



National  
Qualifications  
2017

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**2017 Mathematics Paper 2**

**National 5**

**Finalised Marking Instructions**

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## General marking principles for National 5 Mathematics

*This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.*

*For each question the marking instructions are generally in two sections, namely Illustrative Scheme and Generic Scheme. The illustrative scheme covers methods which are commonly seen throughout the marking. The generic scheme indicates the rationale for which each mark is awarded. In general, markers should use the illustrative scheme and only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.*

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the detailed marking instructions for this assessment.
- (b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.
- (c) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader.
- (d) Credit must be assigned in accordance with the specific assessment guidelines.
- (e) One mark is available for each •. There are no half marks.
- (f) Working subsequent to an error must be **followed through**, with possible credit for the subsequent working, provided that the level of difficulty involved is approximately similar. Where, subsequent to an error, the working for a follow through mark has been eased, the follow through mark cannot be awarded.
- (g) As indicated on the front of the question paper, full credit should only be given where the solution contains appropriate working. Unless specifically mentioned in the marking instructions, a correct answer with no working receives no credit.
- (h) Candidates may use any mathematically correct method to answer questions except in cases where a particular method is specified or excluded.
- (i) As a consequence of an error perceived to be trivial, casual or insignificant, eg  $6 \times 6 = 12$  candidates lose the opportunity of gaining a mark. However, note the second example in comment (j).

- (j) Where a transcription error (paper to script or within script) occurs, the candidate should normally lose the opportunity to be awarded the next process mark, eg

This is a transcription error and so the mark is not awarded.	$x^2 + 5x + 7 = 9x + 4$
Eased as no longer a solution of a quadratic equation so mark is not awarded.	$x - 4x + 3 = 0$
Exceptionally this error is not treated as a transcription error as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.	$x = 1$
	$x^2 + 5x + 7 = 9x + 4$
	$x - 4x + 3 = 0$
	$(x-3)(x-1) = 0$
	$x = 1 \text{ or } 3$

(k) **Horizontal/vertical marking**

Where a question results in two pairs of solutions, this technique should be applied, but only if indicated in the detailed marking instructions for the question.

Example:

$$\begin{array}{cc} \bullet^5 & \bullet^6 \\ \bullet^5 & x = 2 \quad x = -4 \\ \bullet^6 & y = 5 \quad y = -7 \end{array}$$

Horizontal:  $\bullet^5 x = 2 \text{ and } x = -4$       Vertical:  $\bullet^5 x = 2 \text{ and } y = 5$   
 $\bullet^6 y = 5 \text{ and } y = -7$                        $\bullet^6 x = -4 \text{ and } y = -7$

Markers should choose whichever method benefits the candidate, but **not** a combination of both.

- (l) In final answers, unless specifically mentioned in the detailed marking instructions, numerical values should be simplified as far as possible, eg:

$$\begin{array}{ll} \frac{15}{12} \text{ must be simplified to } \frac{5}{4} \text{ or } 1\frac{1}{4} & \frac{43}{1} \text{ must be simplified to } 43 \\ \frac{15}{0.3} \text{ must be simplified to } 50 & \frac{4}{\cancel{5}}/3 \text{ must be simplified to } \frac{4}{15} \\ \sqrt{64} \text{ must be simplified to } 8^* & \end{array}$$

\*The square root of perfect squares up to and including 100 must be known.

- (m) Commonly Observed Responses (COR) are shown in the marking instructions to help mark common and/or non-routine solutions. CORs may also be used as a guide when marking similar non-routine candidate responses.

- (n) Unless specifically mentioned in the marking instructions, the following should not be penalised:
- Working subsequent to a correct answer
  - Correct working in the wrong part of a question
  - Legitimate variations in numerical answers/algebraic expressions, eg angles in degrees rounded to nearest degree
  - Omission of units
  - Bad form (bad form only becomes bad form if subsequent working is correct), eg  $(x^3 + 2x^2 + 3x + 2)(2x + 1)$  written as  $(x^3 + 2x^2 + 3x + 2) \times 2x + 1$
- $2x^4 + 4x^3 + 6x^2 + 4x + x^3 + 2x^2 + 3x + 2$  written as  $2x^4 + 5x^3 + 8x^2 + 7x + 2$  gains full credit
- Repeated error within a question, but not between questions or papers
- (o) In any 'Show that...' question, where the candidate has to arrive at a required result, the last mark of that part is not available as a follow-through from a previous error unless specified in the detailed marking instructions.
- (p) All working should be carefully checked, even where a fundamental misunderstanding is apparent early in the candidate's response. Marks may still be available later in the question so reference must be made continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that the candidate has gained all the available marks.
- (q) Scored-out working which has not been replaced should be marked where still legible. However, if the scored out working has been replaced, only the work which has not been scored out should be marked.
- (r) Where a candidate has made multiple attempts using the same strategy and not identified their final answer, mark all attempts and award the lowest mark. Where a candidate has tried different valid strategies, apply the above ruling to attempts within each strategy and then award the highest resultant mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Detailed marking instructions for each question

