

GCSE

Mathematics B (Linear)

Component **J567/04**: Mathematics Paper 4 (Higher)

General Certificate of Secondary Education

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations used in the detailed Mark Scheme.

Annotation	Meaning
✓	Correct
✗	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign

Subject-Specific Marking Instructions

- M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.
- Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.
- Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by eg FT $3 \times \textit{their} (a)$.

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

4. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.
5. The following abbreviations are commonly found in GCSE Mathematics mark schemes.
 - **cao** means **correct answer only**.
 - **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
 - **isw** means **ignore subsequent working** (after correct answer obtained).
 - **nfw** means **not from wrong working**.
 - **oe** means **or equivalent**.
 - **rot** means **rounded or truncated**.
 - **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.
 - **soi** means **seen or implied**.
6. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
7. As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).
8. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.
9. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

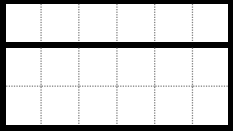
10. If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

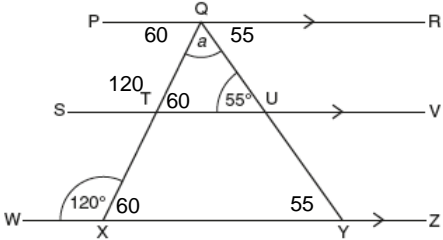
If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.

11. Ranges of answers given in the mark scheme are always inclusive.
12. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
13. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

MARK SCHEME

Question		Answer	Marks	Part marks and guidance	
1	(a)		2	B1 for 6 by 3 or 6 by 2 rectangle only Or SC1 for 8 by 3 or 7 by 3 or 5 by 3 or 4 by 3 rectangle with correct internal line	Use overlay Condone clear intention Condone internal lines for B1 More than one rectangle drawn scores 0
	(b)	480 000 or 4.8×10^5	3	M1 for $\frac{1}{2} \times (40 + 60) \times 80$ And M1 for <i>their</i> 4000×120	Ignore units = 4000 <i>their</i> 4000 must be from area calculation eg $60 \times 80 \times 120$
2	(a)	2 [miles] [£] 1.5[0]	2	B1 for each	
	(b) (i)	3 8.2[0] 16	2	M1 for two correct	
	(ii)	Ruled straight line from (0, 3) to (10, 16)	2	B1FT for at least two points plotted correctly FT <i>their</i> table	Condone dashed line Tolerance half small square
	(c)	City Cabs by 0.6[0]	2	Or FT <i>their</i> graph M1 for [£]14 or [£]13.40 seen	FT reading from <i>their</i> graph tolerance $\pm 20p$ Accept eg 60p but not 60
3	(a)	0.21 oe	2	M1 for $1 - (0.36 + 0.25 + 0.18)$ Or for 0.79 oe seen	ISW incorrect conversion
	(b)	0.82 oe	1		ISW incorrect conversion
4	(a)	$15 - 6t$ final answer	1		

Question		Answer	Marks	Part marks and guidance	
	(b)	$5p(2p + 1)$ final answer	2	M1 for $5(2p^2 + p)$ or $p(10p + 5)$ or $5p(2p + 1)$ seen	Condone missing final bracket Condone $1p(10p + 5)$ for M1
5	(a)	18	1		
	(b)	1.25 or $\frac{5}{4}$	1		Accept $\frac{10}{8}$ or $1\frac{1}{4}$ but not $\frac{1}{0.8}$
	(c)	$3^3 \times 5^2$ or $3 \times 3 \times 3 \times 5 \times 5$	2	M1 for correct method to find prime factors soi leading to at least three correct prime factors	M1 only for $1 \times 3 \times 3 \times 3 \times 5 \times 5$ M1 may be implied by 3, 3, 3, 5, 5
6		2.27 or 2.269 to 2.270[...]	2	M1 for $\pi \times 0.85^2$	Imply M1 for answer 2.26 with no working seen
7		$a = 65^\circ$ Correct reason linked with parallel lines Correct reason linked with triangle or line	B2 B1 B1	Or B1 for $\angle QTU = 60^\circ$ or $\angle QXY = 60^\circ$ or $\angle PQS = 60^\circ$ or $\angle XYQ = 55^\circ$ or $\angle RQU = 55^\circ$ or $\angle QTS = 120^\circ$ soi 	Angles may be indicated on diagram Alternate angles or corresponding angles or interior angles as appropriate [Angles in a] triangle = 180° or [angles on a] line = 180° Do not accept \triangle for triangle
8	(a) (i)	Positive and strong	1	Accept positive and moderate	
	(ii)	Ruled line of best fit 10 to 12	B1 B1		Line passing between (8, 17) to (8, 22) and (20, 54) and (20, 58) Line at least as long as overlay

