

Mathematics B (Linear)

General Certificate of Secondary Education

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

Mark Scheme for March 2013

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations

Annotation	Meaning
	Correct
	Incorrect
	Benefit of doubt
	Follow through
	Ignore subsequent working (after correct answer obtained), provided method has been completed
	Method mark awarded 0
	Method mark awarded 1
	Method mark awarded 2
	Accuracy mark awarded 1
	Independent mark awarded 1
	Independent mark awarded 2
	Misread
	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

1. **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.
2. 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 and applies as a default.
 - **nfww** 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. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
7. In questions with a final answer line following working space,
 - (i) if the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
 - (ii) if the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
 - (iii) if the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.
8. 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).
9. 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.
10. 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.
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)	Rotation [centre] (0,0) or origin or O 90° clockwise or 90°	1 1 1	must be a single transformation condone missing brackets allow +270 etc	condone turn
	(b)	correct enlargement, points at (-2, 3), (7, 3) and (4, 9)	2	B1 for correct triangle in the wrong place or for a correct enlargement sf 2 or for two correct points	see overlay, allow ±2mm by eye which is on or within a small circle Mark to candidate's advantage
2	(a)	48	1		
	(b)	8 (ignoring any units)	2	M1 for diff DKK ÷ diff Pounds (can be implied eg by 8x) isw	eg 80 ÷ 10 or $\frac{4}{5}$ oe or a line on the graph going up from £1 to the line
	(c)	the number of DKK in one pound	1	FT (b), accept any correct statement eg exchange rate, select best one	See exemplars
	(d)	18.2[0] to 19.2[0]	2FT	Correct answer or FT <i>their</i> value in (b) M1 for partitioning 152, eg 80 + 72 and attempt to read from the graph and add them, or 152 ÷ 2 and 'reading at 76' × 2, or 152 ÷ <i>their</i> '8', or 152 × a reasonable figure from the graph for the value of 1DKK	eg (b) 0.8 (d) 152 ÷ 0.8 = 190 scores 2 the reading must be 10DKK or above
3	(a)	43 and 79	1		
	(b)	2 × 3 × 7 [× 1 = 42]	2	M1 for complete factor tree with at most one error or B1 for two of 2, 3 and 7 as factors with at most one error (these could be seen as branch ends on factor tree)	ignore 1 and 42 for M1 ignore 1 for B1 see additional guidance

Question		Answer	Marks	Part Marks and Guidance	
	(c)	168	2	M1 for reduction of 24 to prime factors eg $2^3, 3$ or for a list of at least 3 further multiples of either 24 or 42, or for any multiple of 168	eg 48, 72, 96 or 84, 126, 168 eg 336, 504, 672, 840, 1008
	(d)	(t =) 5 and (m =) 4	2	B1 for correct answers reversed, or one answer correct, or (t =) 3 and (m =) 5, or (t =) 1 and (m =) 6 Or M1 for any correct method eg correctly subtracting 7s/15s from 95 and to reach either 35 or 60, or for correctly listing at least 3 further multiples of both 7 and 15, or for $[7 \times 5 =] 35$ and $[15 \times 4 =] 60$	See additional guidance
4	(a)	5.31[5....] or 5.3[2]	3	M2 for $\sqrt{3.5^2 + 4^2}$ or better or M1 for $3.5^2 + 4^2$ or better eg 28.25	accept 5 if correct working seen
	(b)	(i) rectangle 8 cm by 14 cm with any line joining the 8 cm sides	1	in both parts allow ± 4 mm BOD faint, dotted or freehand lines	use overlay for guidance for perimeter, need an internal line, accuracy by eye
		(ii) rectangle 5 cm by 14 cm with a rectangle 3.5 cm by 14 cm on top	1	after 0 for both (b)(i) and (b)(ii), SC1 for correct outlines in both parts	use overlay – accuracy by eye
5		$6n + 11$	2	M1 for $6n$ seen, allow $6 \times n$ or $n6$	n (or x) = $6n + c$ scores M1 but $6n^{+11}$ or 6^n scores 0 Note: n th or $u_n = 6n + 11$ for 2
6	(a)	$7x - 5$	2	M1 for $5x - 15 + 2x + 10$ with at most one error, or $7x$ or $- 5$ in answer	condone $+5$

