

Applications of Mathematics (Pilot)

General Certificate of Secondary Education

Unit **A382/02**: Higher Tier

Mark Scheme for November 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.

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Annotations used in the detailed Mark Scheme.

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.
 - **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. 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 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. In questions with a final answer line:
 - (i) If one answer is provided on the answer line, mark the method that leads to that answer.
 - (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
 - (iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.
9. In questions with no final answer line:
 - (i) If a single response is provided, mark as usual.
 - (ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.
10. 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.
11. 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.

12. Ranges of answers given in the mark scheme are always inclusive.
13. 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.
14. 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)		3 nfw	3	M2 for $2.2(\dots)$ or M1 for figs $2 \div (75000 \times 12)$ or figs $2 = 75000 \times n \times 12$ or correctly evaluated trial $75000 \times n \times 12$ where n is an integer and $1 < n < 20$	May be done in stages
	(b)		$1 \leq n \leq 3$ and $1 \leq n < 4$ only	2	B1 for one or both correct with at most one error or omission	
2	(a)		280	3	M2 for $0.5 \times (16 + 6 + 6) \times (8 + 6 + 6)$ or M1 for $16 + 6 + 6$ and $8 + 6 + 6$ If M0 scored allow SC1 for $0.5 \times \textit{their length} \times \textit{their width}$ E.g. 154 scores SC1	$0.5 \times 28 \times 20$ 28 and 20 For <i>their</i> length & width allow 16, 22, 28 & 8, 14, 20 respectively
	(b)		2 : 5 oe	1		E.g. 20:50 or 0.2:0.5 or 1:2.5
	(c)		Showing that $51^2 = 24^2 + 45^2$ by, for example, correct evaluation of value(s) E.g. $45^2 + 24^2 = 2601$ and $2601 = 51^2$ or $\sqrt{2601} = 51$	2	M1 for clear use of Pythagoras, but insufficient detail E.g. $\sqrt{(45^2 + 24^2)} = 51$ or $45^2 + 24^2 = 51^2$ or $\sqrt{(51^2 - 24^2)} = 45$	
	(d)		259.5 280.49	1 1		Allow 280.49 – 280.5
3	(a)	(i)	45	1		
		(ii)	Distorted by one high value oe	1		

Question		Answer	Marks	Part Marks and Guidance	
	(b)	(i)	8 - 9½ oe	1	
		(ii)	30	1	
		(iii)	4	2 FT	M1 for <i>their (ii) ÷ their (i)</i> 3.2 – 3.75 FT <i>their</i> values for both marks – final answer must be rounded up
	(c)	(i)	Ease of comparing data oe	1	If comment implies comparison award the mark
		(ii)	George II	1	
	(d)*		Fully correct with conclusion and correct supporting calculations	4	480 ÷ 365 = 1.315... (Allow 365¼ days used) & 1.315 / 2 × 100 = 65.75% or 2 × 60% = 1.2 & conclusion
			Finds % of wheat needed for loaf/day or number of loaves/year with no errors, but no conclusion re 1 year or has used > 65.75% leading to answer no or full calculations with errors in working and valid conclusion	3	or 60% - 75% of 2 = 1.2 – 1.5 & 480 ÷ 1.5 = 320 480 ÷ 1.2 = 400 & conclusion
			At least two steps in calculations or full calculations with errors in working with no conclusion	2 – 1	For lower mark first step to find number of loaves per year, or 60% - 75% of 2, may have errors in working
	(e)	(i)	Decrease with increase in final year(s) oe	1	E.g. became more affordable, then less affordable Allow generally decreases or becomes more affordable Do <u>not</u> allow reference to correlation
		(ii)	2.2[...] 2.6[...]	2	B1 for one correct