Question	Generic scheme	Illustrative scheme	Max mark								
1.	<b>Ans: 23</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> start process</li> <li>•<sup>2</sup> solution</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>18^2 + (-14)^2 + 3^2</math></li> <li>•<sup>2</sup> 23</li> </ul>	<b>2</b>								
<b>Notes:</b> 1. Correct answer without working <span style="float: right;">award 2/2</span>											
<b>Commonly Observed Responses:</b> <b>No working necessary:</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 70%;">1. <math>\sqrt{529}</math></td> <td style="text-align: right;">award 1/2 ✓x</td> </tr> <tr> <td>2. 11·7... (eg <math>\sqrt{324 - 196 + 9} = \sqrt{137}</math>)</td> <td style="text-align: right;">award 1/2 x✓</td> </tr> <tr> <td>3. <math>\sqrt{137}</math></td> <td style="text-align: right;">award 0/2</td> </tr> <tr> <td>4. 2·6... (eg <math>\sqrt{18 - 14 + 3} = \sqrt{7}</math>)</td> <td style="text-align: right;">award 0/2</td> </tr> </table>				1. $\sqrt{529}$	award 1/2 ✓x	2. 11·7... (eg $\sqrt{324 - 196 + 9} = \sqrt{137}$ )	award 1/2 x✓	3. $\sqrt{137}$	award 0/2	4. 2·6... (eg $\sqrt{18 - 14 + 3} = \sqrt{7}$ )	award 0/2
1. $\sqrt{529}$	award 1/2 ✓x										
2. 11·7... (eg $\sqrt{324 - 196 + 9} = \sqrt{137}$ )	award 1/2 x✓										
3. $\sqrt{137}$	award 0/2										
4. 2·6... (eg $\sqrt{18 - 14 + 3} = \sqrt{7}$ )	award 0/2										

Question	Generic scheme	Illustrative scheme	Max mark
2.	<b>Ans: £1369</b> • <sup>1</sup> know how to increase by 4.5% • <sup>2</sup> know how to calculate value after three years • <sup>3</sup> evaluate to nearest £	• <sup>1</sup> $\times 1.045$ • <sup>2</sup> $1200 \times 1.045^3$ • <sup>3</sup> 1369	3
<b>Notes:</b> 1. Correct answer without working award 3/3 2. Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3, eg for $1200 \times 1.45^3 = 3658$ , with working award 2/3 x✓✓ 3. Where division is used, (a) along with $1.045$ , • <sup>1</sup> is not available eg $1200 \div 1.045^3 = 1052$ award 2/3 x✓✓ (b) along with an incorrect percentage, • <sup>1</sup> and • <sup>2</sup> are not available eg $1200 \div 0.955^3 = 1378$ award 1/3 xx✓			
<b>Commonly Observed Responses:</b> 1. No working necessary: (a) 1369.00 award 3/3 (b) 1370 or 1369.40 or 1369.4 award 2/3 ✓✓x 2. Working must be shown: (a) $1200 \times 0.955^3 = 1045$ award 2/3 x✓✓ (b) $1200 \times 0.045 = 54 \rightarrow 1200 + 3 \times 54 = 1362$ award 1/3 ✓xx (c) $1200 \times 1.045 = 1254$ award 1/3 ✓xx (d) $1200 \times 1.045 \times 3 = 3762$ award 1/3 ✓xx (e) $1200 \times 0.045 \times 3 = 162$ award 0/3			

Question		Generic scheme	Illustrative scheme	Max mark
3.		<b>Ans: 413m</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct substitution into cosine rule</li> <li>•<sup>2</sup> evaluate <math>QR^2</math></li> <li>•<sup>3</sup> calculate QR</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>180^2 + 250^2 - 2 \times 180 \times 250 \times \cos 147</math></li> <li>•<sup>2</sup> <math>170380 \cdot 3</math></li> <li>•<sup>3</sup> <math>412 \cdot 77 \dots (m)</math></li> </ul>	<b>3</b>
<b>Notes:</b> 1. Correct answer without working award 0/3 2. Accept 412 metres with working award 3/3 3. Where sine rule is used award 0/3 4. Disregard errors due to premature rounding provided there is evidence (a) $180^2 + 250^2 - 2 \times 180 \times 250 \times (-0 \cdot 84) = 170500 \rightarrow 412 \cdot 9 \dots$ award 3/3 (b) $180^2 + 250^2 - 2 \times 180 \times 250 \times (-0 \cdot 8) = 166900 \rightarrow 408 \cdot 5 \dots$ award 3/3 5. (a) 407 or 408 (RAD) award 2/3 ✓x✓ (b) 394 (GRAD) award 2/3 ✓x✓ Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15.				
<b>Commonly Observed Responses:</b> <b>Working must be shown:</b> 1. $\sqrt{180^2 + 250^2} = 308 \cdot 05 \dots$ award 1/3 xx✓ 2. (a) $180^2 + 250^2 - 2 \times 180 \times 250 \times \cos 147 = 170380 \cdot 0 \dots \rightarrow 410$ award 3/3 (b) $180^2 + 250^2 - 2 \times 180 \times 250 \times \cos 147 \rightarrow 410$ award 2/3 ✓x✓ 3. $32400 + 62500 - 75480 \cdot 35 \dots = 19419 \cdot 64 \dots \rightarrow 139 \cdot 35 \dots$ award 2/3 ✓x✓				

