

**Methods in Mathematics (Pilot)**

General Certificate of Secondary Education

Unit **B392/02**: Higher Tier

**Mark Scheme for January 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.

**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 awarded for a correct final 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.

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.

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.

The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **cao** means **correct answer only**.
- **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).
- **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**.

Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

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).

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.

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.

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'. If the answer is missing, but the correct answer is seen in the body allow full marks. If the correct answer is seen in 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.

Ranges of answers given in the mark scheme are always inclusive.

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.

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	Guidance		
1	(a)	3.24 isw	2	<p><b>M1</b> for <math>0.15 \times 21.60</math> or eg using 10% and 5% with 10% = 2.16 or 1% = 0.216 then <math>\times 15</math></p> <p>or <b>SC1</b> for 18.36 or <math>0.85 \times 21.60</math></p>	eg 10% = 2.16 <b>and</b> 5% = 1.06 <b>and</b> adding their values	
	(b)	£6.63	2	<p><b>M1</b> for 0.13 or 13p or <math>6.5 \times 1.02</math> or <math>6.5 \times 0.02</math></p>		
	(c)	16 %	3	<p><b>M2</b> for <math>4 \div 25</math> or 0.16 or <math>29 \div 25</math> or 1.16 or <math>4 \div 0.25</math> <b>oe</b></p> <p>or <b>M1</b> for 4 used or 1% of 25 = 0.25</p>	eg $4 \div 29$ 4 used could be $29 - 25$ as a numerator but an answer of 4% scores 0	
2	(a)	(i)	5, 11	2	<b>B1</b> for 5 or 11 or for -1 and 5 (using $n = 0$ and 1)	
		(ii)	16	3	<p><b>M2</b> for 16.8[333...] or <math>101/6</math> seen or at least one value of <math>n</math> over 16 tried along with at least one below 16 (not 1 or 2)</p> <p>or <b>M1</b> for <math>6n - 1 = 100</math> or <math>6n - 1 &lt; 100</math> or at least two values of <math>n</math> tried (not 1 or 2)</p> <p>or <b>SC2</b> for 17 following -1 and 5 in part (a)(i)</p> <p>After <b>M0</b> award <b>SC1</b> for answer of 17</p>	Solution by T&I is fine.

Question		Answer	Marks	Guidance		
	(b)	$3n + 2$	2	<b>M1</b> for $3n$		
<b>3</b>	(a)	$\sqrt{2^2 + 3^2} = \sqrt{13} = 3.6(0555)$	3	<b>M2</b> for $\sqrt{2^2 + 3^2}$ <b>or</b> <b>M1</b> for $2^2 + 3^2$ or right angled triangle with 2 and 3 shown or Pythagoras using 2 and 3 <b>and</b> <b>A1</b> for 3.60.....or 3.61 (at least 2dp)	<b>Note:</b> answer given in question so working must be seen.  For <b>A1</b> , must score at least <b>M1</b>	
	(b)	11.3 to 11.33	2	<b>M1</b> for $3.1... \times 3.6$ or for $3.1... \times$ <i>their</i> (a)		
<b>4</b>	(a)	-3.5 or -7/2 <b>oe</b>	2	<b>M1</b> for $x + 5 = 1.5$ or $2x + 10 [=3]$ or <b>FT</b> their first step to a "correct" answer		
	(b)	(i) $m = dv$	1			
		(ii) $b = \frac{2A}{h}$	2	Condone $b = A/0.5h$ or $b = A/1/2h$ <b>M1</b> for $bh = 2A$ or $\frac{1}{2}b = \frac{A}{h}$ <b>SC1</b> for $h = 2A/b$		
<b>5</b>	(a)	26.5	2	<b>M1</b> for $15.9 \div 6$ or $15.9 \div 3$ <b>oe</b> <b>soi</b> by 2.65 ( $\times 10$ ) or 5.3 ( $\times 5$ )		
	(b)	8	2	<b>FT</b> <i>their</i> 26.5 for <b>M1 A1</b> <b>M1</b> for $23 \div 2.65$ <b>oe</b> or 9 or 8.679... or $23 \div$ ( <i>their</i> 26.5/10)		eg $23 \times 6 \div 15.9$ scores <b>M1</b>
<b>6</b>	(a)	(i) 27.98[41] <b>isw</b>	1	Allow 28.0 but not 28		

