

Mathematics B (Linear)

General Certificate of Secondary Education

Component **J567/03**: Mathematics Paper 3 (Higher)

Mark Scheme for June 2012

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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

These should be used whenever appropriate during your marking.

The **M**, **A**, **B**, etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.

It is vital that you annotate these scripts to show how the marks have been awarded.

It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

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.

3. 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.
- **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'. 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.

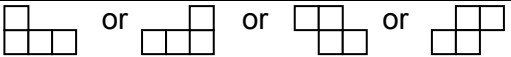
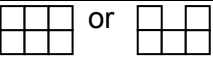
If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.
11. Ranges of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

Question			Answer	Marks	Part Marks and Guidance	
1	(a)	(i)	[0].06	1		
		(ii)	0.2̇ or 0.222[...]	1		Condone poor notation eg 0.22̇
	(b)	(i)	125	2	<p>M1 for 5^3</p> <p>Or</p> <p>SC1 for $\frac{25 \times 3125}{625}$ or $\frac{78125}{625}$</p> <p>or $\frac{5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5 \times 5}$ soi</p>	<p>For SC1 the <u>full</u> method may be done in stages but must all be present</p> <p>Note 12.5 is a possible wrong answer and scores 0 marks</p>
		(ii)	$\frac{3}{2}$ or $1\frac{1}{2}$ or 1.5	3	<p>M2 for $\frac{9}{6}$ or other equivalent unsimplified fraction or mixed number</p> <p>Or</p> <p>M1 for $\frac{20}{6}$ and $\frac{11}{6}$</p> <p>or $3\frac{2}{6}$ and $1\frac{5}{6}$</p> <p>or other conversion to common denominator with at least one correct numerator</p> <p>After M0, SC1 for conversion of the result of <i>their</i> subtraction to lowest terms if improper fraction or mixed number</p>	<p>If $1\frac{3}{6}$ then $1\frac{1}{2}$ on answer line award 3 marks</p> <p>$\frac{10}{3} - \frac{11}{6}$ scores 0 marks</p>

Question		Answer	Marks	Part Marks and Guidance	
2		Correct arcs and bisector of angle DAB $53^\circ \pm 2^\circ$	2	B1 for bisector, without correct arcs	Use overlay Line from A to minimum 5cm from C
		Arc centre C radius 5 cm \pm 2 mm	1		Arc must meet BC and DC within tolerance and be correct by eye or meet <i>their</i> bisector within tolerance if short arc
		Correct area shaded	1		FT <i>their</i> bisector and arc Must be intersection of <i>their</i> line from A and any arc centre C
3	(a)	750 250	2	M1 for figs 75 and 25 seen or $1000 \div 4$ seen	Implied by 250 seen

Question	Answer	Marks	Answer
3 (b)*	<p>Correct final answer of £32.60 with clearly expressed and annotated supporting method showing calculation of quantity and cost of each type of juice, cost of cups and takings</p> <p>Correct final answer of £32.60 without clear supporting method but not from wrong working Or Answer of 32.6(0) with no units or £33.60 (with cost of cups omitted) with clearly expressed and annotated supporting method Or Complete method with annotation with one or two arithmetic slips</p> <p>At least two correct values from A – F calculated Or One correct value from A – F clearly annotated</p> <p>No relevant calculations seen</p> <p>A: $0.25 \times 80 = 20$ litres drink B: 15 litres apple, 5 litres mango required C: Cost Apple: $15 \times 0.56 = \text{£}8.40$ FT <i>their</i> 15 D: Cost Mango: $5 \times 1.20 = \text{£}6$ FT <i>their</i> 5 E: Takings: $0.60 \times 80 = \text{£}48$ F: Donation: $\text{£}48 - \text{£}8.40 - \text{£}6.00 - \text{£}1 = \text{£}32.60$ FT <i>their</i> takings – <i>their</i> costs (condone omitting cups)</p>	<p>5</p> <p>4-3</p> <p>2-1</p> <p>0</p>	<p>For lower mark: Calculation of takings (E), costs of their quantities of each type of juice (C and D, totalling 20 litres) and calculation of takings – costs (F) with one or two arithmetic slips Some annotation or units must be seen</p> <p>For lower mark: One correct value from A – F calculated</p> <p>For 2 or 1 marks units are not required and working may be in pounds, pence, ml or litres B correct implies A for 2 marks For 2 or 1 marks allow any quantity of juice ≤ 20 for C and D</p> <p>Only allow F if takings > costs, and takings and costs each result from a calculation seen</p>

