

# **Applications of Mathematics (Pilot)**

General Certificate of Secondary Education

Unit **A382/02**: Higher Tier

## **Mark Scheme for January 2012**

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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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OCR Publications  
PO Box 5050  
Annesley  
NOTTINGHAM  
NG15 0DL

Telephone: 0870 770 6622  
Facsimile: 01223 552610  
E-mail: [publications@ocr.org.uk](mailto:publications@ocr.org.uk)

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** (method) marks are not lost for purely numerical errors.

**A** (accuracy) marks 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.

Two additional situations may appear in the mark scheme allowing the award of **A** marks or independent (**B**) marks:

- i. Correct answer with no working
- ii. Work follows correctly from a previous answer whether correct or not ("FT" on mark scheme and on the annotations tool).

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

- i. Where you see **oe** in the mark scheme it means **or equivalent**.
- ii. Where you see **cao** in the mark scheme it means **correct answer only**.
- iii. Where you see **soi** in the mark scheme it means **seen or implied**.

- iv. Where you see **www** in the mark scheme it means **without wrong working**.
- v. Where you see **rot** in the mark scheme it means **rounded or truncated**.
- vi. Where you see **seen** in the mark scheme it 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.
- vii. Where you see **figs 237**, for example, this means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.

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.

Where a follow through mark is indicated on the mark scheme for a particular part question, you must ensure that you refer back to the answer of the previous part question if this is not shown within the image zone. You may find it easier to mark follow through questions candidate by candidate rather than question by question by question.

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)	Correct line drawn	1		Condone straight line that passes through (0, 0) and between (10, 7) and (10. 8)
	(b)	From x-axis go up to line then across to y-axis <b>oe</b> or gradient is $\frac{3}{4}$ and $\frac{3}{4}$ of x is equal to y <b>oe</b>	2	<b>M1</b> for part correct or reverse eg start at 10 on x-axis and go up to the line eg start at y = 7.5 go across to line and down to x = 10 eg indication gradient = $\frac{3}{4}$	Must refer to using the line or gradient
2	(a)	(Each population may have been) all rounded the same way or rounded separately	1		Condone 'because of the rounding'
	(b)	10 points plotted $\pm \frac{1}{2}$ small square	2	<b>M1</b> for at least 6 points plotted $\pm \frac{1}{2}$ small square	Allow for points joined or not joined Ignore any line of best fit
	(c)	Population increases (over the century) <b>oe</b>	1		Ignore any reference to (positive) correlation Condone population increases, decreases then increases again