Question		Answer	Marks	Part Marks and Guidance	
	(b)	2.5 or $\frac{5}{2}$ oe	3	<p>M1 for $12x - 4x - 11 = 9$ (dealing with x's)</p> <p>M1 for $12x = 4x + 9 + 11$ (dealing with numbers)</p> <p>M1 for $x = \frac{b}{a}$ after $ax = b$ ($a \neq 1$)</p> <p>(maximum of M2 awarded)</p>	<p>allow better than these</p> <p>SC2 for 2.5 embedded</p>
7	(a)	71.9[5.....] or 72 nfw	4	<p>B1 for midpoints soi eg three from 63, 70, 77, 84</p> <p>M1 for attempt at $\sum mf$ (3094)</p> <p>M1 for <i>their</i> '3094' \div <i>their</i> '$\sum f$'(43)</p> <p>or</p> <p>SC3 for answer of 68.9[5...] or 74.9[5...]</p> <p>or</p> <p>SC2 for $[630+1050+1078+336 \div 43 =]$ 2765[.8...] or for use of a 'midpoint' of 6 with all working correct</p>	<p>B1 can be implied by three from 630, 1050, 1078, 336</p> <p>m can be any value within the group so can be implied by four figures added in ranges 600 – 660, 1005 – 1095, 1036 – 1120 and 324 – 348</p> <p>see additional guidance</p>
	(b)	$\frac{25}{43}$ isw or 0.58[1.....] or 58.[1...]% oe	2	<p>B1 for either 25 as a numerator or 43 as a denominator in a proper fraction, or correct answer in the wrong form eg 25 in 43</p>	<p>isw cancelling or conversion after correct answer seen and ignore any words</p>
8		30.85 to 31	4	<p>B1 for 12^2 soi eg 12×12 or 144</p> <p>and</p> <p>M2 for $\pi \times 6^2$ (accept 113 to 113.15)</p> <p>or</p> <p>M1 for an expression involving π and 6</p>	<p>ignore quartering or halving of areas to award the M or B marks</p> <p>after M0 allow SC1 for $\pi \times 12^2$ (implied by 452[.])</p>
9	(a)	14.8	1		

Question		Answer	Marks	Part Marks and Guidance																																															
	(b)	A C B with two of 0.25, 0.39(14...) and 0.42(00...) oe seen	2	<p>M1 for two of 0.25, 0.39(14...), 0.42(00...) oe seen or B1 for the correct answer with insufficient or incorrect evidence</p> <p>Allow full marks for answers not involving letters. Not allowing surds as values</p>																																															
10	(a)	3.8 one mark for each correct trial in the range $3 < x < 4$, to a maximum of 2 , whose results rot to at least 1sf	B1 M1 M1	<p>If answer line blank condone 3.8 clearly indicated (may be in table)</p> <p>use the list on the right but allow any correct trial for any value of x between 3 and 4</p> <p>do not penalise over-accuracy after 0, SC1 for 3.80 as answer</p> <table border="1"> <tr> <td></td> <td></td> <td>3.7</td> <td>-3.037</td> </tr> <tr> <td>3.1</td> <td>-19.819</td> <td>3.71</td> <td>-2.699</td> </tr> <tr> <td>3.2</td> <td>-17.472</td> <td>3.72</td> <td>-2.359</td> </tr> <tr> <td>3.3</td> <td>-14.953</td> <td>3.73</td> <td>-2.017</td> </tr> <tr> <td>3.4</td> <td>-12.256</td> <td>3.74</td> <td>-1.673</td> </tr> <tr> <td>3.5</td> <td>-9.375</td> <td>3.75</td> <td>-1.328</td> </tr> <tr> <td>3.6</td> <td>-6.304</td> <td>3.76</td> <td>-0.980</td> </tr> <tr> <td>3.7</td> <td>-3.037</td> <td>3.77</td> <td>-0.630</td> </tr> <tr> <td>3.8</td> <td>0.432</td> <td>3.78</td> <td>-0.278</td> </tr> <tr> <td>3.9</td> <td>4.109</td> <td>3.79</td> <td>0.075</td> </tr> <tr> <td></td> <td></td> <td>3.8</td> <td>0.432</td> </tr> </table>						3.7	-3.037	3.1	-19.819	3.71	-2.699	3.2	-17.472	3.72	-2.359	3.3	-14.953	3.73	-2.017	3.4	-12.256	3.74	-1.673	3.5	-9.375	3.75	-1.328	3.6	-6.304	3.76	-0.980	3.7	-3.037	3.77	-0.630	3.8	0.432	3.78	-0.278	3.9	4.109	3.79	0.075			3.8	0.432
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	(b)	8	4	<p>B1 for removing brackets (allow one error) eg $2x - 10 + 9x + 12$ ignore any denominators M1 for collecting terms eg $11x + 2$</p> <p>M1 for dealing with numbers eg $11x = \textit{their}$ '90' - 2</p> <p>M1 for calculating x eg $x = \frac{b}{a}$ after $ax = b$ ($a \neq 1$) (maximum of 3 awarded)</p> <p>accept any correct method non-linear expressions score 0</p> <p>FT <i>their</i> brackets after multiplication seen or implied</p> <p>FT <i>their</i> linear expression</p>																																															