Question			Answer	Marks	Part Marks and Guidance										
4	(a)	(i)	80	1											
		(ii)	$\frac{30}{120}$ isw oe or 0.25 or 25%	2	B1 for fraction with numerator 30 or denominator 120 Or SC1 for ratio 30 : 120 oe										
		(iii)	57	2	M1 for 114 seen or $\frac{68 + 46}{}$ <i>their '80'+their '120'</i> Or SC1 for answer 79% or 78%										
	(b)	(i)	<table style="border-collapse: collapse; margin-left: 20px;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">3</td><td>7 9</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">4</td><td>0 2 5 5 6 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">5</td><td>1 1 2 4 5 7 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">6</td><td>0 2 3 5</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">7</td><td>2</td></tr> </table>	3	7 9	4	0 2 5 5 6 8	5	1 1 2 4 5 7 8	6	0 2 3 5	7	2	3	M2 if correct except for one or two errors or omissions Or M1 for unordered diagram with at most one error or omission
3	7 9														
4	0 2 5 5 6 8														
5	1 1 2 4 5 7 8														
6	0 2 3 5														
7	2														
		(ii)	35	1											

Question		Answer	Marks	Part Marks and Guidance	
	(iii)	No, 10 km at 12 km/h takes 50 minutes so only 8 ran faster than this which is less than half of the runners	4	<p>M2 for 50 [minutes] or 5 min/km or 200 m/min or 11.6 km/h or 11.7 km/h or for 5.1 min/km or 5.15 min/km</p> <p>Or</p> <p>M1 for attempt at $\frac{10}{12}(\times 60)$ or for $10 \div \textit{their}$ time in hours or correct non-unitary distance/time or time/distance</p> <p>AND</p> <p>M1 for 8 people < 50 [mins] or for 12 people > 50 [mins] or for 51.5 or for 51 identified or for correct calculation of min/km for other time</p> <p>AND</p> <p>M1 for correct comparison showing less than half at >12km/h</p>	<p>See exemplars Times for 12 km/h Speeds for median/10th Times for median/10th</p> <p>eg 2km per 10 mins</p> <p>Or FT <i>their</i> stem and leaf diagram</p> <p>eg 8 out of 20 is less than half or half at 51.5 so less than half at 50</p>
5	(a)		2	<p>B1 for </p>	<p>Allow any orientation of correct answer for 2 marks</p> <p>Condone unrulid and omission of internal lines for either 2 or 1 marks</p>

Question			Answer	Marks	Part Marks and Guidance	
	(b)	(i)	Correct isometric drawing of $1 \times 2 \times 3$ cuboid, any orientation	2	B1 for any correct isometric drawing of solid with volume 6 cm^3	If L-shaped solid drawn assume presence of hidden cube for B1 Mark intention, condone unrul
		(ii)	22	2	Or FT <i>their</i> solid M1 for clear attempt to count number of surface squares	
	(c)	(i)	(3, 0, 1)	1		
		(ii)	(1, 1, 3)	1	SC1 for (1, 3, 1) after (3, 1, 0) in (a) or (1x, 1y, 3z) after (3x, 0y, 1z)	
6	(a)		$3n + 5$ oe	2	Mark final answer M1 for $3n$ soi not $-3n$	Condone any letter in place of n $8 + 3(n - 1)$ scores 2 marks as final answer $n = 3n + 5$ scores 1 mark but eg $t = 3n + 5$ scores 2 marks
	(b)		7, 2, -3	2	M1 for 2 correct in correct position Or SC1 for 12, 7, 2 or $-7, -2, 3$	
7	(a)		$3a + 12$	1		
	(b)		$2b(b + 3)$	2	M1 for $2(b^2 + 3b)$ or $b(2b + 6)$	Condone $(2b + 0)(b + 3)$ Condone missing final bracket

