy + 6x - xy - 4$	B1	Both brackets must be removed. Must see $xy$ and $-xy$ Allow +4 for B1
	Expanding LHS and simplifying and stating $6x - 4 = 2(3x - 2)$ or $2(3x - 2) = 6x - 4$ or showing clearly that all terms cancel.	Q1	Strand (ii). For the Q mark this must be clearly shown and not 'assumed'. If + 4 seen in expansion and this is subsequently changed to - 4 do not allow the Q mark unless the error is recognised and 'recovered'.

**Additional Guidance**

The M mark is for expanding both brackets on the LHS, ie multiplying the first by  $x$  and the second by  $-1$ . They are allowed to make one sign error, which basically means +4 instead of  $-4$ . Inevitably this means the Q mark cannot be scored.

The  $6x - 4$  can come from expanding the RHS or simplifying the LHS.

The Q mark is for showing that both sides are equal. If the LHS is expanded and simplified correctly then this could be done by factorising  $6x - 4$  to get  $2(3x - 2)$  or if the RHS is expanded to  $6x - 4$  then the LHS must also be shown to be  $6x - 4$  and/or terms cancelled.

**NB** The most common (incorrect) response will be

$$xy + 6x - xy + 4 = 6x - 4$$

Then  $6x + 4 = 6x - 4$  or  $6x - 4 = 6x - 4$

This is B1, B1, Q0

Q	Answer	Mark	Comments
14	$2(2x + 3) - 4(3x - 3)$ <b>or</b> $4x + 6 - 12x + 12$	M1	This mark is for the numerator of the LHS. Ignore any denominators. Three terms correct if expanded without brackets seen.
	$-8x + 18$	A1	
	Their $-8x + 18 = 16$	M1	This mark is for dealing with the denominators of the LHS and the value on the RHS <b>NB</b> $2(2x + 3) - 4(3x - 3) = 16$ is M2
	0.25, $\frac{1}{4}$ , $\frac{2}{8}$ oe	A1ft	ft on one error only. Do not accept $-1/-4$

**Exemplars**

$$2(2x + 3) - 4(3x - 3) = 4x + 6 - 12x - 12 = -8x - 6 = 16, x = -22/8 \text{ (oe), M1, A0, M1, A1ft}$$

$$2(2x + 3) - 4(3x - 3) = 4x + 6 - 7x + 12 = -3x + 18 = 16, x = 2/3 \text{ (at least 2 dp) (oe), M1, A0, M1, A1ft}$$

$$2(2x + 3) - 4(3x - 3) = 4x + 6 - 7x - 12 = -3x - 6 = 16, x = -22/3 \text{ (oe), M1, A0, M1, A0ft (2 errors)}$$

14 Alt1	$(2x + 3) - 2(3x - 3)$ <b>or</b> $2x + 3 - 6x + 6$	M1	This mark is for the numerator of the LHS. Ignore any denominators. Three terms correct if expanded without brackets seen.
	$-4x + 9$	A1	
	Their $-4x + 9 = 8$	M1	This mark is for dealing with the denominators of the LHS and the value on the RHS <b>NB</b> $(2x + 3) - 2(3x - 3) = 8$ is M2
	0.25, $\frac{1}{4}$ , $\frac{2}{8}$ oe	A1ft	ft on one error only. Do not accept $-1/-4$

**Exemplars**

$$(2x + 3) - 2(3x - 3) = 2x + 3 - 6x - 6 = -4x - 3 = 8, x = -11/4 \text{ (oe), M1, A0, M1, A1ft}$$

$$(2x + 3) - 2(3x - 3) = 2x + 3 - 5x + 6 = -3x + 9 = 8, x = 1/3 \text{ (at least 2 dp) (oe), M1, A0, M1, A1ft}$$

$$(2x + 3) - 2(3x - 3) = 2x + 3 - 5x - 6 = -3x - 3 = 8, x = -11/3 \text{ (oe), M1, A0, M1, A0ft (2 errors)}$$

Q	Answer	Mark	Comments
14 Alt2	$\frac{x}{2} + \frac{3}{4} - \frac{3x}{2} + \frac{3}{2}$	M1	Three correct terms for M1
	$-x$ or $2\frac{1}{4}$	A1	
	$-x + 2\frac{1}{4} = 2$ or $-x + -\frac{3}{4} = 2$	M1	
	0.25, $\frac{1}{4}$ , $\frac{2}{8}$ oe	A1ft	ft on one error only. Do not accept $-1/-4$

**Exemplar**

$$\frac{x}{2} + \frac{3}{4} - \frac{3x}{2} - \frac{3}{2} = -x + -\frac{3}{4} = 2, x = 2.75 \text{ is M1, A0, M1, A1ft}$$

15(a)	$0.1 \times 400 (=40)$ or $0.2 \times 500 (=100)$	M1	
	40 and 100	A1	
	140 or 140/900 but not 140 : 900	A1ft	Sc2 760 Sc1 Digits 14... ft on their 40 + their 100 if complete correct method seen.

