

Applications of Mathematics (Pilot)

General Certificate of Secondary Education

Unit **A382/02**: Higher Tier

Mark Scheme for June 2012

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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.

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).
 - 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.

Question		Answer	Marks	Part Marks and Guidance	
1	(a)	Both positions marked	1		
	(b)	(6, 6) and (0, -2)	2	M1 for either one correct If M0 scored, then SC1 for both (5, 7) & (-1, -1) or either both x or both y ordinates correct	
	(c)	(4.5, 4) or (1.5, 0)	1		
2		Plan view fully correct Front view fully correct Side view fully correct	2 2 2	M1 for rectangle with line same length & parallel to shorter side dividing shape into two rectangles, dimensions may not be accurate or rectangle 10cm by 3cm with no line M1 for rectangle, dimensions may not be accurate M1 for trapezium with two right angles, dimensions may not be accurate	Condone diagrams drawn without a ruler Condone diagrams not labelled side/plan/view or labels incorrectly assigned If more than 3 views allow all marks as appropriate if extras are duplicates Do not accept a net or 3D diagrams

Question		Answer	Marks	Part Marks and Guidance	
3	(a)	$\begin{array}{r} 5.8 \quad 0.8 \quad 5.4 \\ 5.4 \quad 5.370 \quad 0.0296 \quad 5.3851 \\ 5.3851 \quad 5.38514.. \quad 0.00004... \end{array}$	5	<p>M1 for 5.8 and $(\pm) 0.8$ (1st row)</p> <p>and M1 for 5.4 in 1st row final column</p> <p>and M1 for 5.4 in 2nd row 1st column or same value given in 1st row final column and 2nd row 1st column</p> <p>and M1 for 5.370 and $(\pm)0.0296$ or 5.3851</p> <p>and B1 for 5.38514... and 0.00004...</p>	<p>For 5.8 allow $29 \div 5$</p> <p>For 5.370 allow $29 \div 5.4$ or $5.37 - 5.3704$</p> <p>For 0.0296 ignore \pm and allow $0.0296 - 0.03$</p> <p>For 5.3851 allow $5.385 - 5.39$</p> <p>For 5.38514... allow $5.38 - 5.386$</p> <p>For 0.00004 allow 4×10^{-5}</p>
	(b)	5.385	1	Correct or FT <i>their</i> value in last row of N/C column provided answer given to 4 significant figures	
4		(Nevada) Oregon Arizona Washington California	4	<p>B1 for California in correct position (last)</p> <p>B1 for Arizona placed anywhere below Oregon</p> <p>B1 for Washington placed anywhere below Oregon</p> <p>B1 for Washington placed anywhere below Arizona</p>	Accept clear abbreviations

Question		Answer	Marks	Part Marks and Guidance	
5		84.2 - 84.45 nfww Allow 84 provided complete <u>trig</u> method seen	5	<p>M4 for $180 \sin 11 + 200 \sin 14.5$ or $180 \sin 11/\sin 90 + 200 \sin 14.5/\sin 90$</p> <p>or</p> <p>M3 for $180 \sin 11$ and $200 \sin 14.5$ or $180 \sin 11/\sin 90$ and $200 \sin 14.5/\sin 90$</p> <p>or</p> <p>M2 for $180 \sin 11$ or $180 \sin 11/\sin 90$ or $200 \sin 14.5$ or $200 \sin 14.5/\sin 90$</p> <p>or</p> <p>M1 for $\sin 11 = h/180$ or $h/\sin 11 = 180/\sin 90$ or $\sin 14.5 = h/200$ or $h/\sin 14.5 = 200/\sin 90$</p> <p>If M0 then</p> <p>SC2 for $180 \cos 11 + 200 \cos 14.5$ or $180 \tan 11 + 200 \tan 14.5$</p> <p>or</p> <p>SC1 for consistent use of same trig ratio to find both heights eg $180 \cos 11$ & $200 \cos 14.5$ or $180 \tan 11$ & $200 \tan 14.5$</p> <p><u>Alternative:</u> For scale drawing angles $\pm 2^\circ$ and lengths $\pm 2\text{mm}$</p> <p>M1 for two right-angled triangles one with angle 11 & the other with angle 14.5</p> <p>M1 for two right-angled triangles one with hyp 180 & other with hyp 200 drawn using the same scale</p> <p>M1 dep for appropriate side lengths $\pm 2\text{mm}$ added</p>	<p>$34. (3\dots) + 50(. \dots)$ $34.(3\dots)$ and $50(. \dots)$ $34.(3\dots)$ or $50(. \dots)$ www</p> <p>Award M marks as appropriate if rads/grads</p> <p>If Rads then -179.998... & 186.979... & final answer 6.98 - 7</p> <p>If Grads then 30.947... & 45.16... & final answer 76 - 76.11</p> <p>NB Scale drawing giving final answer from correct triangles of 84.2 - 84.45 scores full marks</p>
6	(a)	75	1		Allow 74 - 76
	(b)	120	1		Allow 115 - 125