Question		Answer	Marks	Part Marks and Guidance	
	(c)	4.5 oe	3	M2 for $2x = 9$ Or M1 for $5x - 3x - 2 = 7$ or better collecting x or $5x = 3x + 7 + 2$ or better collecting constants AND M1 for $x = \frac{b}{a}$ after $ax = b$ seen If M0 , SC2 for $5 \times 4.5 - 2 = 3 \times 4.5 + 7$ as final answer	Implied by $2x = b$ Implied by $ax = 9$ $a \neq 1$
	(d)	(i) $y \geq 2$	2	M1 for $4y \geq 5 + 3$ or better Or B1 for answer of 2 with no or incorrect inequality symbol or $y = 2$ Or SC1 for $4 \times 2 - 3 \geq 5$	
		(ii) Solid circle at 2 and line to right of 2	1	Or FT <i>their</i> inequality	
8	(a)	Triangle B correctly positioned Vertices (4, -2), (5, -2), (4, -4)	3	M2 for correct translation of <i>their</i> reflected triangle Or M1 for correct reflection of A in x -axis Or M1 for any translation of correct B Or SC2 for triangle B (-1, 0), (0, 0), (0, 2) or triangle B (-4, 1), (-2, 1), (-2, 5)	Use overlay Green triangle scores 3 marks Red triangle scores SC2 Translation of green triangle scores M1 Accept intention if triangles not labelled Condone unruled

Question			Answer	Marks	Part Marks and Guidance	
	(b)		Enlargement [Centre] (0, 0) oe [Scale factor] -2	1 1 1		Marks are independent but if more than one transformation so award 0 for first mark Allow origin, O for centre
9	(a)	(i)	6.14×10^7	1		Condone 6.1×10^7
		(ii)	$9 \times 10^9 \div 6 \times 10^7 = 150$ Or $60 \times 1500 = 90\,000$ Or $6.14 \times 10^7 \times 1500 = 9.21 \times 10^{10}$ Or Clearly showing Chloe's answer is ten times too big	2	B1 for 9×10^9 o.e. seen or 6×10^7 o.e. seen or 9000 and 60 seen or $1500 \times$ figs 61.4 seen or figs 9325 \div figs 61.4 seen or figs 9325 \div 1500 seen or scaling method to show Chloe not correct without final comment	Numbers need not be in standard form for either 2 or 1 marks
	(b)		1.35×10^6	2	M1 for figs 135 or $1.34(7\dots) \times 10^6$	1347292 scores 0 marks
10	(a)		Tree diagram complete	2	B1 for correct placement of $\frac{9}{10}$ or $\frac{4}{5}$	Allow any equivalent fractions or decimals
	(b)		$\frac{36}{50}$ oe isw	2	FT <i>their</i> tree diagram M1 for <i>their</i> $\frac{9}{10} \times \frac{4}{5}$ oe	
11	(a)		90	1		
	(b)		90 85 70	2	B1 for 85 or 70 correct	

Question		Answer	Marks	Part Marks and Guidance	
	(c)		Smooth curve through six correct points	2	B1 for 5 points correctly plotted FT table Use overlay Tolerance ± 1 mm vertically from correct position for points Intention of correct smooth curve
	(d)	(i)	58 – 60	1	Or FT curve Tolerance ± 1 for FT
		(ii)	4.1 – 4.3	1	Or FT curve for first crossing Tolerance ± 0.1 for FT
12			8	3	M1 for $3w + d = 28$ $w + d = 12$ AND M1 for $2w = 16$ FT <i>their</i> equations Or M1 for correct trial calculating number of points when 'wins + draws' = 12 or number of wins and draws when points = 28 AND M1 for improved trial M2 for $3w + (12 - w) = 28$ o.e. Alternative Method M1 for $36 - 28 = 8$ (points dropped) M1 for $8 \div 2 = 4$ (draws) A1 $12 - 4 = 8$ (wins) Be aware of answer from wrong working, $36 - 28 = 8$ scores M1 only
13	(a)		36	1	

