

GCSE

Applications of Mathematics (Pilot)

Unit **A382/02**: Higher Tier

General Certificate of Secondary Education

Mark Scheme for June 2014

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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
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
✓	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

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).
 - **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.
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

1	(a)	52800	3	<p>M2 for $60 \times 40 \times 12 + 30 \times 20 \times 40$ Or $40 \times (60 \times 12 + 30 \times 20)$ Or $90 \times 40 \times 12 + 30 \times 8 \times 40$ Or $40 \times (90 \times 12 + 30 \times 8)$ Or $90 \times 20 \times 40 - 60 \times 8 \times 40$</p> <p>or</p> <p>M1 for $90 \times 12 + 30 \times 8$ Or $60 \times 40 \times 12$ Or $30 \times 20 \times 40$ Or $90 \times 20 \times 40$ Or $60 \times 8 \times 40$ Or $90 \times 40 \times 12$ Or $30 \times 8 \times 40$</p>	<p>28800 + 24000 $40 \times (720 + 600)$ 43200 + 9600 $40 \times (1080 + 240)$ or 40×1320 72000 – 19200</p> <p>M1 may be implied 1080 + 240 or 1320 28800 24000 72000 19200 43200 9600</p>
	* (b)	Product dimensions 5000- 5400 cm ³ inclusive with dimensions in approximate ratio 2:4:5 & correct calculation(s) shown	4		<p>Allow inexplicit evidence of product calculation(s) eg factor tree</p> <p>Condone the three dimensions given in the working & not on the diagram Condone the three dimensions on diagram in wrong positions</p>
		Dimensions in ratio as above with product 5000 - 5400 cm ³ but no calculation(s) Or product dimensions 5000 - 5400 cm ³ & correct calculation(s) shown, but not in approximate ratio 2:4:5	3 – 2	<p>For lower mark value dimensions that would give product 5000 – 5400, but no calculation(s) & not in correct ratio Or values that give product 1000 or 4500 – 6000 cm³ & calculation(s) shown</p>	
		3 values that would give volume 1000 or 4500 – 6000 cm ³ , but no calculation(s)	1		
(c)	(i)	33	2	M1 for $30 + 10\% \times 30$ oe, soi	<p>May be done in stages Do not accept 'of' for 'x'</p>

(ii)	17.25	4	<p>M3 for $30 \times 140 - \text{their (c) (i)} \times 75$</p> <p>or</p> <p>M2 for 30×140 <u>and</u> $\text{their (c) (i)} \times 75$</p> <p>or</p> <p>M1 for 30×140 <u>or</u> $\text{their (c) (i)} \times 75$</p> <p>If M0 then SC1 for final answer 19.50 or 1950p</p>	<p>Accept all equivalent values if done in £ throughout</p> <p>Allow 1725p given as final answer</p> <p>If $\text{their (c) (i)} \times 75$ not shown explicitly FT for M marks</p> <p>4200 2475</p>
(d)	(i) 30 nfw	2FT	<p>M1 for $510 / \text{their (c) (ii)}$ or $29.5 - 29.6\dots$</p> <p>Or T&I method using the two consecutive integer values $\times \text{their (c) (ii)}$ that lead to answers either side of 510</p> <p>Eg $[30 \times 17.25 =] 517.5[0]$ & $[29 \times 17.25 =] 500.25$ so</p>	<p>Condone both $29.5 - 29.6\dots$ & 30 on answer line</p> <p>For 2FT must see working using their (c) (ii) leading to rounded up answer</p>
(ii)	270	3	<p>M2 for $9 \times (510 / (5 + 9 + 3))$ seen</p> <p>or</p> <p>M1 for $510 / (5 + 9 + 3)$ or $9 / (5 + 9 + 3)$ seen</p> <p>If M0 or M1 only then also SC1 for final answer 150 or 90</p>	<p>If 270 seen in the working, but not final answer award M2 only</p> <p>30 9/17</p>

*(e)	Reasoned answer with correct supporting calculations / values using at least two of <i>their</i> (c) (ii), 1½ years & £240	3		eg $52 \times 1\frac{1}{2} \times 17.25 = \text{£}1345.5[0]$; over 5 times recovery cost or saves $\text{£}1105.5[0]$ or $240 \div 17.25 = 13.9$; puncture every 14 weeks would be cheaper or $240 \div (52 \times 1\frac{1}{2}) = 3 - 3.1$; only £3 per puncture
As above, but some errors in calculation(s) / values or full correct calculation, but no explanation	2 – 1	For lower mark one calculation using two of <i>their</i> (c) (ii), 1½ years & £240 & no explanation; calculation may include errors	Error in <u>calculations</u> includes incorrect assumptions eg no. of weeks in 1½ years $\neq 78$	
(f) (i)	30900 000 nfw	4	<p>B3 for 30940 000 – 30950 000</p> <p>or M2 for $2 \times \pi^2 \times \text{value} < 210$ from & including $209.5 \times \text{value} < 87$ from & including 86.5 squared</p> <p>or M1 for $2 \times \pi^2 \times \text{value} < 210$ from & including $209 \times \text{value} < 87$ from & including 86 squared Or 209.5 seen <u>or</u> 86.5 seen</p> <p>And B1 for <i>their</i> calculation for V correctly rounded <u>down</u> to 3 sig figs</p>	Allow π button or 3.142 for all marks
				For rounding B1 mark must see evidence of using formula, condone error(s) in squaring, & <i>their</i> result > 3 sig figs