Question		Answer	Marks	Part Marks and Guidance	
	(c)	30	1		
	(d)	15	2	M1 for use of any pair of values, readings from graph $\pm\frac{1}{2}$ small square, in $\Sigma(v - 30)/w$ eg $(90 - 30) / 400$ or $(60 - 30) / 200$	For M1 allow $45 - 30 (/100)$
	(e)	(i)	3	M2 for correct part line or any two points on the line plotted or identified eg in a table or M1 for one point identified on the line except (0, 0)	
		(ii)	1	Correct answer or if straight line graph drawn in part (e)(i) FT where their graphs cross $\pm\frac{1}{2}$ small square	Allow 145 - 155
	(f)	(i)	1		Condone 4256 pence

Question		Answer	Marks	Part Marks and Guidance	
	(ii)	121.6(0) or 12160 pence	3	<p>M2 for <i>their</i> '42.56' $\div 0.35$ or M1 for 35% of X = <i>their</i> '42.56'</p> <p>If M1 then also SC1 for final answer 121 or 122</p> <p>If M0 then SC2 for 17.37 or SC1 for $6.08 \div 0.35$</p> <p>If M0 and T & I method then SC2 for first trial £110 - £130 inclusive and another trial £115 - £125 inclusive <u>and</u> improved from the first trial; both trials and solutions correct or SC1 for first trial £110 - £130 inclusive, both trial and solution correct</p>	<p>Trial Solution (rot)</p> <p>110 38.5</p> <p>111 38.85</p> <p>112 39.2</p> <p>113 39.55</p> <p>114 39.9</p> <p>115 40.25</p> <p>116 40.6</p> <p>117 40.95</p> <p>118 41.3</p> <p>119 41.65</p> <p>120 42</p> <p>121 42.35</p> <p>122 42.7</p> <p>123 43.05</p> <p>124 43.4</p> <p>125 43.75</p> <p>126 44.1</p> <p>127 44.45</p> <p>128 44.8</p> <p>129 45.15</p> <p>130 45.5</p>
7	(a)	$30 < v \leq 40$	1		<p>Allow any indication of this class eg 30 - 40</p> <p>Do not allow frequency 68</p>
	(b)	29.6 nfw Allow final answer 30 provided $5920 \div 200$ seen	4	<p>M1 for at least 4 midpoints seen or used and M1 for <i>their</i> midpoints \times freq or 5920 and M1 for <i>their</i> $\Sigma(\text{midpoints} \times \text{freq}) \div 200$</p> <p>If M0 then SC2 for 24.6 or 34.6</p>	<p>Midpoints \times freq: 80 480 1100 2380 1440 440</p> <p>For <i>their</i> midpoints allow any value in class both endpoints inclusive</p>