Question		Answer	Marks	Part marks and guidance	
	(b)	20	3	B1 for 2.25 seen M1 for $45 \div \textit{their time}$	Accept figs 45 for 45 Accept 2.25 or 2.15 or 2h 15 or 215 or 135 for <i>their time</i>
9	(a)	9	1		
	(b)	2 correct trials of x for $3 < x < 4$ with one outcome less than 20 and one greater than 20 $x = 3.4$	M2 B1	M1 for any correct trial for $3 < x \leq 4$ Independent mark	Correct outcome rounded or truncated to at least 3sf, accept trials of any value of x in given range Accept evaluation of $x^3 - 6x - 20$

x	$x^3 - 6x$
4	40
3.1	11.191
3.2	13.568
3.3	16.137
3.4	18.904
3.5	21.875
3.6	25.056
3.7	28.453
3.8	32.072
3.9	35.919
3.45	20.363
3.44	20.067

Question	Answer	Marks	Answer
10	<p>Length extending above wall = 0.75 m or 75cm or 0.8 m or 80 cm with units and fully correct calculations using at least 2sf or accurate scale drawing seen, expressed correctly and clearly annotated and laid out</p> <p>A Correct answer with some method, units may be incorrect or omitted, answer may be given to more than 2 sf accuracy.</p> <p>B Correct calculation/scale drawing to find length of ladder to wall 1.75 m or 175cm or 1.7 m or 170 cm or 1.8 m or 180 cm with units, expressed correctly and clearly annotated and laid out</p> <p>Correct use of Pythagoras to $L = \sqrt{0.7^2 + 1.6^2}$ or $\sqrt{3.05}$ Or accurate scale drawing with no scale stated and correct measurements not found</p>	<p>5</p> <p>4-3</p> <p>2-1</p>	<p>Length to wall = $\sqrt{0.7^2 + 1.6^2} = 1.746\dots$ Length above wall = $2.5 - 1.746\dots = 0.754$</p> <p>Or accurate scale drawing with scale correctly stated</p> <p>A Length of ladder to wall found correctly, with unclear method Or accurate scale drawing with scale stated but correct measurements not found</p> <p>B Full method to find length extending with errors in calculation $(2.5 - \sqrt{0.7^2 + 1.6^2} \text{ oe})$</p> <p>Attempt to use Pythagoras (involving two of 0.7, 1.6 or 2.5), adding or subtracting squares or use of scale drawing</p>

Question		Answer	Marks	Part marks and guidance	
11	(a)	$x > \frac{10}{4}$ oe or $x > 2.5$ oe final answer	2	<p>M1 for $4x > 7 + 3$ or better AND M1 for $x < \frac{b}{a}$ after $ax > b$ seen max 1 mark if answer incorrect</p> <p>After M0, SC1 for answer $\frac{10}{4}$ oe or $x \dots \frac{10}{4}$ with any incorrect equality or inequality symbol or answer $4 \times \frac{10}{4} - 3 > 7$</p>	<p>Condone use of = or incorrect inequality symbol in place of < for all method marks $a \neq 1, b \neq 0$</p> <p>Trial and improvement methods can only score for correct answer or correct embedded answer</p> <p>ISW for incorrect simplification of $\frac{10}{4}$</p>
	(b)	$q = 2p - 5$ final answer	2	<p>M1 for $2p = q + 5$ or for $p - \frac{5}{2} = \frac{q}{2}$ After M0, SC1 for either $2p - 5$ or $q = 2p + 5$ or $q = 2(p - 5)$ or $q = 2p - 10$ as answer</p>	
	(c)	-7	3	<p>B1 for $5x + 2 = 6x + 9$ AND M1 FT for collecting constants on one side AND M1 FT for collecting terms in x on other side Max 2 marks if answer incorrect</p>	<p>FT <i>their</i> $ax + b = cx + d$ Eg $5x - 7 = 6x$</p>
12	(a)	65	2	<p>M1 for $\frac{247}{380}$ [$\times 100$]</p>	