Question		Answer	Marks	Guidance
	(ii)	12 000	1	Allow answer in standard form
	(b)	35 : 38	2	<b>M1</b> for division by 5 attempted or non-integer answers eg 87.5 : 95, 17.5 : 19, 1 : 1.08....., 0.921...: 1, etc.
<b>7*</b>		Correct answer (250) with complete correct working eg $(4 + 1) \times 5 \times 10$ .	4	Working correctly communicated in stages is acceptable for 4 marks eg $4 + 1 = 5$ , $5 \times 5 = 25$ , $25 \times 10 = 250$ . Full written explanation is also acceptable.  3: The working is correct but no final answer stated $(4 + 1) \times 5 \times 10$ or the working is poorly communicated but is clear eg $4 + 1 = 5 \times 5 = 25 \times 10 = 250$ or number greater than 200 with complete correct working.  2: 250 with no (or incomplete) working or for acceptable number over 200 with poorly communicated working  1: Acceptable number greater than 200 with no, or incomplete, working or for $(4 \times 5) \times 10$ [ $\times 1$ ] condoning error in calculation or for <b>two</b> trials leading to numbers below 200 (condone poor communication). or acceptable calculation with their answer minimum 200 but error in evaluation  0: 200 with no working gets zero  For 1 or 2 marks 'acceptable' implies number, minimum 200, that can be made.



Question		Answer	Marks	Guidance
8	(a)	$x = 20, y = 30$	5	<p><b>M2</b> for at least two of  <math>x + 3y + 70 = 180</math>; <math>x = y - 10</math>;  <math>3y + 70 + y - 10 = 180</math> <b>oe</b></p> <p><b>or</b></p> <p><b>M1</b> for one of these equations</p> <p><b>and</b></p> <p><b>M1</b> for getting a correct, simplified equation in just one variable  eg <math>4y + 60 = 180</math></p> <p><b>A1</b> <math>x = 20</math>  <b>A1</b> <math>y = 30</math></p>
	(b)	$c = 128\frac{4}{7}, d = 77\frac{1}{7}$ <b>oe</b>	5	<p><b>M1</b> for angle sum of heptagon or exterior angle of heptagon  <b>and</b>  <b>M1</b> for <math>\text{sum} \div 7</math> or <math>180 - \text{ext angle}</math>  <b>and</b>  <b>A1 exact</b> angle c  <b>and</b>  <b>M1</b> for use of isosceles triangle  <b>and</b>  <b>A1</b> for angle d (can be decimal to at least 1dp – rounded or truncated)</p> <p><b>or</b></p> <p><b>B4</b> for answers of 128.6 and 77.2</p>
9		67.4	3	<p><b>M2</b> for <math>\tan^{-1} 14.4/6</math>  <b>or</b></p> <p><b>M1</b> for <math>\tan R = \frac{14.4}{6}</math> <b>oe</b></p> <p><b>or</b></p> <p><b>M1</b> for use of their inverse trig function eg</p>

Question		Answer	Marks	Guidance
				$\sin^{-1}\left(\frac{6}{14.4}\right)$ or $\sin R = 6/14.4$ and $R = 24.6$ <b>SC2</b> for angle P to 1 dp instead of angle R  Must use values from diagram  ie 22.6  If using Pythagoras followed by sin/cos - first M1 awarded for statement involving a trig function.
10	(a)	Showing width of rectangle is $x - 1$ eg Perimeter of square = $4x$ Perimeter of rectangle = $x - 1 + x + 1 + x - 1 + x + 1 = 4x$	1	
	(b)*	Complete clear proof  eg Area of rectangle = $[(x - 1)(x + 1) =] x^2 - 1$ Area of square = $x^2$ Correct comparison, eg area of the square is larger  Area of rectangle or area of square clearly stated  Numerical calculations only	3-2           1           0	Allow the lower mark if both area of rectangle and area of square are found, with the former expanded, but no comment to compare them or comparison made but areas not clearly identified. Condone $x - 1 \times x + 1 = x^2 - 1$  <b>Note:</b> an alternative proof which considers the area removed from the top of the square and the area added at the side in going from square to rectangle is acceptable  Area of square = $x^2$ or Area of rectangle = $(x - 1)(x + 1)$ or better also allow 1 for $x^2$ and $(x - 1)(x + 1)$ seen with no indication of which is which

Question		Answer	Marks	Guidance	
11	(a)	Equation	1		
	(b)	Expression	1		
	(c)	Identity	1		
12	(a)	$6x^2 - x - 2$	3	<p><b>M2</b> for three of the following terms seen:  <math>6x^2 - 4x + 3x - 2</math>  <b>or</b>  <b>M1</b> for two of the above terms</p>	<p>eg <math>6x^2 + 7x - 2</math>  or <math>6x^2 - 7x - 2</math>  or <math>6x^2 - x + 2</math> could earn  <b>M2</b> (one error only)</p>
	(b)	$2(x - 2)(x + 2)$	2	<p><b>M1</b> for correct partial factorisation  <b>or</b>  <b>SC1</b> for <math>(x - 2)(x + 2)</math></p>	<p>eg <math>(2x - 4)(x + 2)</math>  or <math>2(x^2 - 4)</math>  or <math>(x - 2)(2x + 4)</math></p>
	(c)	3, 0.5	3	<p><b>M2</b> for correct factors <math>(2x - 1)(x - 3)</math>  <b>or</b>  <b>M1</b> if <i>their</i> factors multiply to give two terms  correct in the expansion  or <math>(2x \pm 1)(x \pm 3)</math>  or <math>x(2x - 1) - 3(2x - 1)</math>  <b>or</b>  <b>B1</b> for one correct solution</p>	<p><u>Alternative:</u>  ... use of formula  <b>M2</b> for correct substitution and  simplification of  formula to  at least obtain <math>(7 \pm \sqrt{25})/4</math>  <b>or</b>  <b>M1</b> for substitution in  formula  with a maximum of two  errors  <b>or</b>  ... completing the square  <b>M2</b> for correct completed  square expression  <b>or</b>  <b>M1</b> for correct squared  bracket</p>