Question	Generic scheme	Illustrative scheme	Max mark
4.	<p>Ans: <math>x = -3.1, x = 0.6</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> substitute correctly into quadratic formula</li> <li>•<sup>2</sup> evaluate discriminant</li> <li>•<sup>3</sup> calculate both values of <math>x</math> correct to one decimal place</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times (-4)}}{2 \times 2}</math></li> <li>•<sup>2</sup> 57 (stated or implied by •<sup>3</sup>)</li> <li>•<sup>3</sup> -3.1, 0.6</li> </ul>	3

**Notes:**

1. Correct answer without working award 0/3
2. The final mark is only available if  $b^2 - 4ac > 0$ ; see CORs 2 - 5
3. The final mark is only available when answer requires rounding

**Commonly Observed Responses:**

1. 57 ( $b^2 - 4ac$ ) award 1/3 x✓x
2.  $\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times (-4)}}{2 \times 2} \rightarrow \frac{-5 \pm \sqrt{-7}}{2 \times 2} \rightarrow -1.9, -0.6$  award 1/3 ✓xx  
 (Beware: candidate may get  $\sqrt{-7}$  then change it to  $\sqrt{7}$ )
3.  $\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times (-4)}}{2 \times 2} \rightarrow \frac{-5 \pm \sqrt{7}}{2 \times 2} \rightarrow -1.9, -0.6$  award 2/3 ✓x✓
4.  $\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times 4}}{2 \times 2} \rightarrow \frac{-5 \pm \sqrt{-7}}{2 \times 2} \rightarrow -1.9, -0.6$  award 1/3 x✓x  
 (Beware: candidate may get  $\sqrt{-7}$  then change it to  $\sqrt{7}$ )
5.  $\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times 4}}{2 \times 2} \rightarrow \frac{-5 \pm \sqrt{7}}{2 \times 2} \rightarrow -1.9, -0.6$  award 1/3 xx✓

Question		Generic scheme	Illustrative scheme	Max mark
5.		<p>Ans: 4200</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> know that 115% = 4830</li> <li>•<sup>2</sup> begin valid strategy</li> <li>•<sup>3</sup> complete calculation within valid strategy</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 115% = 4830</li> <li>•<sup>2</sup> <math>1\% = \frac{4830}{115}</math> or equivalent</li> <li>•<sup>3</sup> 4200</li> </ul>	3
<p><b>Notes:</b></p> <p>1. For 4200 with or without working award 3/3</p> <p>2. For 4105 or 4106 (85% of 4830) or 5554 or 5555 (115% of 4830)</p> <p>(i) and evidence of •<sup>1</sup> award 1/3 ✓xx</p> <p>(ii) otherwise award 0/3</p>				
<p><b>Commonly Observed Responses:</b></p> <p>1. <math>\frac{4830}{1.15} = 4200</math> award 3/3</p> <p>2. 85% = 4830 → 5682 award 2/3 x✓✓</p> <p>3. 15% = 4830 → 32200 award 2/3 x✓✓</p>				

Question	Generic scheme	Illustrative scheme	Max mark
6.	<p>Ans: 4180mm<sup>3</sup></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> know to find difference of two volumes</li> <li>•<sup>2</sup> substitute correctly into formula for volume of large sphere</li> <li>•<sup>3</sup> substitute correctly into formula for volume of small sphere</li> <li>•<sup>4</sup> carry out all calculations correctly (must involve difference or sum of two volume calculations and include a fraction)</li> <li>•<sup>5</sup> round final answer to 3 significant figures and correct units</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> evidence of difference in two volumes</li> <li>•<sup>2</sup> <math>\frac{4}{3} \times \pi \times 12^3 (= 7238.229\dots)</math></li> <li>•<sup>3</sup> <math>\frac{4}{3} \times \pi \times 9^3 (= 3053.628\dots)</math></li> <li>•<sup>4</sup> 4184.601</li> <li>•<sup>5</sup> 4180mm<sup>3</sup></li> </ul>	5