Question	Answer	Marks	Part Marks and Guidance																																																																																																		
3	<p>No, with clear comparisons between at least two sets of places on both street map and underground map.</p> <p>For comparison allow: Two or more scale factors given to at least 1dp.</p> <p>Where two measurements taken on the same map give the same value (eg OxC to PC and TCR to PC both 61) and their corresponding measurements from the other map differ (29 and 20) allow all 4 marks even if no sf calculations provided a convincing reasoned argument why map scales must be different.</p>	4	<p><b>M3</b> for two pairs of consistent measurements from both maps with scale factor calculations to at least 1dp or clear comparison of relative size between places or use of one scale factor for a second pair of places and no conclusion or incorrect conclusion or clear comparison of scale factors between at least two sets of places on both maps and correct conclusion, but some errors in measurements</p> <p><b>or</b></p> <p><b>M2</b> for one pair of consistent measurements with scale factor calculation given to at least 1dp or for two pairs of consistent measurements for two pairs of places</p> <p><b>or</b></p> <p><b>M1</b> for a pair of measurements for one pair of places Allow M1 where units are inconsistent</p> <p><u>Alternative method:</u> for bearings Measurements <math>\pm 4^\circ</math> For full marks require consideration of position of North line on both maps</p> <p>Where scale factor to 1dp gives same value do not award final mark for an answer of yes. Check both maps for measurements</p> <table border="1" data-bbox="1547 379 2069 587"> <thead> <tr> <th>Street</th> <th>BSt</th> <th>OxC</th> <th>TCR</th> <th>PC</th> <th>LSq</th> <th>CG</th> </tr> </thead> <tbody> <tr> <td>BSt</td> <td>–</td> <td>46</td> <td>112</td> <td>98</td> <td>127</td> <td>149</td> </tr> <tr> <td>OxC</td> <td></td> <td>–</td> <td>65</td> <td>67</td> <td>88</td> <td>106</td> </tr> <tr> <td>TCR</td> <td></td> <td></td> <td>–</td> <td>61</td> <td>49</td> <td>50</td> </tr> <tr> <td>PC</td> <td></td> <td></td> <td></td> <td>–</td> <td>36</td> <td>64</td> </tr> <tr> <td>LSq</td> <td></td> <td></td> <td></td> <td></td> <td>–</td> <td>29</td> </tr> <tr> <td>CG</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>–</td> </tr> </tbody> </table> <table border="1" data-bbox="1547 619 2069 826"> <thead> <tr> <th>Tube</th> <th>BSt</th> <th>OxC</th> <th>TCR</th> <th>PC</th> <th>LSq</th> <th>CG</th> </tr> </thead> <tbody> <tr> <td>BSt</td> <td>–</td> <td>19</td> <td>36</td> <td>38</td> <td>50</td> <td>56</td> </tr> <tr> <td>OxC</td> <td></td> <td>–</td> <td>17</td> <td>23</td> <td>33</td> <td>37</td> </tr> <tr> <td>TCR</td> <td></td> <td></td> <td>–</td> <td>20</td> <td>19</td> <td>21</td> </tr> <tr> <td>PC</td> <td></td> <td></td> <td></td> <td>–</td> <td>16</td> <td>26</td> </tr> <tr> <td>LSq</td> <td></td> <td></td> <td></td> <td></td> <td>–</td> <td>10</td> </tr> <tr> <td>CG</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>–</td> </tr> </tbody> </table> <p>Measurements in table <math>\pm 4\text{mm}</math> All measurements in table in mm, measurements may be given in other units If no units condone consistent measurements for any pair of places</p>	Street	BSt	OxC	TCR	PC	LSq	CG	BSt	–	46	112	98	127	149	OxC		–	65	67	88	106	TCR			–	61	49	50	PC				–	36	64	LSq					–	29	CG						–	Tube	BSt	OxC	TCR	PC	LSq	CG	BSt	–	19	36	38	50	56	OxC		–	17	23	33	37	TCR			–	20	19	21	PC				–	16	26	LSq					–	10	CG						–
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Question		Answer	Marks	Part Marks and Guidance	
4	(a)	One triangle all sides $\pm 2\text{mm}$ , Correct position of 'equilateral' triangles to give net of tetrahedron Accurate net with at least one pair of correct arcs visible	M1 M1 A1		
	(b)	$\frac{1}{2} \times \textit{their base} \times \textit{their height}$ where their base and their height are not equal or $\frac{1}{2} \textit{ their side lengths} \times \sin 60$ $4 \times \frac{1}{2} \times \textit{their base} \times \textit{their height}$ or $4 \times \frac{1}{2} \textit{ their side} \times \sin 60$ 3100 – 3900 (mm <sup>2</sup> ) or 31 – 39 (cm <sup>2</sup> ) Units, mm <sup>2</sup> or cm <sup>2</sup> as appropriate	M1  M1 dep  A1 B1	Base 45mm $\pm 2\text{mm}$ or 4.5 cm $\pm .2\text{cm}$ <b>and</b> height 39mm $\pm 2\text{mm}$ or 3.9mm $\pm .2\text{cm}$	If side 45mm $\pm 2\text{mm}$ or 4.5 cm $\pm .2\text{cm}$ the height implied by <i>their side</i> $\times \sin 60$ <b>oe</b> Pythag / trig method Allow for full alternative trig method where angle 60 or 30
5	(a)	30	1		
	(b)	0.4 or $\frac{2}{5}$	2	<b>M1</b> for $30 \div 75$ <b>oe</b>	
	(c)	Fully correct	3	<b>M2</b> for three of the four conditions correct <b>or</b> <b>M1</b> for two of the four conditions correct	
	(d)	37 – 38	1	<b>FT</b> their graph	

Question		Answer	Marks	Part Marks and Guidance	
6	(a)	(£)4250 > (£)2590 oe	1		May be in words or words and numbers eg expenses less than allowance or expenses less than (£)4250
	(b)	£106.80	4	<b>M3</b> for $0.2 \times ((92 \times 52) - 4250)$ <b>or</b> <b>M2</b> for $(92 \times 52) - 4250$ or 534 or $0.2 \times (92 \times 52)$ or 956.80 seen <b>or</b> <b>M1</b> for $92 \times 52$ <b>soi</b> (4784)  If <b>M0</b> allow <b>SC1</b> for final answer £850	Condone £106.8 May be done in stages FT their arithmetical errors provided method shown  If Method A treat as misread & 3 marks for £438.80; 2 marks for $0.2 \times ((92 \times 52) - 2590)$