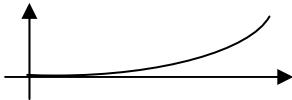
Question		Answer	Marks	Part Marks and Guidance		
	(c)	Decision and reason eg Modal class (mode) more than 30 & No Mean under 30 & Yes Mean under and modal class (mode) over 30 & Cannot tell Less than half or 92 under 30 oe & No	1	Must have reason & decision If <i>their</i> modal class and mean both >30 then allow 'Average over 30 so No'	Condone use of the word average for any of mean, median or modal class or mode FT <i>their</i> values to (a) and/or (b) provided consistent decision	
	(d)	(i)	16, 48, 92, 160, 192, 200	1		
		(ii)	Fully correct cumulative frequency graph all points $\pm\frac{1}{2}$ small square & curve or lines joining points within $\frac{1}{2}$ small square	3	For all M marks FT <i>their</i> values in (d)(i) provided increasing & non-linear & clear attempt to add frequency not speeds M2 for points correct $\pm\frac{1}{2}$ small square, no graph or correct graph translated horizontally with heights within correct class interval or M1 for 4 or 5 points correct $\pm\frac{1}{2}$ small square or all heights correct within correct class interval (implied by bar chart) If M0 then SC1 for all <i>their</i> points $\pm\frac{1}{2}$ small square plotted at upper cumulative boundary	Condone (0, 0) missing Bar chart with increasing heights in correct classes: - scores 3 marks if correct graph superimposed - scores M2 if midpoints of bars joined - scores M1 if no graph If part of cumulative frequency graph has double line assume correct version & use this to FT in (iii) & (e)
		(iii)	31.5	1	FT <i>their</i> increasing cumulative frequency graph $\pm\frac{1}{2}$ small square	

Question		Answer	Marks	Part Marks and Guidance	
	(e)	<p>Yes, (just) over half travel faster</p> <p>43% of 200 = 86 or 57% of 200 = 114 or reading at 35mph</p> <p>Reading at 86 or reading at 114 or <i>their</i> reading at 35mph given as % of 200 or 200 – <i>their</i> reading given as % of 200</p> <p>No (less than 43%)</p>	<p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p>	<p>FT <i>their</i> median</p> <p>For both M marks FT <i>their</i> reading from increasing cumulative frequency graph $\pm \frac{1}{2}$ small square</p> <p><u>Must</u> have at least one M mark</p> <p>If M0 then SC2 for 37% <u>and</u> No</p>	<p>May use table & value 92 under 30, 108 above 30</p> <p>The A mark may be awarded without 'No' by implication given eg only 36% exceeded speed limit (provided <i>their</i> 36% follows correct method)</p>
8	(a)	<p>Anything which rounds to 4.9 nfww</p> <p>Allow final answer 5 provided at least $60 \times 40 \times \pi \times 650$ oe shown</p>	4	<p>M3 for $60 \times 40 \times \pi \times 650 \div 1000000$</p> <p>or</p> <p>M2 for $60 \times 40 \times \pi \times$ figs 65 or $60 \times 40 \times 2 \times \pi \times$ figs 325 or $\pi \times 650 \div 1000000$ or $60 \times 40 \times 650 \div 1000000$</p> <p>or</p> <p>M1 for 60×40 or $\pi \times$ figs 65 or $2 \times \pi \times$ figs 325 or $650 \div 1000000$</p> <p>If M0 then</p> <p>SC2 for $60 \times 40 \times \pi \times 325 \div 1000000$ or $60 \times 40 \times \pi \times 650^2 \div 1000000$ or $60 \times 40 \times \pi \times 325^2 \div 1000000$</p>	<p>Allow π or 3.142</p> <p>May be done in stages</p> <p>A final answer figs 49... scores M2</p> <p>For M2 & M1 follow working through as the product or quotient may not be seen explicitly</p>
	(b)	14.7(...)	1 FT	Correct answer or FT <i>their</i> (a) $\times 3$	