Question		Answer	Marks	Part Marks and Guidance	
11		(A is $y =$) $x + 4$ (B is $y =$) $x^3 - 4x$ (C is $y =$) $-4x - 4x^2$	3	B1 for each correct one, allow any correct unambiguous identification (may be on diagrams)	
12	(a)	1.6×10^4	1		
	(b) (i)	15.3 or 1.53×10^1	2	M1 for $9.28 (\times 10^{20}) \div 6.08 (\times 10^{19})$ or figs 15, 152, 1526 or 153	allow standard form
	(ii)	(Me) 5427[...] or 5430 (V) 5247[...] or 5248 or 5250 (E) 5527[...] or 5530 (Ma) 3938[...] or 3940 [and indicates E as the largest]	3	M2 for two correct densities or M1 for one correct density, or two densities with correct figs <u>densities could be rounded to 1sf or rot to 2sf or more</u> after M0 allow SC1 for consistent division the wrong way round eg 0.00018, 0.00019, 0.00018, 0.00025	allow other methods eg conversion of all planets to Earth size eg E 5.97×10^{24} Ma $4.2(5\dots) \times 10^{24}$ V $5.6(7\dots) \times 10^{24}$ Me $5.8(6\dots) \times 10^{24}$
13		$[c=] \sqrt{\frac{E}{m}}$	2	M1 for $c^2 = \frac{E}{m}$ or for square root seen	
14		$y = 5 [x] x^2$	3	M1 for $y = kx^2$ soi oe B1 for 5	implied by $80 = k \times 4^2$ or better, or an expression $y = ax^2$ ($a \neq 1$) allow embedded 5
15	(a) (i)	5	1		
	(ii)	42 to 44	1		
	(iii)	20 to 22 nfww	2	M1 for UQ = 55 to 56 or LQ = 34 to 35	award M1 if numbers seen unless it comes from wrong working