**Notes:**

1. Correct answer without working award 0/5

2. Accept variations in  $\pi$

eg  $\frac{4}{3} \times 3.14 \times 12^3 - \frac{4}{3} \times 3.14 \times 9^3 = 4182.48 = 4180 \text{ mm}^3$

3. In awarding •<sup>5</sup>

(a) Intermediate calculations need not be shown

eg  $\frac{4}{3} \times \pi \times 12^3 - \frac{4}{3} \times \pi \times 9^3 = 4180 \text{ mm}^3$

award 5/5

(b) Where intermediate calculations are shown, they must involve at least four significant figures

eg  $7238.229\dots - 3053.628\dots = 7240 - 3050 = 4190 \text{ mm}^3$

award 4/5 ✓✓✓✓×

4. Volume of second sphere may be calculated using volume scale factor

eg accept  $\left(\frac{3}{4}\right)^3 \times \frac{4}{3} \times \pi \times 12^3$  for the award of •<sup>3</sup>

Question	Generic scheme	Illustrative scheme	Max mark
<b>Commonly Observed Responses:</b>			
<b>Working must be shown:</b>			
1. (a)	$\frac{4}{3} \times \pi \times 12^3 - \frac{4}{3} \times \pi \times 10 \cdot 5^3 = (7238 \cdot \dots - 4849 \cdot \dots) = 2390 \text{mm}^3$	award 4/5 ✓✓x✓✓	
(b)	$\frac{4}{3} \times \pi \times 12^3 - \frac{4}{3} \times \pi \times 10 \cdot 5^3 = 7240 - 4850 = 2390 \text{mm}^3$	award 3/5 ✓✓x✓x	
2.	$\frac{4}{3} \times \pi \times 12^3 - \frac{4}{3} \times \pi \times 3^3 = 7130 \text{mm}^3$	award 4/5 ✓✓x✓✓	
3.	$\frac{4}{3} \times \pi \times 12^3 = 7240 \text{mm}^3$	award 2/5 x✓x x✓	
4.	$\frac{4}{3} \times \pi \times 12^3 + \frac{4}{3} \times \pi \times 9^3 = 10300 \text{mm}^3$	award 4/5 x✓✓✓✓	
5.	$\frac{4}{3} \times \pi \times 24^3 - \frac{4}{3} \times \pi \times 18^3 = 33500 \text{mm}^3$	award 4/5 ✓x✓✓✓	
6.	$\frac{4}{3} \times \pi \times 24^3 - \frac{4}{3} \times \pi \times 21^3 = 19100 \text{mm}^3$	award 3/5 ✓xx✓✓	
7.	$\frac{4}{3} \times \pi \times 1 \cdot 5^3 = 14 \cdot 1 \text{mm}^3$	award 1/5 xxx x✓	
8.	$\frac{4}{3} \times \pi \times 12^2 - \frac{4}{3} \times \pi \times 9^2 = 264 \text{mm}^3$	award 4/5 ✓x✓✓✓	
9.	$\frac{4}{3} \times \pi \times 12^3 - \frac{4}{3} \times \pi \times 9^3 = 1332\pi \text{mm}^3$	award 4/5 ✓✓✓✓x	

Question	Generic scheme	Illustrative scheme	Max mark
7.	<p><b>Ans: No, with valid reason</b></p> <p><b>Method 1</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> valid strategy (Converse of Pythagoras' Theorem in correct triangle with correct combination of sides)</li> <li>•<sup>2</sup> evaluation</li> <li>•<sup>3</sup> comparison and state conclusion</li> </ul> <p><b>Method 2</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> valid strategy (Pythagoras' Theorem in correct triangle with correct combination of sides)</li> <li>•<sup>2</sup> evaluation</li> <li>•<sup>3</sup> comparison and state conclusion</li> </ul> <p><b>Method 3</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> valid strategy (correct substitution into cosine rule to find largest angle in correct triangle)</li> <li>•<sup>2</sup> evaluation</li> <li>•<sup>3</sup> find angle and state conclusion</li> </ul> <p><b>Method 4</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> valid strategy (correct substitutions into cosine rule to find angle opposite 6 in triangle A and angle opposite 16 in triangle B)</li> <li>•<sup>2</sup> evaluation of both cos values</li> <li>•<sup>3</sup> find sum of angles and state conclusion</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>8^2 + 19^2</math> and <math>22^2</math></li> <li>•<sup>2</sup> <math>8^2 + 19^2 = 425</math>, <math>22^2 = 484</math></li> <li>•<sup>3</sup> <math>8^2 + 19^2 \neq 22^2</math>; No</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>8^2 + 19^2</math></li> <li>•<sup>2</sup> length of longest side = <math>20 \cdot 6</math></li> <li>•<sup>3</sup> <math>20 \cdot 6 \neq 22</math>; No</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\cos x^\circ = \frac{8^2 + 19^2 - 22^2}{2 \times 8 \times 19}</math></li> <li>•<sup>2</sup> <math>\cos x^\circ = -0 \cdot 194</math></li> <li>•<sup>3</sup> (<math>x =</math>) <math>101 \cdot 2</math>; No</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\cos x^\circ = \frac{8^2 + 7^2 - 6^2}{2 \times 8 \times 7}</math> and <math>\cos y^\circ = \frac{7^2 + 19^2 - 16^2}{2 \times 7 \times 19}</math></li> <li>•<sup>2</sup> <math>\cos x^\circ = 0 \cdot 6875</math> and <math>\cos y^\circ = 0 \cdot 5789</math></li> <li>•<sup>3</sup> (sum =) <math>101 \cdot 2</math>; No</li> </ul>	3