Question		Answer	Marks	Part Marks and Guidance	
7	(a)	Median 2	2	<b>M1</b> for identifying 12 <sup>th</sup> and 13 <sup>th</sup> value	Allow 2.7 if method seen Mark at most accurate & ignore attempt at conversion to seconds 67 ÷ 25 & allow one error in finding $\Sigma$ (0) 4 10 12 16 7 18 & allow one error
		Mean 2.68	3	<b>M2</b> for $(4+2 \times 5+3 \times 4+4 \times 4+7+9 \times 2) \div 25$ <b>or</b> <b>M1</b> for $4 + 2 \times 5 + 3 \times 4 + 4 \times 4 + 7 + 9 \times 2$	
		Range 9	1		
	(b)	Fully correct	4	<b>M3</b> for box and whisker with at least 4 correct values <b>or</b> <b>M2</b> for box and whisker with at least 3 correct values or all 5 correct values identified, but no/incorrect diagram <b>or</b> <b>M1</b> for box and whisker with at least two correct values or three correct values identified, but no/incorrect diagram	For all <b>M</b> marks values for box & whisker as follows: Median either 2 or <b>FT</b> <i>their</i> median from part (a) and LV = 0 LQ = 1 UQ = 4 HV = 9  Where box has several 'medians' treat lower end as LV and upper end as HV and choice for median
	(c) (i)	Average waiting times are less	1		For average accept mean or median, but not mode Explanation must be about a summary value, not an individual waiting time Ignore extra comments unless contradictory
	(ii)	Times are more consistent	1		Allow smaller range Explanation must be about a summary value, not an individual waiting time Ignore extra comments unless contradictory

Question		Answer	Marks	Part Marks and Guidance	
8		Split side length as $2x + y = 2000$ <b>oe soi</b>  Use of Pythagoras $2x^2 = y^2$ <b>oe</b> or trig $x = y \sin 45$ or $x = y \cos 45$ <b>soi</b>  Sub for $y$ or for $x$ : eg: $x = (2000 - 2x) \sin 45$ or $2x^2 = (2000 - 2x)^2$ or $2x + x\sqrt{2} = 2000$ or $2y \sin 45 + y = 2000$ or $2y/\sqrt{2} + y = 2000$  Rearrange to $x =$ or finding $y$ $x = 2000 \div (2 + \sqrt{2})$ or $y = 828.(4\dots)$  586	M1  M1  M1 dep  M1 dep  A1	Allow M marks for working in metres or cm throughout  $x^2 - 4000x + 2000000 = 0$ <b>oe</b>  $(x - 2000)^2 = 2000000$  Mark at most accurate	
9	(a)	90/600 <b>oe</b>	1	0.15 15% 3/20	
	(b)	2.4	3	<b>M2</b> for their $90/600 \div 25/400$ <b>or</b> <b>M1</b> for $25/400$  If <b>M0</b> then <b>SC1</b> for <i>their</i> $90/600 \div$ <i>their</i> relative risk for women or final answer 3.6	$0.15 \div 0.0625$
	(c)	$25/400 \times 360 < 90/600 \times 220$ or $5/80$ and $12/80$ and $5 \times 360 < 12 \times 220$ <b>oe</b> use of fractions with common denominators	3	<b>M2</b> for both calculations with no comparison or use of common denominator method with one error in calculation <b>or</b> <b>M1</b> for one calculation or one of £22.50 or £33 seen or $25/400 < 90/600$ <b>soi</b>	Allow equivalent fractions/decimals 'Risk for women is lower' is insufficient, must see numerical values from table &/or calculations