	(ii)	24.7[2] or 24.7[5...]	3	<p>M2 for $0.8 \times \textit{their} (f) (i) / 10^6$</p> <p>or</p> <p>M1 for $\textit{their} (f) (i) / 10^6$ or $0.8 \times \textit{their} (f) (i)$</p> <p>If not correct or <u>not</u> FT $\textit{their} (f) (i)$ then SC2 for $0.8 \times 2 \times \pi^2 \times R \times r^2 / 10^6$ where $209.5 \leq R \leq 210.5$ & $86.5 \leq r \leq 87.5$</p> <p>or</p> <p>SC1 for $0.8 \times 2 \times \pi^2 \times R \times r^2$ or $2 \times \pi^2 \times R \times r^2 / 10^6$ where $209.5 \leq R \leq 210.5$ & $86.5 \leq r \leq 87.5$</p>	<p>Allow 24 as final answer if $0.8 \times (30940000 - 30950000) / 10^6$ Or $0.8 \times 30900000 / 10^6$ used</p> <p>Allow rounded, unrounded or truncated for $\textit{their} (f) (i)$ for M marks</p> <p>Allow π button or 3.14[2]</p>
2	(a)	(i) Fully correct with sides labelled bedroom & heating, and 1 – 6 or 0 – 6 & electric / gas / oil respectively	3	<p>M2 for two way table with numbers for bedrooms & electric / gas / oil</p> <p>or</p> <p>M1 for two way table with either numbers for bedrooms or electric / gas / oil or sides labelled bedroom & heating</p> <p>If M0 then SC1 for list with 18(+) unique possible outcomes eg 18 rows labelled gas1 gas2 etc</p>	<p>Allow none included on heating type</p> <p>Condone labelling of sides included in row / column</p> <p>Condone more than 6 bedrooms, but not less than 6</p>
	(ii)	14 in cell 3 bedrooms & oil	1		Allow number or tallies (do not need 5 bar gate)
	(b)	Number of bedrooms greater than number of people oe	1		Accept specific example Do not accept 'average' or 'compare bedrooms & people' oe

3	(a)	10	3	<p>M2 for $11 \div (3.25 - 2.05)$ or 9 or $9.16 - 9.17$incl or embedded final answer eg $2.05 \times 10 + 11 < 3.25 \times 10$</p> <p>or M1 for $11 < 3.25x - 2.05x$ or better</p> <p>If M0 then SC2 for correct substitution and calculation for $x = 10$ & $x = 9$</p> <p>or SC1 for at least one complete correct substitutions and both calculations for x</p>	<p>Condone $<$ missing or $=$ sign used</p> <p>Eg: $x = 10$; 31.5[0] & 32.5[0] & $x = 9$; 29.45 & 29.25 seen</p> <p>Eg: $x=10$; 31.5[0] & 32.5[0] seen</p>
(b)	(i)	$100 < 2.05x + 11$ oe eg $89 < 2.05x$	2	<p>M1 for $100 > 2.05x + 11$ or better or $100 = 2.05x + 11$ or better</p>	<p>If correct inequality seen in working & further work allow M1 only</p>
	(ii)	44	3	<p>M2 for $(100 - 11) \div 2.05$ or $43 - 43.42$ or embedded final answer eg $2.05 \times 44 + 11 > 100$</p> <p>or M1 for $2.05x > 100 - 11$</p> <p><u>Alternative: T & I method</u> M2 for subst & correct solⁿ for $x=43$ & $x=44$</p> <p>or M1 for at least two subst & correct solⁿ for x where $30 < x \leq 60$</p>	
(c)	(i)	Correct plots $\pm \frac{1}{2}$ small square	2	<p>M1 for 5 or 6 correct plots $\pm \frac{1}{2}$ small square</p>	<p>Ignore any 'working' for (ii) / August</p>
	(ii)	52 - 52.4	1		