15(b)	$\frac{4}{10}$ and $\frac{3}{9}$ identified as probabilities	M1	May be on branches of a tree diagram.
	$(\frac{4}{10} \times \frac{3}{9}) = \frac{12}{90} = \frac{2}{15}$	A1	Evidence of cancelling is necessary but $\frac{12}{90} = \frac{2}{15}$ is enough. NB $\frac{2}{5} \times \frac{1}{3}$ is 2 marks

16	$\pi r l + \pi r^2 = 24\pi$	M1	$15\pi$
	$3l + 9 = 24$	M1	oe eg $3\pi l = 15\pi$
	5	A1	Sc1 8 from $\pi r l = 24\pi$ Must see working Sc1 6 from $\pi r l + 2\pi r = 24\pi$ Must see working <b>NB</b> if height calculated after 5 seen ignore

Q	Answer	Mark	Comments
17(a)	$\sqrt{25} \sqrt{3}$ or $\sqrt{(25 \times 3)}$ $\sqrt{5 \times 5 \times 3}$ or $\sqrt{(5^2 \times 3)}$	B1	
17(a) Alt	$(5\sqrt{3})^2 = 25 \times 3$	B1	
17(b)	$\frac{6\sqrt{3}}{3}$ or $\frac{6\sqrt{3}}{\sqrt{3} \times \sqrt{3}}$ or $\sqrt{12}$	M1	
	$2\sqrt{3}$	A1	
17(c)	$(5\sqrt{3} + 5\sqrt{3} + \text{their } 2\sqrt{3}) \div 3$	M1	Must use $5\sqrt{3} +$ not $\sqrt{75}$ Condone missing brackets. Working must be seen as answer can be obtained from wrong work.
	$4\sqrt{3}$	A1ft	ft on their answer to (b) if of form $a\sqrt{3}$ accuracy to 2 dp.
18	$(3x - 1)(3x + 1)$	B1	
	$(3x \pm a)(x \pm b)$	M1	$ab = \pm 1$
	$(3x - 1)(x + 1)$	A1	
	Their $\frac{(3x-1)(3x+1)}{(3x-1)(x+1)} \times \frac{x-2}{3x+1}$	M1	This mark is for turning the second fraction upside down and multiplying by it. It can be awarded for cross multiplying at any stage eg $(9x^2 - 1)(x - 2) \div (3x^2 + 2x - 1)(3x + 1)$
	$\frac{x-2}{x+1}$	A1ft	Do not accept incorrect further work ft on $\frac{(3x-1)(3x+1)}{(3x+1)(x-1)} \times \frac{x-2}{(3x+1)}$  $= \frac{(3x-1)(x-2)}{(3x+1)(x-1)}$

Q	Answer	Mark	Comments
19	Evidence that any bar area has been calculated eg applying a scale to side and multiplying by width. These should be multiples of 12, 16, 22, 23, 19 and 8 but as 23 and 19 can be read from graph, do not award for these values unless an area calculation seen	M1	<b>NB</b> each little square is one mouse but if this is assumed and the total area is not shown to be 500 then only this M1 can be awarded.
	Total area calculated. Sum of above is 100.	A1	<b>NB</b> The bars cover 20 'big' squares, so if this is stated this is M1, A1
	Area scaled to 500 or a calculation done such as $12 \times 500 \div 100$	M1	Scale of 25, 50 for 'big' squares as fd.
	60	A1ft	This must come from valid working, so answer of 60 alone or 60 from, say, $3 \times 20$ is M1. ft their first bar total $\times 500 \div$ their total <b>and</b> rounded or truncated to an integer.

19 Alt	20 'big' squares stated as area of all bars	M1	
	$500 \div 20 (= 25)$	A1	
	Their $25 \times 2.4$	M1	
	60	A1ft	

### Additional Guidance

This must be marked in stages. The first step is to assign a 'scale' to the frequency density axis and multiply this by the class width. This only needs to be done for any one bar to get the mark. However, as the first bar is the one that will be relevant, they may calculate this as 60 straight away. This is **not** full marks. It is only M1 at this stage. Also if a scale of 5, 10 etc is applied then the two bars that are one unit wide have heights equal to their area, so be careful that 23 and 19 are 'calculated' and not just read from the axis. I would expect that other 'bars' would indicate if the candidate was calculating an area or reading a scale.

The second mark is for working out all the bar areas and adding to get a total frequency. Only award A1 if this is correctly calculated for their scale. If they do use a scale that gives 60 for the first bar this total will be 500. They then basically get the next mark by default.

The third mark is for scaling their first bar area to their total area and a total frequency of 500.

Final mark is for 60 or a 'follow-through', if they get a wrong total area for the second mark.

**NB** 60 as answer and correct fd scale but 500 not justified is M2.