Question	Generic scheme	Illustrative scheme	Max mark
<p><b>Notes:</b></p> <p>1. In Method 1 <math>\bullet^3</math> is <b>not</b> available when evaluations at <math>\bullet^2</math> have <b>not</b> been carried out  eg <math>8^2 + 19^2 = 64 + 361</math> , <math>22^2 = 484</math>; <math>8^2 + 19^2 \neq 22^2</math>; No award 1/3 ✓××  <math>8^2 + 19^2 = 64 + 361 = 425</math>, <math>22^2 = 484</math>; <math>8^2 + 19^2 \neq 22^2</math>; No award 3/3</p> <p>2. Where the wrong triangle is chosen, <math>\bullet^2</math> is only available for consistent application of Pythagoras or cosine rule; see CORs 2 and 3</p>			
<p><b>Commonly Observed Responses:</b></p> <p>1. <math>8^2 + 19^2 = 64 + 361 = 425</math>, <math>22^2 = 484</math>; <math>8^2 + 19^2 &lt; 22^2</math>; No award 3/3</p> <p>2. <math>7^2 + 16^2 = 305</math>, <math>19^2 = 361</math>; <math>7^2 + 16^2 \neq 19^2</math>; No award 2/3 ×✓✓</p> <p>3. <math>7^2 + 19^2 = 410</math>, <math>16^2 = 256</math>; <math>7^2 + 19^2 \neq 16^2</math>; No award 1/3 ××✓</p> <p>4. <math>8^2 + 22^2 = 548</math>, <math>19^2 = 361</math>; <math>8^2 + 22^2 \neq 19^2</math>; No award 2/3 ×✓✓</p> <p>5. (a) <math>8^2 + 19^2 = 425</math>, <math>22^2 = 484</math>; The <b>square of the hypotenuse</b> is not equal to the sum of the squares of the other two sides; No award 3/3  (b) <math>8^2 + 19^2 = 425</math>, <math>22^2 = 484</math>; The <b>hypotenuse</b> is not equal to the sum of the squares of the other two sides; No award 2/3 ✓✓×</p>			

Question		Generic scheme	Illustrative scheme	Max mark
8.	(a)	<b>Ans: <math>d - c</math></b> • <sup>1</sup> answer	• <sup>1</sup> $d - c$ or equivalent	1
<b>Notes:</b> 1. Accept $-c + d$ or $d + -c$ 2. Accept $D - C$ as bad form				
<b>Commonly Observed Responses:</b>				
	(b)	<b>Ans: <math>\frac{3}{2}d - \frac{1}{2}c</math></b> • <sup>1</sup> valid pathway • <sup>2</sup> correct simplified expression	• <sup>1</sup> $\overline{TP} + \frac{1}{2}\overline{PR}$ or $\overline{TQ} + \overline{QR} + \frac{1}{2}\overline{RP}$ • <sup>2</sup> $\frac{3}{2}d - \frac{1}{2}c$ or equivalent	2
<b>Notes:</b> 1. Correct answer without working <span style="float: right;">award 2/2</span> 2. Accept $\frac{3}{2}D - \frac{1}{2}C$ 3. $\overline{TP} + \overline{PV}$ or $\overline{TQ} + \overline{QR} + \overline{RV}$ alone is not enough for the award of • <sup>1</sup> 4. For the award of • <sup>1</sup> (a) accept $d + \frac{1}{2}\overline{PR}$ but not $d + \overline{PV}$ (b) accept $2d - c + \frac{1}{2}\overline{RP}$ but not $2d - c + \overline{RV}$ (c) accept $\overline{PV} = \frac{1}{2}(d - c)$ but not $\frac{1}{2}(d - c)$ alone (d) accept $\overline{RV} = \frac{1}{2}(c - d)$ but not $\frac{1}{2}(c - d)$ alone				
<b>Commonly Observed Responses:</b> 1. $\frac{1}{2}(3d - c)$ <span style="float: right;">award 2/2</span>				