Question		Answer	Marks	Part Marks and Guidance	
	(b)	70% of the workers in this survey worked between 30 and 45 hours, which is more than in the national survey	4	<p>M1 for at least 3 of 21, 36, 60, 75, 40, 18</p> <p>M1 dep for sum of <i>their</i> 6 frequencies [= 250]</p> <p>M1 for $0.54 \times \textit{their}$ '250' or $(\textit{their} 60 + 75 + 40) \div \textit{their}$ '250'</p> <p>M1 for comparison of two correct percentages/fractions/numbers of workers seen</p>	<p>M1 implied by 175 Frequencies may be seen on graph 250 seen implies first M2 NB this may be in two or more steps</p> <p>Must compare like with like and comparisons must be of 65% to 75% with 54% or 130 to 140 workers with 175 for final M1</p>
14	(a)	$Fd = 18\,000$ oe	2	<p>M1 for 300×60 soi or for $F \propto \frac{1}{d}$ or $F = \frac{k}{d}$ o.e. seen</p>	k can be any letter or number
	(b)	450	1	Or FT from <i>their</i> equation in F and d in (a)	eg 200 after $F = 5d$ in (a)
15	(a)	$(x + 4)^2 - 6$	3	<p>M2 for $(x + 4)^2 - 16$ [+ 10] or $x^2 + 4x + 4x + 16 - 16$ [+ 10] Or M1 for $(x + 4)$ or $(x + 4)^2$ or -6 seen Or SC2 for $(x - 4)^2 - 6$</p>	
	(b)	-6	1	Or FT <i>their</i> constant term from completed square expression	

Question			Answer	Marks	Part Marks and Guidance
16	(a)	(i)	$\begin{pmatrix} 9 \\ -3 \end{pmatrix}$	1	Condone line in vector if numbers correctly placed
		(ii)	$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$	1	
	(b)		$j = 3, k = 2$	2	<p>B1 for one correct or p or q or 3p or p+q drawn on grid or for one of $3j - 2k = 5$ or $j + 2k = 1$</p> <p>Or</p> <p>SC1 for $\begin{pmatrix} 9 \\ -3 \end{pmatrix} + \begin{pmatrix} -4 \\ 4 \end{pmatrix} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$</p>
17	(a)		$\frac{1}{27}$	2	<p>Mark final answer</p> <p>M1 for $\frac{1}{3}$ or $\frac{1}{729}$ or $\frac{1}{27}$ or 27 seen</p> <p>0 marks for $\frac{3}{81}$ if no correct working seen</p>
	(b)		$17 + 8\sqrt{2}$	2	<p>M1 for $15 + 5\sqrt{2} + 3\sqrt{2} + 2$ at least 2 terms correct</p> <p>For M1 $(\sqrt{2})^2$ or $\sqrt{4}$ is acceptable in place of the 2</p> <p>Allow M1 for $8\sqrt{2}$ or $15 + 2$ but not just 17</p>
18			$\frac{7x-1}{(x+2)(x-3)}$ or $\frac{7x-1}{x^2-x-6}$	3	<p>M1 for $3(x-3) + 4(x+2)$ or $3x-9 + 4x+8$ or better seen</p> <p>M1 for correct common denominator seen as a denominator</p> <p>Mark final answer but isw for incorrect expansion of denominator after correct answer seen</p> <p>Condone missing brackets in denominator for M1 if intention clear, but for 3 marks all brackets must be present or correct expansion</p>

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