Question	Answer	Marks	Answer
(b)*	<p>The response “Yes”, or an equivalent statement, supported by a fully correct calculation of percentage of pupils achieving a C or above with clearly expressed supporting method. The figure 18 – 19 (from 32 – 13/14) and the percentage 56 – 59 (56.25 or 59.375) seen, percentage must be given to at least 2sf, or compares 18/19 to 17.6. Clear annotation and explanation of reasoning. Correct spelling, punctuation and grammar.</p> <p>Alternatives include fully correct solution but no or wrong summary, or a clear reasoning following one error in working out the number who obtained C or above. This error could be misreading from 40 or 41marks or the use of the figure 13 or 14 leading to the summary “No” with the figure correctly calculated of 40.625% or 43.75 rot. Alternatively they compare 17.6 with 13 or 14 and make the correct conclusion of “No”. They might compare 17.6 with 18 or 19 and make no conclusion. There could have a fully correct solution with the use of 35 instead of 32.</p> <p>Alternatives include 18 or 19 pupils clearly seen but incorrect attempt to calculate percentage achieving C or better or calculates that 55% of the 32 = 17.6.</p> <p>No worthwhile work attempted.</p>	<p>5</p> <p>4–3</p> <p>2–1</p> <p>0</p>	<p>The accuracy required is at least 2sf for the percentages and 55% of 32 (or 35) needs to be at least 3sf</p> <p>They calculate 13 or 14 out of 32, or 18 or 19 out of 35, as a percentage. Alternatively calculates that 55% of the 32 = 17.6 and also have 13/14. They could find 18 or 19 as a percentage of 35 and reach no or wrong conclusion.</p> <p>The figure 13 or 14 obtained from the graph but nothing further achieved or a bogus figure converted to a percentage out of 32. They might work out 55% of 35 and get no further.</p>

Question		Answer	Marks	Part Marks and Guidance	
	(c)	generally the class is a small sample or there may be bias in the class eg his class may be a 'set'	1	allow any comment which suggests that the class may not be a random selection	
16	(a)	correct heights and bar widths	2	B1 for two out of these three frequency densities seen 2.32, 0.8, 0.3 or two bar heights correct or 1 bar correct.	see overlay – accuracy ± 1 mm by eye
	(b)	two correct different comments	2	B1 for each acceptable comment one comment must have 'distance' stated or implied to score 2 marks comments must be sufficiently different to score 2 marks	See additional guidance
17	(a)	$(3x + 2)^2 = x^2 - 2x + 10$ $9x^2 + 6x + 6x + 4 [= x^2 - 2x + 10]$ or better $8x^2 + 14x - 6 = 0$ $4x^2 + 7x - 3 = 0$	M1 M1 M1dep	equating both expressions multiplying out brackets, three of the four terms correct collection of terms on one side and division by 2 soi, dep on M2 ,	implied by $9x^2 + 4 = x^2 - 2x + 10$ or two expressions starting $y^2 = \dots$

Question	Answer	Marks	Part Marks and Guidance																				
(b)	-2.11 and (0).36	3	<p>M2 for $\frac{-7 \pm \sqrt{7^2 - 4 \times 4 \times -3}}{2 \times 4}$ or better (allow one error) or M1 for the formula with two errors or SC2 for -2.1 and (0).4 or one answer correct or SC1 for -2.11(...) and (0).36(...)</p> <p>better includes $\frac{-7 \pm \sqrt{97}}{8}$ accept other appropriate methods such as completing the square</p>																				
18	34.75 to 35	3	<p>M1 for $\frac{\sin a}{17} = \frac{\sin 54}{24}$ oe M1 for [sin] a = 0.57[30...] soi or use of \sin^{-1} soi allow any correct method</p> <p>allow x for a</p>																				
19 (a)	4 775 436	1	<p>isw rounding or truncating</p>																				
(b)	11 or 1 December (2014) nfw	3	<p>M1 for each correct attempt up to a maximum of two, rot to at least 3sf</p> <p>allow solution of $1.02^n = 1.2222\dots$</p> <p>2 1.04... 3 1.06... 4 1.08... 5 1.10... 6 1.126... 7 1.148... 8 1.178... 9 1.195... 10 1.218... 11 1.243...</p> <table border="1" data-bbox="1715 900 1966 1257"> <tbody> <tr><td>3</td><td>4775436.00</td></tr> <tr><td>4</td><td>4870944.72</td></tr> <tr><td>5</td><td>4968363.61</td></tr> <tr><td>6</td><td>5067730.89</td></tr> <tr><td>7</td><td>5169085.50</td></tr> <tr><td>8</td><td>5272467.21</td></tr> <tr><td>9</td><td>5377916.56</td></tr> <tr><td>10</td><td>5485474.89</td></tr> <tr><td>11</td><td>5595184.39</td></tr> <tr><td>12</td><td>5707088.08</td></tr> </tbody> </table>	3	4775436.00	4	4870944.72	5	4968363.61	6	5067730.89	7	5169085.50	8	5272467.21	9	5377916.56	10	5485474.89	11	5595184.39	12	5707088.08
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20		1469.5 to 1470.9 or 1471 or 468π	4	M1 for $\frac{1}{3}\pi \times 10^2 \times 15$ or 1570(.79...) rot M1 for $\frac{1}{3}\pi \times 4^2 \times 6$ or 100.(53...) rot M1 for <i>their</i> ('1570(.79...)' – '100.(53...)') or SC3 for 268π or 841.9 to 842	π must be seen or used in both expressions
21		31.3 to 31.5	5	M2 for $\sqrt{4^2 + 9^2}$ or 9.8... or M1 for $4^2 + 9^2$ and M1 for correct trig/cos rule/sin rule statement eg $\tan 'x' = 6 \div \textit{their} '9.848...'$ and M1 use of inv trig. fn. soi	allow alternative methods eg M2 for $\sqrt{4^2 + 9^2 + 6^2}$ or 11.53... M1 for $\sin 'x' = 6 \div \textit{their} '11.53...'$ M1 use of inv trig. fn.