Question		Generic scheme	Illustrative scheme	Max mark
9.	(a)	<b>Ans:</b> $(2x-5)(2x+5)$ • <sup>1</sup> factorise	• <sup>1</sup> $(2x-5)(2x+5)$	1
<b>Notes:</b>				
<b>Commonly Observed Responses:</b>				
	(b)	<b>Ans:</b> $\frac{2x+5}{x+2}$ • <sup>1</sup> start to factorise • <sup>2</sup> complete factorising • <sup>3</sup> simplify	• <sup>1</sup> $(2x-5)(x+2)$ • <sup>2</sup> $(2x-5)(x+2)$ • <sup>3</sup> $\frac{2x+5}{x+2}$	3
<b>Notes:</b>				
1. Correct answer without working award 3/3 2. For $(2x-10)(x+1)$ or $(2x-2)(x+5)$ etc award 1/3 ✓×× 3. For subsequent incorrect working, the final mark is not available eg $\frac{2x+5}{x+2} = \frac{7}{3}$ award 2/3 ✓✓× 4. • <sup>3</sup> is only available when both the numerator and denominator have at least two factors				
<b>Commonly Observed Responses:</b>				

Question	Generic scheme	Illustrative scheme	Max mark
10.	<p><b>Ans: 9.9 kilometres</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> calculate size of angles DEF and DFE</li> <li>•<sup>2</sup> correct substitution into sine rule</li> <li>•<sup>3</sup> rearrange formula</li> <li>•<sup>4</sup> calculate DF</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 40 and 104</li> <li>•<sup>2</sup> <math>\frac{DF}{\sin 40} = \frac{15}{\sin 104}</math></li> <li>•<sup>3</sup> <math>\frac{15 \times \sin 40}{\sin 104}</math></li> <li>•<sup>4</sup> 9.9(36...)</li> </ul>	4

**Notes:**

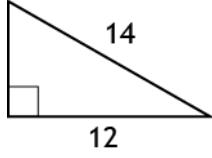
1. Correct answer without working award 0/4
2. Accept a final answer of 10, with working award 4/4
3. •<sup>1</sup> may be awarded for sizes of angles DEF and DFE marked on the diagram
4. Where incorrect sizes are used for angles DEF and DFE
  - (a) with prior evidence of angle sizes (marked on diagram or clearly attached to **named** angles), marks •<sup>2</sup>, •<sup>3</sup> and •<sup>4</sup> are available
  - (b) **without** prior evidence of angle sizes, only marks •<sup>3</sup> and •<sup>4</sup> are available
5. **BEWARE**  $\frac{DF}{\sin 40} = \frac{15}{\sin 76} \rightarrow 9.9$ 
  - (a) with prior evidence of DEF = 40 and DFE = 76 award 3/4 x✓✓✓
  - (b) **without** prior evidence of sizes of angles DEF and DFE award 2/4 xx✓✓
6. Disregard errors due to premature rounding provided there is evidence
7. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15
  - (a) -34.7... (RAD)
  - (b) 8.8... (GRAD)

**Commonly Observed Responses:**

1.  $\frac{DF}{\sin 36} = \frac{15}{\sin 90} \rightarrow 8.8$ 
  - (a) with prior evidence of sizes of angles DEF and DFE marks award 3/4 x✓✓✓
  - (b) **without** prior evidence of sizes of angles DEF and DFE award 2/4 xx✓✓
2.  $\frac{DF}{\sin 230} = \frac{15}{\sin 126} \rightarrow -14.2$  award 2/4 xx✓✓
3.  $\frac{DF}{40} = \frac{15}{104} \rightarrow 5.769.....$  award 1/4 ✓xxx

Question		Generic scheme	Illustrative scheme	Max mark
11.		<p>Ans: <math>\frac{3}{5}</math> or 0.6</p> <p>•<sup>1</sup> isolate term in <math>y</math> or divide throughout by 5</p> <p>•<sup>2</sup> state gradient explicitly</p>	<p>•<sup>1</sup> <math>-5y = -3x... \text{ or } 3x... = 5y \text{ or}</math>  or <math>\frac{3x}{5} - \frac{5y}{5} - \frac{10}{5} = 0</math></p> <p>•<sup>2</sup> <math>\frac{3}{5}</math> or 0.6</p>	2
<p><b>Notes:</b></p> <p>1. Correct answer without working award 2/2</p> <p>2. Do not accept <math>x = \frac{3}{5}</math> or <math>y = \frac{3}{5}</math> for the award of •<sup>2</sup></p> <p>3. Where gradient formula is used with two points which  (a) lie on the line <math>3x - 5y + 10 = 0</math>,  award •<sup>1</sup> for correct substitution into gradient formula  award •<sup>2</sup> for correct calculation of gradient  (b) do not lie on the line <math>3x - 5y + 10 = 0</math>, award 0/2</p>				
<p><b>Commonly Observed Responses:</b></p> <p>1. <math>\frac{3}{5}x</math> or <math>0.6x</math> (with working) award 1/2 ✓x</p>				