Question		Answer	Marks	Part Marks and Guidance																				
10	(a)	Swiftquid £25 Dosh-4-U £9 Payday Xpress £3.03	B1 B1 2	<p><b>M1</b> for <math>100 \times (1.01)^3</math> May be done in stages Allow <b>M1</b> for 103.0301 or 3.0301 given with or without working If <b>MO</b> then <b>SC1</b> for 104.06(...) or 1.0406(...) or 102.01 or 1.0201</p>																				
	(b)	<p>6<sup>th</sup> February with clear working for Payday Xpress with no errors and reasons Dosh-4-U not cheapest</p> <p>No date or incorrect date with clear working for Payday Xpress with no errors and reasons Dosh-4-U not cheaper than Swiftquid or 6<sup>th</sup> February or loan for 23 days indicated with Payday Xpress unclear/errors/omissions in working and/or some errors in method for and reasoning Dosh-4-U not cheaper than Swiftquid</p> <p>Evidence of Swiftquid cheaper than Dosh-4-U after two weeks or Payday Xpress interest found for any one of 15 – 28 days inclusive (allow simple interest)</p> <p>No working or calculations for at least 2 companies that would lead to a solution</p>	<p>5</p> <p>4 – 3</p> <p>2 – 1</p> <p>0</p>	<p>For all marks accept either interest only or full amount to be repaid &amp; accept amounts rounded or truncated</p> <p>For lower mark some working to find compound interest for Payday Xpress for days &gt; 21 allow arithmetic errors) and reasoning Dosh-4-U not cheapest or final answer for Payday Xpress 5<sup>th</sup>, 6<sup>th</sup> or 7<sup>th</sup> February and no comment for Dosh-4-U</p> <p>For lower mark Dosh-4-U £18 for 2 weeks or £27 for three weeks or £36 for four weeks or attempt to find interest for Payday Xpress for more than 7 days (allow simple interest as 'attempt')</p> <p>NB: Days                      Interest                      Full amount</p> <table> <tr> <td>14</td> <td>£14.94(7...)</td> <td>£114.94(7...)</td> </tr> <tr> <td>15</td> <td>£16.09(6...)</td> <td>£116.09(6...)</td> </tr> <tr> <td>16</td> <td>£17.25(7...)</td> <td>£117.25(7...)</td> </tr> <tr> <td>17</td> <td>£18.43(...)</td> <td>£118.43(...)</td> </tr> <tr> <td>18</td> <td>£19.61(...)</td> <td>£119.61(...)</td> </tr> <tr> <td>19</td> <td>£20.81(...)</td> <td>£120.81(...)</td> </tr> </table>			14	£14.94(7...)	£114.94(7...)	15	£16.09(6...)	£116.09(6...)	16	£17.25(7...)	£117.25(7...)	17	£18.43(...)	£118.43(...)	18	£19.61(...)	£119.61(...)	19	£20.81(...)	£120.81(...)
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					20	£22.01(9...)	£122.01(9...)																											
					21	£23.23(9...)	£123.23(9...)																											
					<b>22</b>	<b>£24.47(...)</b>	<b>£124.47(...)</b>																											
					<b>23</b>	<b>£25.71(6...)</b>	<b>£125.71(6...)</b>																											
					24	£26.97(...)	£126.97(...)																											
					25	£28.24(...)	£128.24(...)																											
					26	£29.52(5...)	£129.52(5...)																											
					27	£30.82(...)	£130.82(...)																											
					28	£32.12(9...)	£132.12(9...)																											
<b>11</b>	(a)	(i)	56.25      56.71 – 56.72	B1 B1																														
		(ii)	Both points plotted $\pm \frac{1}{2}$ small square Curve drawn through at least 1 plotted point and all given plotted points	B1 B1	<b>FT</b> <i>their</i> (a)																													
	(b)		5.3 - 5.5	1	<b>FT</b> <i>their</i> graph, must peak at a point If no graph then no marks		<b>Must</b> have drawn graph for at least between 5 and 5.5																											
	(c)		Any evaluated trial between 2.5 and 3 in either $30 = \frac{3}{4} r^2(8-r)$ <b>oe</b> or $40 = r^2(8-r)$ <b>oe</b>  An improved evaluated trial between 2.7 and 2.8, that is a trial value to 2dp (allow 2. 8 if 2.75 is first trial)  For two evaluated trials from 2.76 to 2.765 inclusive leading to answers above and below 30 or 40 as appropriate or numerical evidence that 2.76 is closer than 2.77	M1  M1dep  B1	Evaluated trial means trial and correct outcome, clearly shown Allow outcome to be rounded or truncated  <table border="1"> <thead> <tr> <th>Trial</th> <th>Outcome</th> <th></th> </tr> </thead> <tbody> <tr> <td>2.6</td> <td>27.378</td> <td>36.504</td> </tr> <tr> <td>2.7</td> <td>28.97775</td> <td>38.637</td> </tr> <tr> <td>2.8</td> <td>30.576</td> <td>40.768</td> </tr> <tr> <td>2.9</td> <td>32.16825</td> <td>42.891</td> </tr> <tr> <td>2.71</td> <td>29.1377(...)</td> <td>38.85...</td> </tr> <tr> <td>2.72</td> <td>29.297664</td> <td>39.06...</td> </tr> <tr> <td>2.73</td> <td>29.457587(...)</td> <td>39.276...</td> </tr> <tr> <td>2.74</td> <td>29.617(...)</td> <td>39.489...</td> </tr> </tbody> </table>			Trial	Outcome		2.6	27.378	36.504	2.7	28.97775	38.637	2.8	30.576	40.768	2.9	32.16825	42.891	2.71	29.1377(...)	38.85...	2.72	29.297664	39.06...	2.73	29.457587(...)	39.276...	2.74	29.617(...)	39.489...
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Question		Answer	Marks	Part Marks and Guidance			
		2.76 nfw	A1dep	<p><b>Dep</b> on both <b>M</b> marks only Allow embedded answer</p> <p><b>SC1</b> only – (embedded) answer 2.76 with no working shown</p>	2.75	29.777(...)	39.7...
					2.76	29.937(...)	39.9...
					2.77	30.09695(...)	40.1...
					2.78	30.256686	40.3...
					2.79	30.416(...)	40.555...
					2.761	29.953(...)	39.9...
					2.762	29.969(...)	39.958...
					2.763	29.985(...)	39.98...
					2.764	30.001(...)	40.001...
					2.765	30.017(...)	40.02...
12		73 nfw	4	<p><b>B3</b> for <math>12050 \div 165</math> <b>or</b> <b>M2</b> for <math>(\text{value} &gt; 12000) \div 165</math> or <math>12050 \div (\text{value} &lt; 170)</math> <b>or</b> <b>M1</b> for <math>(\text{value} &gt; 12000) \div (\text{value} &lt; 170)</math> or <math>12000 \div 165</math> or <math>12050 \div 170</math> or both 12050 and 165 seen <b>SC1</b> for 73 with no working shown</p>	<p>Must check <b>nfw</b> Allow all marks for working in kg consistently</p>		
13	(a)	Fully correct with scale on vertical axis or correct key for area given	3	<p><b>M2</b> for at least 4 bars correct in proportion or all fd correct fd 0.3, 0.8, 7.2, 8.8, 0.4 <b>or</b> <b>M1</b> for at least 3 fd soi</p>	<p>Condone only two values on vertical axis &amp; assume scaled linearly</p>		
	(b)	54	2	<b>M1</b> for $6 + 12 + (1/3 \times 108)$			
14		5.83 nfw	4	<p><b>B3</b> for <math>2000 / 343 - 2000 / 3 \times 10^8</math> <b>or</b> <b>M2</b> for <math>2000 / 343</math> and <math>2000 / 3 \times 10^8</math> <b>or</b> <b>M1</b> for <math>2000 / 343</math> or <math>2000 / 3 \times 10^8</math></p>	<p>Allow 5.8 or 6 or 5.829 - 5.831 provided full method shown May be done in stages</p> <p>Allow method marks for speeds converted to km/s</p>		