Question		Answer	Marks	Part Marks and Guidance	
	(iii)	2 plots correct $\pm \frac{1}{2}$ small square And all points joined	2 FT	B1 for 2 plots correct $\pm \frac{1}{2}$ small square & no line or both FT heights correct & all points joined or both midpoints correct & all points joined or 1 or 2 plots correct $\pm \frac{1}{2}$ small square and 7 points joined	Midpoints at 1743.5 & 1790
	(iv)	Valid comparison	1		E.g. Different, Yasmin decrease then increase then decrease E.g. Similar only 1 place where the trend differs Allow here both negative correlation
	(v)	Use all years / more data E.g. use smaller time intervals	1		Do <u>not</u> allow make both groups the same
4	(a)	May not use mouthwash Six months may not be long enough	2	B1 for any one correct that is not contradicted <u>and</u> is about either the mouthwash or the time frame Ignore extra that do not contradict or are irrelevant	See appendix for list
	(b) (i)	Any possibility that does not fit the given responses E.g. twice/month or three times/day	1		
	(ii)	At least 3 non-overlapping options with no gaps	1		E.g. Every day, Sometimes, Never
5	(a) (i)	11.52	2	M1 for 0.09×128 or 0.09×2^7 or $0.09 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	
	(ii)	6	3	M2 for 2^{nd} better correct evaluation 0.09×2^n n an integer or M1 for correct evaluation 2^n n an integer 2 – 6 incl	$2^2 = 4 \quad \times .09 \quad 0.36$ $2^3 = 8 \quad \quad \quad 0.72$ $2^4 = 16 \quad \quad \quad 1.44$ $2^5 = 32 \quad \quad \quad 2.88$ $2^6 = 64 \quad \quad \quad 5.76$

Question		Answer	Marks	Part Marks and Guidance	
	(b)	$T = 1.3 \times 2^n$	1		
6	(a)	Ditchling Beacon or P 530 – 600 inclusive	1 1		
	(b)	Reading at O: 130 – 170 (FT) Distance O to P: 0.9 – 3 (miles) (<i>their</i> (a) – <i>their</i> reading at O) \div <i>their</i> distance OP Answer and decision that fits with their answer	1 1 1 1		May be seen on graph
	(c)	(i) Rides up and down	1		Accept hill or valley
		(ii) All plots correct $\pm \frac{1}{2}$ small square	5	M4 for 7 or more correct plots or M3 for 5 or 6 correct plots or M2 for 3 or 4 correct plots or M1 for 2 correct plots	(9.30am, 0) (11am, 10) (12:30pm, 20) (2:30pm, 30) (3pm, 30) (4:30pm, 40) (5pm, 48) (6:30pm, 50) (7:30pm, 54)
		(iii) <i>Their</i> '21'	2 FT	M1 for <i>their</i> reading at 3.30pm (must have graph) or 54 – '30 something' (no need for graph)	For 2 marks must have drawn graph
	(d)	(i) Fully correct cumulative frequency graph all points $\pm \frac{1}{2}$ small square & curve or lines joining points within $\pm \frac{1}{2}$ small square of plots	4	M3 for 5 points correct, not joined or incorrectly joined or 4 points correct and joined or M2 for 3 points correct or M1 for 2 points correct	(3, 0) (4, 2000) (7.5, 20000) (9, 23000) (11, 24000) If part of cumulative frequency graph has double line assume correct version & use this to FT in (ii) & (iii) & (iv)

Question		Answer	Marks	Part Marks and Guidance	
	(ii)	<i>Their</i> reading from 12 000 converted to hours & minutes	2 FT	M1 for <i>their</i> median and answer in hours only E.g. for reading at 6.5 condone 6 hours 5(0) minutes or 6½ hours or 6.5 hours	For M marks strict FT <i>their</i> reading from increasing cumulative frequency graph ±½ small square
	(iii)	<i>Their</i> readings from 18 000 & 6000 subtracted & final answer converted to hours & minutes '1 hour 48 minutes'	3FT	M2 for <i>their</i> UQ – <i>their</i> LQ with both readings correctly converted to hours and minutes & subtraction incorrect or <u>result</u> of <i>their</i> UQ – <i>their</i> LQ in hours only (condone decimal/fraction hours or incorrect conversion) or M1 for <i>their</i> UQ & <i>their</i> LQ readings may be given in hours or incorrectly converted to minutes	For both M marks strict FT <i>their</i> reading from increasing cumulative frequency graph ±½ small square
	(iv)	No; median > 6 (hours) or only 9000 after 6 hours or median = 6 hours so 'cannot tell' or no	1FT	<u>Must</u> have reason following through <i>their</i> median or <i>their</i> reading at 6 hours	
	(v)	£2.70	3	M2 for $3\,500\,000 \div (24\,000 \times 54)$ or figs 27(...) or M1 for figs $35 \div (\text{figs } 24 \times 54)$	