Question		Generic scheme	Illustrative scheme	Max mark
12.		<p>Ans: <math>x^{-\frac{1}{3}}</math></p> <p>•<sup>1</sup> apply <math>\sqrt[n]{x^m} = x^{\frac{m}{n}}</math></p> <p>•<sup>2</sup> apply <math>\frac{1}{x^n} = x^{-n}</math></p>	<p>•<sup>1</sup> <math>\frac{1}{x^{\frac{1}{3}}}</math> stated or implied by •<sup>2</sup></p> <p>•<sup>2</sup> <math>x^{-\frac{1}{3}}</math></p>	2
<p><b>Notes:</b></p> <p>1. Correct answer without working award 2/2</p> <p>2. Accept <math>x^{\frac{1}{3}}</math> for •<sup>1</sup></p> <p>3. Where a number or letter (excluding <math>n</math>) other than <math>x</math> is used</p> <p>eg <math>a^{\frac{1}{3}}</math> or <math>8^{-\frac{1}{3}}</math> award 1/2</p> <p><math>n^{-\frac{1}{3}}</math> award 0/2</p>				
<p><b>Commonly Observed Responses:</b></p> <p>1. <math>n = -\frac{1}{3}</math> award 2/2</p> <p>2. <math>-x^{\frac{1}{3}}</math> award 1/2 ✓x</p> <p>3. <math>x^{-3}</math> award 1/2 x✓</p>				

Question	Generic scheme	Illustrative scheme	Max mark
13.	<p>Ans: 42.4 centimetres</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> marshal facts and recognise right-angled triangle</li> <li>•<sup>2</sup> consistent Pythagoras statement</li> <li>•<sup>3</sup> calculation of <math>x</math></li> <li>•<sup>4</sup> find height of the logo</li> </ul>	 <ul style="list-style-type: none"> <li>•<sup>1</sup></li> <li>•<sup>2</sup> <math>x^2 = 14^2 - 12^2</math></li> <li>•<sup>3</sup> 7.2</li> <li>•<sup>4</sup> 42.4</li> </ul>	4

**Notes:**

1. Correct answer without working award 0/4
2. The final mark is for doubling the result of a **Pythagoras (or trig.)** calculation and then adding 28
3. In the absence of a diagram accept  $x^2 = 14^2 - 12^2$  as evidence for the award of •<sup>1</sup> and •<sup>2</sup>
4. **BEWARE**  
Where a diagram is shown, working must be consistent with the diagram.  
•<sup>2</sup> is not available for an **incorrect** diagram leading to  $x^2 = 14^2 - 12^2$
5. Disregard errors due to premature rounding provided there is evidence

**Commonly Observed Responses:**

1. For  $x^2 = 14^2 + 12^2 \rightarrow x = 18.4$  height = 64.8... or 64.9
  - (a) working inconsistent with correct diagram award 3/4 ✓x✓✓
  - (b) working consistent with candidate's diagram award 3/4 x✓✓✓  
(cosine rule may be used to calculate  $x$ )
  - (c) no diagram award 2/4 xx✓✓
2. For  $x^2 = 24^2 - 14^2 \rightarrow x = 19.4$ ... height = 66.9... or 67
  - (a) working consistent with candidate's diagram award 3/4 x✓✓✓
  - (b) no diagram or working not consistent with candidate's diagram award 2/4 xx✓✓
3. For  $x^2 = 24^2 + 14^2 \rightarrow x = 27.8$ ... height = 83.5... or 83.6
  - (a) working consistent with candidate's diagram award 3/4 x✓✓✓  
(cosine rule may be used to calculate  $x$ )
  - (b) no diagram or working not consistent with candidate's diagram award 2/4 xx✓✓