	(iii)	Outside range of values oe	1		Ignore non contradictory or irrelevant statements See appendix for list
4	(a)	For every 10mph/16kmph thinking distance increases by 3m Or thinking distance = speed/3 1/3 oe	2	B1 for as speed increases thinking distance increases oe with no or incorrect values Or [direct] proportion stated, with no or incorrect values	Condone 3.3 for 3 1/3 If refer to thinking <u>time</u> treat as MR-1 See appendix for list
	(b)	Thinking distance as weather conditions will not affect time taken to think oe	1	Must have reason	NOT reason related to braking in the wet Ignore non contradictory or irrelevant statements See appendix for list
	(c)	(i) 120 175	2	M1 for one correct	
		(ii) All [stopping distances] the same except one [which is very close] Or [At 40mph] 118 is close to 120 Or at 40mph the values are close	1FT	FT (c) (i) for their reason provided <i>their</i> values in (c) (i) increase and are between 75 and 240 and are <u>NOT</u> 118 & 175	
		(iii) Both points plotted $\pm \frac{1}{2}$ small square And smooth curve through 5 or 6 points	2	M1 for 1 point plotted $\pm \frac{1}{2}$ small square Or curve through at least 4 plots	Curve through new points implies points plotted
	(d)	Any number n where $0 < n < 20$	1		
5	(a)	(i) 6.5 6.5 6.5 7 7 identified <i>Their</i> $(6.5 + 6.5 + 6.5 + 7 + 7) / 5$ $0.6 \times ((6.5 + 6.5 + 6.5 + 7 + 7)/5) \times 3$	B1 B1 B1		33.5 seen or values indicated in table 6.7 seen $0.6 \times 6.7 \times 3$

	(ii)	Gold Silver	Lewis Tapani	13.02 12.3	4	<p>M3 for final score for any two of Chu, Tapani or Lewis</p> <p>or</p> <p>M2 for final score for any one of Chu, Tapani or Lewis Or all totals or better</p> <p>or</p> <p>M1 for totals or better for any two of Chu, Tapani or Lewis Or Lewis & Tapani correct in table</p>	<p>For all M marks ft their arithmetical errors where full method shown Allow M3 for Lewis final score 13 along with Tapani or Chu correct final score Award M marks where final scores (for Tapani & Lewis) given in table</p> <p>Tapani: 12.3; $0.6 \times 2.5 \times 41/5$ $8+8+8+8.5+8.5=41$</p> <p>Chu: 11.97; $0.6 \times 3.5 \times 28.5/5$ $5.5+6+5.5+5.5+6=28.5$</p> <p>Lewis: 13.02; $0.6 \times 3.5 \times 31/5$ $6+6.5+6.5+6+6=31$</p>
(b)	(i)	3			1		
	(ii)	1.31			1		Allow any value <u>strictly between</u> 1.3 and 1.32
	(iii)	-5			3	<p>M2 for <i>their</i> vertical measure / <i>their</i> horizontal measure, at least one correct Or final answer 5 Or <i>their</i> vertical measure / <i>their</i> horizontal measure & final answer negative</p> <p>or</p> <p>M1 for (\pm) 1m every 0.2 seconds oe Or final answer negative or ± 0.2 Or triangle on diagram and either correct vertical or horizontal measure seen</p>	<p>Must see evidence of working from graph for <i>their</i> measures For both M marks allow <i>their</i> measures to be \pm</p> <p>Treat for embedded answer as MR-1 eg $y = -5x \pm c$ award 2 marks Eg $y = 5x \pm c$ award 1 mark</p>
	(iv)	Speed or velocity or metres per second or 'how fast'			1		Condone incorrect time stated Do not allow 'average speed'

6	(a)	Correct side marked	1		Side 't' must be clear by eye ie not an angle or middle of triangle
	(b)	$\cos [a =] 3.4 / 8.9$ $[a =] \cos^{-1} (3.4 / 8.9)$ $67.5[4\dots]$	M1 M1 A1 ag	If <i>their</i> show that (with either method) starts by using angle 67.5 then allow max SC1 mark for full correct argument	Allow full marks for fully correct alternative trig methods that <u>show</u> 67.5° Eg $\cos A = 8.9^2 + 6.8^2 - 8.9^2 / 2 \times 6.8 \times 8.9$ Eg first finding vertical height of triangle and then using tan or sin
		<u>Alternatives: starting from net</u> $4x = 180$ or sum all triangles top angles form a straight line or = 180 $180/4 = 45$ $\frac{1}{2} (180 - 45) = 67.5$	Or B1 M1 A1 ag		
		$4(180 - 2a) = 180$ $a = 67.5$	Or M2 A1ag		