Question	Answer	Marks	Part Marks and Guidance	
(c)*	<p>Gear ratio 3.7[...] : 1 greater than gear ratio 3.4 : 1 so No or 54.6 .. < 60 so No</p> <p>Travels in 1 hour = 54.6 ...km with no clear comparison to 60 km/h or figs 546... with a comparison to 60 or substantial attempt to find speed involving the ratio 51 : 15 and compared to 60 or gear ratio 3.7[...] (: 1) with no clear comparison to calculation using sprockets with 51 and 15 teeth or attempt to find Chris's gear ratio with errors in calculation and calculation using sprockets with 51 and 15 teeth seen</p> <p>Substantial attempt to find gear ratio or substantial attempt to find distance but 51 & 15 not used or ratio calculation using sprockets with 51 and 15 teeth seen and either first step to find distance in 1 hour or first step in attempt to find Chris's gear ratio</p> <p>No relevant measurement or calculation</p>	<p>5</p> <p>4 – 3</p> <p>2 – 1</p> <p>0</p>	<p>Allow 3.4 : 1 to be just 3.4</p> <p>For lower mark – errors in calculation to finding gear ratio Chris needs or figs 546 for distance or calculation using sprockets with 51 and 15 teeth seen and either substantial attempt to find distance in 1 hour or Chris's gear ratio</p> <p>For lower mark calculation using sprockets with 51 and 15 teeth seen or first step to find distance in 1 hour or first step in attempt to find Chris's gear ratio</p>	<p>For 54.6 allow 54 - 55</p> <p>For 3.736 ... allow 3.7 - 3.8</p> <p>Sprockets gear ratio 51 : 15 = 3.4 : 1 oe</p> <p>Substantial attempt means working to at least the same standard as for a mark of M2 or SC2 in part (a)</p> <p>Distance in 1 hour $\frac{(51 \div 15) \times 60 \times 120 \times \pi \times 710}{1000000}$ </p> <p>One rev $\pi \times \frac{710}{1000000} = 0.00223... \text{km}$</p> <p>120 revs/min = 0.26766... km 120 revs/hour = 16.0598.. km</p> <p>Chris's gear ratio $60 \div (60 \times 120 \times \pi \times \frac{710}{1000000})$ </p> <p>To achieve target speed need gear ratio 60/16.0598... = 3.736...</p>

Question		Answer	Marks	Part Marks and Guidance	
9	(a)	Yes; $0.12 > 0.075$	1	<u>Must</u> have reason	Condone 'Sam' for 'Yes' Allow reference to .12 & .075 or probability if Yes / Sam and no other reason given
	(b)	$0.075 \times 3200 \times 1.3 (= 312)$	1	If 0 then SC1 for $0.12 \times 2080 \times 1.25 (= 312)$	Allow 1.3 written as $1 + 30 \div 100$ and 1.25 written as $1 + 25 \div 100$ Allow the mark if 312 is used to show that $\mu = 3200$ oe
	(c)	2500	3	M2 for $150 \div (0.05 \times 1.2)$ or M1 for $0.05 \times \mu \times (1 + 20 \div 100) = 150$ or better	If no answer given accept value 2500 in correct position of table for all marks For M1 condone attempt at 5% and 20% in correct places