Question	Generic scheme	Illustrative scheme	Max mark
14.	<p>Ans: 282°</p> <p><b>Method 1</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> expression for arc length</li> <li>•<sup>2</sup> know how to find angle</li> <li>•<sup>3</sup> calculate angle</li> </ul> <p><b>Method 2</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> arc length: circumference ratio</li> <li>•<sup>2</sup> know how to find angle</li> <li>•<sup>3</sup> calculate angle</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{\text{angle}}{360} \times \pi \times 12.8</math></li> <li>•<sup>2</sup> <math>\frac{31.5 \times 360}{\pi \times 12.8}</math></li> <li>•<sup>3</sup> 282(. )</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{31.5}{\pi \times 12.8} (= 0.78\dots)</math></li> <li>•<sup>2</sup> <math>\frac{31.5 \times 360}{\pi \times 12.8}</math></li> <li>•<sup>3</sup> 282(. )</li> </ul>	3
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>Correct answer without working <span style="float: right;">award 0/3</span></li> <li>Accept variations in <math>\pi</math></li> <li>Premature rounding of <math>\frac{31.5}{\pi \times 12.8}</math> must be to at least 2 decimal places</li> <li>For the award of •<sup>3</sup>, the calculation must involve a division by a product. The calculation must include 31.5, <math>\pi</math>, 360 and the candidate's chosen diameter or radius</li> <li>For subsequent incorrect working, the final mark is not available eg <math>360 - 282 = 78</math> <span style="float: right;">award 2/3 ✓✓✗</span></li> </ol>			
<p><b>Commonly Observed Responses:</b></p> <ol style="list-style-type: none"> <li>For <math>\frac{31.5 \times 360}{\pi \times 6.4} = 564</math> <span style="float: right;">award 2/3 ✗✓✓</span></li> <li>For <math>\frac{31.5 \times 360}{\pi \times 6.4^2} = 88.1\dots</math> <span style="float: right;">award 2/3 ✗✓✓</span></li> <li>For <math>\frac{31.5}{360} \times \pi \times 12.8 = 3.518\dots</math> <span style="float: right;">award 0/3</span></li> </ol>			

Question		Generic scheme	Illustrative scheme	Max mark
15.	(a)	<b>Ans: 51.5 metres</b> • <sup>1</sup> calculate height	• <sup>1</sup> 51.5	1
<b>Notes:</b> 1. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15 (a) 18.1... (RAD) (b) 53.5... (GRAD)				
<b>Commonly Observed Responses:</b> 1. 51.5, 308.5 <span style="float: right;">award 0/1</span>				
	(b)	<b>Ans: 17 metres</b> • <sup>1</sup> calculate minimum height	• <sup>1</sup> 17	1
<b>Notes:</b> 1. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15 (a) 26.2... (RAD) (b) 18.1... (GRAD)				
<b>Commonly Observed Responses:</b>				
	(c)	<b>Ans: 24.1° and 335.9°</b> • <sup>1</sup> substitute 61 correctly into equation • <sup>2</sup> calculate $\cos x$ • <sup>3</sup> calculate value of $x$ • <sup>4</sup> calculate 2 <sup>nd</sup> value of $x$	• <sup>1</sup> $61 = 40 + 23 \cos x$ • <sup>2</sup> $\cos x = \frac{21}{23}$ • <sup>3</sup> 24(.07...) • <sup>4</sup> 335(.92...)	4

Question	Generic scheme	Illustrative scheme	Max mark								
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1. Correct answers               <table style="width: 100%; border: none;"> <tr> <td style="width: 80%;">(a) without working</td> <td style="text-align: right;">award 1/4 ***✓</td> </tr> <tr> <td>(b) by repeated substitution</td> <td style="text-align: right;">award 1/4 ***✓</td> </tr> </table> </li> <li>2. Accept 24 and 336 with valid working</li> <li>3. Disregard errors due to premature rounding provided there is evidence</li> <li>4. Do not penalise omission of degree sign throughout the question</li> <li>5. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15               <table style="width: 100%; border: none;"> <tr> <td style="width: 80%;">(a) 0.418..., 359.5... (RAD)</td> <td></td> </tr> <tr> <td>(b) 26.7... , 333.3... (GRAD)</td> <td></td> </tr> </table> </li> </ol>				(a) without working	award 1/4 ***✓	(b) by repeated substitution	award 1/4 ***✓	(a) 0.418..., 359.5... (RAD)		(b) 26.7... , 333.3... (GRAD)	
(a) without working	award 1/4 ***✓										
(b) by repeated substitution	award 1/4 ***✓										
(a) 0.418..., 359.5... (RAD)											
(b) 26.7... , 333.3... (GRAD)											
<p><b>Commonly Observed Responses:</b></p> <ol style="list-style-type: none"> <li>1. <math>61 = 40 + 23 \cos x \rightarrow 61 = 63 \cos x \rightarrow \cos x = \frac{61}{63} \rightarrow x = 14.5, 345.5</math>      award 3/4 ✓*✓✓</li> <li>2. <math>\cos x = \frac{-2}{60} \rightarrow x = 91.9, 268.1</math>      award 2/4 **✓✓</li> </ol>											

**[END OF MARKING INSTRUCTIONS]**