Question		Answer	Marks	Part marks and guidance	
	(b)	160	3	M2 for $136 \div 0.85$ oe Or B1 for 0.85 seen or 85% seen or $\frac{85}{100}$ seen	
13		$x \leq 5$ or $x < 6$ $y \geq 3$ or $y > 2$ $y \leq x + 1$ or $y < x + 2$	3	M2 for two correct inequalities or three equations of lines correctly stated Or M1 for one correct inequality or two equations of lines correctly stated	Accept any correct inequalities eg $x < 5.5$ etc M marks for equations may be implied by inequalities with incorrect symbols Condone double inequalities if they apply to these points eg $1 < x \leq 5$ etc
14	(a)	(7, -12)	2	B1 for one correct or for 7 and -12 seen or for vector $\begin{pmatrix} 2 \\ -4 \end{pmatrix}$ soi or for $\frac{x+3}{2} = 5$ and $\frac{y+(-4)}{2} = -8$	(2, -4) seen does not imply vector
	(b) (i)	Vector $\begin{pmatrix} 9 \\ 3 \end{pmatrix}$ drawn	1		Must have arrow Condone arrow on each part vector
	(ii)	Vector $\begin{pmatrix} 5 \\ 3 \end{pmatrix}$ drawn	1	After 0 in (i) and (ii), award SC1 for two correct lines with no/incorrect arrows	Must have arrow Accept drawn as two vectors without resultant shown if arrows correct Condone arrow on each part vector
15	(a) (i)	5.15×10^7	1		
	(ii)	4.81×10^7	2	B1 for figs 481	

Question		Answer	Marks	Part marks and guidance	
	(b)	Two different correct comments comparing coal and all fuels	2	B1 for each Comments must compare coal and all fuels	Eg Most electricity was generated from coal in 1960 but by 2010 it was less than half of the total After 1990 the amount generated from coal decreased, but the total amount generated continued to increase See exemplars
	(c) (i)	133.75 134	2	B1 for each	
	(ii)	135	2	M1 for 136.25×4 oe or 136.5×4 oe	545 or 546
16	(a)	0.2 0.2 0.8 0.8 0.2 0.8	1		All branches correctly completed
	(b)	0.32 oe	3	M2FT for $0.2 \times 0.8 + 0.8 \times 0.2$ Or M1FT for 0.2×0.8 seen	For method marks follow through their tree diagram, if probabilities < 1 ISW incorrect conversion of final answer
	(c)	0.008 oe	2	M1 for $0.2 \times 0.2 \times 0.2$ soi	ISW incorrect conversion of final answer M1 implied by answer 0.0008

Question		Answer	Marks	Part marks and guidance	
17	(a)	32.6[1...] or 32.62	3	M2 for $\tan^{-1}(4.8 \div 7.5)$ Or M1 for $\tan [] = 4.8 \div 7.5$ or $\tan [] = 0.64$	Allow M2 for complete method using sine rule leading to $\sin^{-1}\left(\frac{4.8 \sin 90}{\sqrt{4.8^2 + 7.5^2}}\right)$ or M1 for $\sin BAC = \frac{4.8 \sin 90}{\sqrt{4.8^2 + 7.5^2}}$ oe
	(b)	13.8[2...]	3	M1 for $PR^2 = 6.2^2 + 9.3^2 - 2 \times 6.2 \times 9.3 \cos 125$ And M1 for $PR = \sqrt{191.07}$	$PR^2 = 191.07...$
18		4.8	3	M2 for $8 \times \frac{9}{15}$ oe Or M1 for $\frac{9}{15}$ or $\frac{8}{15}$ seen or for $\frac{x}{9} = \frac{8}{9+6}$ oe	Working leading to answer 12 is incorrect use of lengths and scores 0
19	(a)	325 315	2	B1 for one correct or for reversed answers	Do not accept 324.999 etc
	(b)	275.5	2	M1 for <i>their</i> $325 - w$, where $45 \leq w < 50$ or for subtraction involving 49.5	Answer 275.49... implies M1
20	(a)	1500	1		Not 1560
	(b)	4 [%]	1		