Question		Answer	Marks	Part Marks and Guidance	
	(d)	$\mu = \text{£}1\,000\,000$ Unlikely to happen or to prove claim $P = 1500$	1 1 3	M2 for $\left(1 + \frac{p}{100}\right) = 80 \div (\text{their } \mu' \times 0.000\,005)$ or better or M1 for $\text{their } \mu' \times 0.000\,005 \times \left(1 + \frac{p}{100}\right) = 80$ or better or $\mu \times \left(1 + \frac{p}{100}\right) = 16\,000\,000$ or better or $80 \div (1\,000\,000 \times 0.000\,005) (= 16)$	If 1500 seen in working & final answer 15 for P then allow all 3 marks Condone brackets missing for M marks
10	(a)	$21 \times 26 \div (21 - 1.5)$ or $21 \div ((21 - 1.5) \div 26)$	2	M1 for $26 \div (21 - 1.5)$ or $(21 - 1.5) \div 26$ or $21 \div 1.5 = (26 + x) \div x$ or $x \div (26 + x) = 1.5 \div 26$	Allow for fully correct alternative solutions eg $28 \div 21 \times 1.5 = 2$ and $26 + 2 = 28$
	(b)	$4707 - 4708.3$ nfw Accept 4700 or 4710 provided correct working shown	4	M1 for $h = 20$ with $r = 15$ or $h = 2$ with $r = 1.5$ and M1 for $\frac{1}{3} \pi 15^2 \times \text{their } 20$ or $\frac{1}{3} \pi 1.5^2 \times \text{their } 2$ seen and M1 for $(\frac{1}{3} \pi 15^2 \times \text{their } 20) - (\frac{1}{3} \pi 1.5^2 \times \text{their } 2)$ If M0 then SC1 for $\frac{1}{3} \pi 21^2 \times 28$	Allow π or 3.142 $4712(\dots)$ or $4.7(\dots)$ For the 3 rd M1 , allow $h = 1$ with $r = 1.5$ & condone $\frac{1}{3}$ missing in both places

Question		Answer	Marks	Part Marks and Guidance		
	(c)	(i)	-0.675 -0.6 to -0.75 provided full correct working shown & allow fraction or decimal	3	<p>M1 for clear use of tangent to find vertical and horizontal displacement and M1 for <i>their</i> vertical value \div <i>their</i> horizontal value</p> <p>If M0 or M1 then also SC1 for final answer negative value</p>	<p>Ignore \pm for M marks ie working leading to answer in range 0.6 to 0.75 (fraction or decimal) gets M2</p> <p>For final answer embedded in equation $y = mx + c$ or just mx award M2 for m negative in correct range or M1 for m positive in correct range</p>
		(ii)	Rate of decrease in depth	1	Anything linking the change in depth with respect to time & not implying volume or amount	
	(d)			2	<p>M1 for incorrect graph starting at (0, 0) or correct shape graph not through (0, 0)</p>	Allow if 60 marked on horizontal axis & extra straight horizontal line drawn after 60
11	(a)		Initial (rabbit) population or number (of rabbits) released	1	Allow if extra reasons given provided not contradictory	
	(b)		<p>$b = 1.196\dots$ or 1.2 with working shown or $(600\,000\,000/12)^{1/99}$ seen</p> <p>19.(6 ...) % or 20% nfww</p>	<p>3</p> <p>1</p>	<p>M2 for $(600\,000\,000 / 12) = b^{99}$ or M1 for $600\,000\,000 = 12 \times b^{99}$</p> <p>If M0, then SC2 for 1.193 – 1.194</p> <p>If M0 or M1, then SC1 for $b = 1.04\dots$ Correct or FT(<i>their</i> $b - 1$) $\times 100$</p>	<p>Allow standard form in working For M1 condone incorrect number of zeroes in 600 million eg for M1 allow $600 = 12 \times b^{99}$</p>

APPENDIX 1

Exemplar responses for questions **10(c)(ii)**

Response	Mark awarded
Rate of change in height or depth or water level	1
Rate of decrease in height	1
Change in depth/second	1
Rate of decrease	1 BOD
Speed of loss in height or speed at which depth decreases	1 BOD
Rate of change (how quickly the water trickles down)	0
Rate of change of water trickling down	0
Speed of loss	0
How much liquid is falling or decrease in height	0
Speed the water is flowing	0
Acceleration	0
Rate of liquid with time	0
Steepness of the curve	0
How fast the amount of water was lost	0

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