Question		Answer	Marks	Guidance	
13		$\frac{4}{33}$ or $\frac{12}{99}$ <b>oe</b> (must be fraction)	2	<b>M1</b> for 0.12 or 0.1212 or $\frac{5}{11}$ <b>oe</b>	
14		HF = FJ sides of square GF = FE sides of square angle HFG = angle JFE = 90° or (vertically) opposite  triangles are congruent SAS	3	<b>M2</b> for all three statements with reasons <b>or</b> <b>M1</b> for all three statements with no reason or for 2 statements with reasons  <b>and</b> <b>A1</b> for SAS (dep. on three statements with, or without, reasons)	After two correct sides given allow: GH = $\sqrt{(HF^2 + GF^2)}$ and EJ = $\sqrt{(FJ^2 + FE^2)}$ then SSS (or poss. RHS)
15	(a)	12.5	4	<b>M3</b> for $m = 5\sqrt{p}$ or $5 \times \sqrt{6.25}$  <b>or</b> <b>M2</b> for $k = 5$  <b>or</b> <b>M1</b> for $m = k\sqrt{p}$ or $10 = k\sqrt{4}$  <b>or</b> <b>SC1</b> for $m = 5p^2/8$ or $m = 20/\sqrt{p}$ <b>and</b> <b>SC1</b> FT to 24.4.... or 8	For <b>M1</b> condone $10 \propto k\sqrt{4}$
	(b)	400	2	<b>M1</b> for $100 = 5\sqrt{p}$  <b>FT</b> from <i>their</i> formula, or <i>their</i> k, for <b>M1 A1</b> (dep on formula involving either a square or a square root)	<b>FT</b> from <b>SC</b> in (a) to 12.6.. or 25

Question		Answer	Marks	Guidance	
16	(a)	8.37 to 8.38 isw	3	<p><b>M1</b> for 37.6 to 37.7 or <math>2 \times \pi \times 6</math> and</p> <p><b>M1</b> for <math>\frac{80}{360}</math> oe</p> <p><b>A1</b> 8.37 to 8.38 or 8.4</p>	Answer to at least 1 dp or in terms of $\pi$ (ie $8\pi/3$ )
	(b)	77.1 to 77.3	4	<p><b>M1</b> for <math>2\pi r = \text{their (a)}</math></p> <p><b>A1 FT</b> for radius of base circle (<math>r</math>)</p> <p><b>M1</b> for <math>\cos \theta = \frac{\text{their}(r)}{6}</math></p> <p><b>A1</b> 77.1 to 77.3 or 77</p>	<p>(their(a))/<math>2\pi</math> soi by figs 1333.... 1.3333...</p> <p>Use of eg Pythagoras followed by sine rule – FT their (<math>r</math>) Use of radians leading to 1.3467...or gradians leading to 85.73379....scores <b>M1 A1 M1</b></p>
17		<p>Correct curve, reasonably smooth, between 0 and 360.</p>	2	<p><b>M1</b> for indication of correct turning points and intersections on x axis or for <math>\cos [\theta]</math></p> <p><b>SC1</b> for reflection in <math>h = 0</math> or sin curve</p>	eg allow <b>M1</b> for $h = 1.5\cos\theta$ drawn

Question		Answer	Marks	Guidance	
18	(a)	40	2	M1 for $\frac{1}{3} \times 4^2 \times 7.5$	
	(b)	35	4	M1 for "pyramids similar" (may be implied by calculating corresponding lengths) M1 for length sf = 2 <b>soi</b> (eg by 3.75) M1 for vol sf = 8 seen or small pyramid vol = 5 (cm <sup>3</sup> ) <b>oe</b>	Vol. of small pyramid = 5 or $\frac{7}{8} \times$ <i>their</i> <b>(a)</b> implies first 3 marks.  <u>Alternative:</u> It is possible to do this by splitting the frustum into a cuboid, 4 prisms and 4 pyramids. Allow <b>B1</b> for each different correct volume: 15, 3.75, 1.25.

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