APPENDIX

Exemplar responses for Q2(b)

Response	Mark
8	2
1 pound = 8DKK	2 BOD
8DKK	2
£8	2
8/1	2 BOD
8%	M1 BOD
8x	M1
$y = 8x + c$	M1
0.8	M1
$y = .8x + c$	M1
$y = x + 8$	0
1/8	0
8 : 1	M1

Exemplar responses for Q2(c)

Response	Mark
£1 is worth 8DKK (or FT (b) 0.8DKK)	1
as you increase the pounds the DKK increases with it	1 BOD
conversion between pounds and DKK	1
how many DKK in one pound	1
the steepness of the line	1
increase in pounds equals increase in DKK	1 BOD
the number used to convert the currency	1 BOD
conversion factor	1
The pound is worth 8 times the Danish Kroner (or FT (b) 0.8DKK)	1
By how much DKK it goes up each pound	1
By how much DKK it goes up each one	1 BOD
how many pounds in one DKK	0
a steady increase	0
By how much it goes up each one	0

Exemplar responses for Q15(c)

Response	Mark
his class may not be a representative sample (eg may be a set)	1
sample too small	1
(a lot) more students in the country	1
less students in the class	1
his class may have talented students	1
This is a class of 32 whereas the comparison is to national	1
Because there is a lot more people included in the national % than Mr Chalmers %	1
They might have been a smaller class	1
Because he may have an overall less able class than the average (hints at not representative)	1
The average is taken nationally which means grammar schools(or sec mods) are included (hints at not representative)	1
The students may not be in their GCSE year(s) at school (so comparison not valid)	1
Because the difference isn't very big between the classes and the national average	0
It may be biased	0
We don't know the ability of his students	0

Exemplar responses for Q16(b)

Response	Mark
(on average/mean/mode/median) the Arrowe ball travels further	1
the Arrowe ball has a greater range (or more spread out) of distances	1
Arrowe balls go over 300 m (Flylite balls do not)	1
the same number of balls for both travelled 0 – 150 m	1
more Arrowe balls go over 200/225/250 m (than Flylite)	1
The distance of the flylite ball is more constant	1BOD
the greatest distance the Arrowe balls went was greater than the greatest distance the Flylite balls went	1
Arrowe has higher modal class (may give figures)	1
Between 0 and 150 both balls have the same frequency density	1 BOD
Flylite ball was more consistent over a shorter distance	1
With the Arrowe ball he reaches between 250 – 300m more times than he does with the Flylite ball	0
He hits a higher frequency of balls for $150 \leq d < 200$ m with Flylite balls	0
more Arrowe balls go between 200 – 225 m than Flylite	0
Arrowe balls are better	0

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