(c)	115 – 115.5	6	<p>M1 for $\tan 67.5 = x/3.4$ Or $\sin 67.5 = x/8.9$ Or $8.9^2 - 3.4^2$ or 79.21 – 11.56 or 67.65 Or $6.8^2 + 6.8^2$ or 92.48</p> <p>And M1 for $3.4 \times \tan 67.5$ or 8.08... Or $8.9 \times \sin 67.5$ or 8.22... Or $\sqrt{8.9^2 - 3.4^2}$ or 8.22... Or $\sqrt{(6.8^2 + 6.8^2)}$ or 9.61665...</p> <p>And M1 for $(3.4 \times \tan 67.5)^2 - 3.4^2$ or 55.8.. Or $(8.9 \times \sin 67.5)^2 - 3.4^2$ or 56.04998... Or $(\sqrt{8.9^2 - 3.4^2})^2 - 3.4^2$ or 56.09 Or $8.9^2 - (\frac{1}{2}\sqrt{(6.8^2 + 6.8^2)})^2$ or 56.09</p> <p>And M1 for $\sqrt{(3.4 \times \tan 67.5)^2 - 3.4^2}$ or 7.47.. Or $\sqrt{(8.9 \times \sin 67.5)^2 - 3.4^2}$ or 7.48665.. Or $\sqrt{(\sqrt{8.9^2 - 3.4^2})^2 - 3.4^2}$ or 7.489... Or $\sqrt{8.9^2 - (\frac{1}{2}\sqrt{(6.8^2 + 6.8^2)})^2}$ or 7.489...</p> <p>And M1 for $\frac{1}{3} \times 6.8^2 \times \text{their height}$</p> <p>or B4 for final answer 115.6</p> <p>or B3 for $\frac{1}{3} \times 6.8^2 \times \text{ht wrt } 7.5$</p> <p>or B2 for height wrt 7.5 with <u>no</u> working seen</p>	<p>FT their method to find vertical height allow rounding & arithmetical errors for all M marks</p> <p>FT correct alternative trig / Pythag methods</p> <p>First M1 for first correct trig/Pythag equality</p> <p>Second M1 for trig/Pythag leading to answer 8 . (...) or 9.6...</p> <p>Third M1 for 55.(8...) or 56.0 – 56.1</p> <p>Fourth M1 for 7.4... or 7.5 provided working seen</p> <p>$(\frac{1}{2}\sqrt{(6.8^2 + 6.8^2)})^2 = 23.12$</p> <p>$6.8^2 = 46.24$</p> <p>Allow final M mark for ht wrt 7.5 or provided some evidence of working to find vertical height eg scale drawing (may be seen anywhere within question), but not for height = 8.9</p>
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	(d)	8.9	1		8.9 MUST be seen on answer line for either width or length or clearly stated within body of working as width or length
		24.067 – 24.1nfww	4	M3 for $2 \times 8.9 + 6.8 \times \sin 67.5$ oe or M2 for $\sin 67.5 [=] \times 6.8$ oe or better or M1 for $2 \times 8.9 +$ <i>their</i> calculated extra side length (NOT 8.9 or 6.8) <u>Alternative</u> for length by scale drawing Award full marks for length 24.07 – 24.1 or SC1 for $24 - < 24.07$ or $> 24.1 - 24.2$	FT <i>their</i> calculation for M marks 6.282... FT equivalent trig eg $\cos(90 - 67.5)$
7	(a)	2800 600 200	3	M2 for any two correct or M1 for any one correct or any one of 11200/4, 6000/10, 3000/15 seen	
	(b)	All three bars correct	2	M1 for all widths correct or all heights correct or 2 bars correct	
	(c)	58200	3	M2 for $(0.25 \times 12000) + 14000 + 9200 + 11800 + 11200 + 6000 + 3000$ Or $15000 + 12000 + 14000 + 9200 + 11800 + 11200 + 6000 + 3000 - (15000 + 0.75 \times 12000)$ or M1 for 0.25×12000 Or $15000 + 0.75 \times 12000$ Or attempt at proportion of 12000 $+14000 + 9200 + 11800 + 11200 + 6000 + 3000$	3000 + 55200 82200 - 24000 3000 15000 + 9000 or 24000 If frequency density used treat as misread ie 2 marks for 17975 & 1 mark for full 'correct' method

APPENDIX

Exemplar responses for Q3 (c) (iii).

Response	Mark
She cant keep getting quicker	1
Two months away	1
Time may go up	1 BOD
No data for November	1 BOD
May not decrease steadily	1 BOD
Time decrease is not constant	1 BOD
Below graph	0
Its cold in December	0
[Less than 50 so] off graph	0
Doesn't swim as often in December	0
No pattern in the data	0

Exemplar responses for Q 4 (a).

Response	Mark
The faster the car the further you travel whilst thinking	1
The faster the car the further you travel whilst thinking, the further the thinking time	0
Thinking time x 10 = speed x 3	1 (2 – MR1)

Exemplar responses for Q 4 (b).

Response	Mark
Thinking distance because still think at same speed	1
Thinking distance because travelling at same speed	0
Braking distance because ...	0
Thinking distance because longer to brake in the wet	0
Thinking distance because go further in wet	0
Thinking distance because not affected by roadworks or other distractions	0

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