Question		Answer	Marks	Part Marks and Guidance	
	(e)	(i)	163 – 163.4	2	M1 for $2 \times \pi \times 26$ or $2 \times 3.142 \times 26$ Allow π or 3.142 for all marks
		(ii)	43.9 – 44	3	M2 for $10 + \left(\frac{1}{5}\right) \times 2 \times \pi \times 27$ Or M1 for $\left(\frac{1}{5}\right) \times 2 \times \pi \times 27$ or $10 + \left(\frac{1}{5}\right) \times \pi \times 27$ or $10 + \left(\frac{1}{5}\right) \times 2 \times \pi \times 26$ Allow π or 3.142 for all marks $\left(\frac{1}{5}\right) \times 2 \times \pi \times 27 = 33.9\dots$ $10 + \left(\frac{1}{5}\right) \times \pi \times 27 = 26.96\dots$ $10 + \left(\frac{1}{5}\right) \times 2 \times \pi \times 26 = 42.67$

Question	Answer	Marks	Part Marks and Guidance	
(f)	235.3 – 235.5 nfw Allow 235 from <u>trig</u> method seen	6	<p>M5 for $40 + 42 + 54 + 54 \times \tan 33 + 54 \div \cos 33$</p> <p>or</p> <p>M4 for $40 + 42 + 54 + 54 \div \cos 33$ or $40 + 42 + 54 + 54 \times \tan 33$ or $54 \div \cos 33 + 54 \times \tan 33$</p> <p>or</p> <p>M3 for $54 \div \cos 33$ and $54 \times \tan 33$</p> <p>or</p> <p>M2 for $54 \div \cos 33$ or $54 \times \tan 33$</p> <p>or</p> <p>M1 for first correct trig step to find one missing side</p> <p>If M0 or M1 then also SC1 for $40 + 42 + 54 +$ <i>their</i> two missing sides provided trig/Pythag working shown</p> <p><u>Alternative:</u> For scale drawing angle $\pm 2^\circ$ and length $\pm 2\text{mm}$ M1 for right-angled triangle one with angle 33 and adjacent side 54 M1 for two other lengths measured using the same scale M1 dep for <u>sum all</u> appropriate side lengths $\pm 2\text{mm}$</p>	<p>$54 \times \tan 33 = 35 - 35.1$ $54 \div \cos 33 = 64.3 - 64.4$ or 64</p> <p>Award M marks as appropriate for use Pythag/other trig method for 2nd side after one found Or if rads/grads used</p> <p>If Rads then -4066.9... & -4067.26... & final answer -7998.16... If Grads then 30.8... & 62.16675... & final answer 228.96675...</p> <p><i>Their</i> missing sides MUST be from use of trig/Pythag</p> <p>NB Scale drawing giving final answer from correct triangle of 235.3 - 235.5 scores full marks</p>

Question			Answer	Marks	Part Marks and Guidance	
7	(a)	(i)	432π	3	<p>M2 for $\pi \times 24^2 - \pi \times 12^2$ or $1357 - 1357.5$</p> <p>or</p> <p>M1 for $\pi \times 24^2$ or $\pi \times 12^2$</p> <p>If M0 then SC1 for $\pi \times 48^2 - \pi \times 24^2$ or $\pi \times n^2 - \pi \times (n-12)^2$ where $n \leq 60$ & multiple of 12 or $2 \times \pi \times 24 - 2 \times \pi \times 12$ but NOT for $2 \times \pi \times 12$</p>	
		(ii)	$\pi \times 12^2$: <i>their (a)(i)</i> 1 : 3 nfww	1 1		Be sure answer nfww May find area first ring again
	(b)		Area and score not in same proportion oe	1		Allow for any comparison of likelihood of landing in areas with scores
	(c)*		Fully correct solution using trig with either length comparison to 60 cm or angle comparison to $\frac{1}{2}^\circ$	4 – 3	Distance calculated correctly with no comparison to 60cm or correct angle found with no comparison of angle to $\frac{1}{2}^\circ$ or correct calculation / trig ratio seen, but value outside of given ranges AND correct comparison	$70 \times \tan \frac{1}{2} = 0.61 - 0.611$ [m] $\tan^{-1}(0.6 \div 70)$ $= 0.49 - 0.4911^\circ$
			Correct use of tan but length or angle incorrect/not found	2 – 1	For lower mark first trig step towards finding distance or angle or scale drawing	

APPENDIX 1

Exemplar responses for question 4(a)

Response	Mark awarded
Not specified how often to use mouthwash	1
Usual mouthwash may be different	1 BOD
May not always use it	1
May only use it once or twice	1
Could ask people to use it for longer	1
Some may have better teeth	0
Ask more people	0
Some may have better diets	0
Don't know what toothpaste they use	0

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