Question	Answer	Marks	Part Marks and Guidance
15	5.23 or better <b>nfww</b>	5	<p><b>M4</b> for <math>\pi \times (13.5 / 2 \pi)^{2/3}</math>  <b>or</b>  <b>M3</b> for <math>r = \sqrt[3]{13.5 / 2\pi}</math>  <b>or</b>  <b>M2</b> for <math>r^3 = 13.5 / 2\pi</math>  <b>or</b>  <b>M1</b> for <math>\frac{1}{2} \times 4/3 \times \pi r^3 = 4.5</math> oe</p> <p>If <math>4/3 \times \pi r^3 = 4.5</math> used then <b>SC1</b> for finding <i>their</i> <math>r</math> (<math>r^3 = 1.07\dots</math>, <math>r = 1.02\dots</math>)  <b>and SC1</b> for <math>\pi \times</math> <i>their</i> <math>r^2</math></p> <p>If <b>M0</b> or <b>M1</b> or <b>M2</b> then <b>also SC1</b> for <math>\pi \times</math> <i>their</i> <math>r^2</math> provided <i>their</i> <math>r</math> from use of a formula involving <math>\pi</math></p> <p>Condone rounding to 5.2 provided method shown  For <b>M</b> marks allow working with evaluated <math>r</math> and <math>r^3</math> that is rounded or truncated ie</p> <p><math>r = 1.29 - 1.3</math> <math>r^3 = 2.14 - 2.15</math>  (<math>r^3 = 2.14859 \dots</math>)</p> <p>(If <math>\pi = 3.142</math>, <math>r^3 = 2.1483\dots</math>)</p>

**OCR (Oxford Cambridge and RSA Examinations)**  
1 Hills Road  
Cambridge  
CB1 2EU

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

**[www.ocr.org.uk](http://www.ocr.org.uk)**

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