Question		Answer	Marks	Part marks and guidance																																																										
	(c)	18	2	B1 for answer 17.67 or 17.7 Or M1 for correct trial > 5 years rounded or truncated to 3sf seen	Mark answer line first																																																									
					<table border="1"> <thead> <tr> <th>Years</th> <th>Amount</th> <th>Multiplier</th> </tr> </thead> <tbody> <tr><td>5</td><td>1824[.979]</td><td>1.217</td></tr> <tr><td>6</td><td>1897[.979]</td><td>1.265</td></tr> <tr><td>7</td><td>1973[.898]</td><td>1.316</td></tr> <tr><td>8</td><td>2052[.854]</td><td>1.369</td></tr> <tr><td>9</td><td>2134[.968]</td><td>1.423</td></tr> <tr><td>10</td><td>2220[.366]</td><td>1.480</td></tr> <tr><td>11</td><td>2309[.181]</td><td>1.539</td></tr> <tr><td>12</td><td>2401[.548]</td><td>1.601</td></tr> <tr><td>13</td><td>2497[.61]</td><td>1.665</td></tr> <tr><td>14</td><td>2597[.515]</td><td>1.732</td></tr> <tr><td>15</td><td>2701[.415]</td><td>1.801</td></tr> <tr><td>16</td><td>2809[.472]</td><td>1.873</td></tr> <tr><td>17</td><td>2921[.851]</td><td>1.948</td></tr> <tr><td>18</td><td>3038[.725]</td><td>2.026</td></tr> <tr><td>19</td><td>3160[.274]</td><td>2.107</td></tr> <tr><td>20</td><td>3286[.685]</td><td>2.191</td></tr> <tr><td>21</td><td>3418[.152]</td><td>2.279</td></tr> <tr><td>22</td><td>3554[.878]</td><td>2.370</td></tr> </tbody> </table>	Years	Amount	Multiplier	5	1824[.979]	1.217	6	1897[.979]	1.265	7	1973[.898]	1.316	8	2052[.854]	1.369	9	2134[.968]	1.423	10	2220[.366]	1.480	11	2309[.181]	1.539	12	2401[.548]	1.601	13	2497[.61]	1.665	14	2597[.515]	1.732	15	2701[.415]	1.801	16	2809[.472]	1.873	17	2921[.851]	1.948	18	3038[.725]	2.026	19	3160[.274]	2.107	20	3286[.685]	2.191	21	3418[.152]	2.279	22	3554[.878]	2.370
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21		$x = 1.3, y = 7.3$ $x = -2.3, y = 3.7$	5	<p>M2 for $x^2 + x - 3 [= 0]$ Or M1 for attempt to equate eg $x + 6 = x^2 + 2x + 3$</p> <p>AND M1 for substitution into quadratic formula $\frac{-1 \pm \sqrt{1^2 - 4 \times -3}}{2}$</p> <p>A1 for $x = 1.3, x = -2.3$ AND A1 for $y = 7.3, y = 3.7$</p> <p>After A0 allow SC1 for one pair of x and y values correct or for both y values correctly FT their x values substituted into $y = x + 6$</p>	<p>Allow 4 marks if answers given to more than 1dp $x = 1.3027\dots, y = 7.3027\dots$ $x = -2.3027\dots, y = 3.7027\dots$</p> <p>Condone one error in substitution $= \frac{-1 \pm \sqrt{13}}{2}$</p> <p>Allow A marks if solutions are clear in working, but transferred to wrong places on answer lines</p>

APPENDIX

Exemplar responses for Q.15(b)

Award 1 mark only if both statements make the same comparison

Response	Mark
The amount of electricity generated from coal decreased <i>not a comparison</i>	0
The amount of electricity generated from coal was less <i>ambiguous, less than what?</i>	0
The amount of electricity generated from coal was less than all fuels	1
All fuels always generated more electricity	1
Both coal and all fuels dropped after 2005	1
There is much more electricity generated from all fuels in 1995 than for coal <i>accept a comparison for a specific year but second comment must compare a different aspect of the graph rather than similar comment for a different year</i>	1
All fuels went up steadily but coal went up and down <i>accept overall trend</i>	1

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