



National  
Qualifications  
2019

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## 2019 Applications of Mathematics

### National 5 - Paper 2

### Finalised Marking Instructions

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## General marking principles for National Applications of Mathematics

*Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.*

*For each question, the marking instructions are generally in two sections:*

- *generic scheme – this indicates why each mark is awarded*
- *illustrative scheme – this covers methods which are commonly seen throughout the marking*

*In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.*

- Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.
- If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.
- One mark is available for each •. There are no half marks.
- If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.
- Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.
- Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.
- If an error is trivial, casual or insignificant, for example  $6 \times 6 = 12$ , candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) overleaf.

- (h) If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example

This is a transcription error and so the mark is not awarded.

$$x^2 + 5x + 7 = 9x + 4$$

This is no longer a solution of a quadratic equation, so the mark is not awarded.

$$x - 4x + 3 = 0$$

$$x = 1$$

The following example is an exception to the above

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.

$$x^2 + 5x + 7 = 9x + 4$$

$$x - 4x + 3 = 0$$

$$(x - 3)(x - 1) = 0$$

$$x = 1 \text{ or } 3$$

- (i) **Horizontal/vertical marking**

If a question results in two pairs of solutions, apply the following technique, 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:  $\bullet^5 x = 2$  and  $x = -4$       Vertical:  $\bullet^5 x = 2$  and  $y = 5$   
 $\bullet^6 y = 5$  and  $y = -7$                        $\bullet^6 x = -4$  and  $y = -7$

You must choose whichever method benefits the candidate, **not** a combination of both.

- (j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$$\frac{15}{12} \text{ must be simplified to } \frac{5}{4} \text{ or } 1\frac{1}{4} \quad \frac{43}{1} \text{ must be simplified to } 43$$

$$\frac{15}{0.3} \text{ must be simplified to } 50 \quad \frac{4/5}{3} \text{ must be simplified to } \frac{4}{15}$$

$$\sqrt{64} \text{ must be simplified to } 8^*$$

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

(k) 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.

(l) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:

- working subsequent to a correct answer
- correct working in the wrong part of a question
- legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
- omission of units
- bad form (bad form only becomes bad form if subsequent working is correct), for example

$$(x^3 + 2x^2 + 3x + 2)(2x + 1) \text{ written as}$$

$$(x^3 + 2x^2 + 3x + 2) \times 2x + 1$$

$$= 2x^4 + 5x^3 + 8x^2 + 7x + 2$$

gains full credit

- repeated error within a question, but not between questions or papers

(m) In any ‘Show that...’ question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.

(n) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate’s response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.

(o) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.

(p) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest 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.		<ul style="list-style-type: none"> <li>•<sup>1</sup> Strategy: know how to calculate percentage increase</li> <li>•<sup>2</sup> Strategy: identify power</li> <li>•<sup>3</sup> Strategy: know how to calculate percentage decrease</li> <li>•<sup>4</sup> Process: calculate the value of the stamp after 3 years and round to 3 significant figures</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> Evidence of 1.07 or equivalent</li> <li>•<sup>2</sup> ...<sup>2</sup> or equivalent</li> <li>•<sup>3</sup> Evidence of 0.96 or equivalent</li> <li>•<sup>4</sup> <math>1011 \cdot 18 = 1010</math></li> </ul>	<b>4</b>										
<p><b>Notes:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">1. Correct answer with no working</td> <td style="text-align: right;">award 3/4</td> </tr> <tr> <td>2. 1011.18 or 1011.17 with no working</td> <td style="text-align: right;">award 3/4</td> </tr> <tr> <td>3. 1006.85 or 1006.84 with no working</td> <td style="text-align: right;">award 2/4</td> </tr> <tr> <td>4. When working in pounds, where rounding or truncation has taken place, working must be given to at least 2 decimal places.</td> <td></td> </tr> <tr> <td>5. •<sup>3</sup> not available <math>0 \cdot 96^n</math> where <math>n \neq 1</math></td> <td></td> </tr> </table>					1. Correct answer with no working	award 3/4	2. 1011.18 or 1011.17 with no working	award 3/4	3. 1006.85 or 1006.84 with no working	award 2/4	4. When working in pounds, where rounding or truncation has taken place, working must be given to at least 2 decimal places.		5. • <sup>3</sup> not available $0 \cdot 96^n$ where $n \neq 1$	
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<p><b>Commonly Observed Responses:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">1. For <math>(920 \times 0 \cdot 93^2) \times 0 \cdot 96</math> leading to 764</td> <td style="text-align: right;">award 3/4 <math>\times \checkmark \checkmark \checkmark</math></td> </tr> <tr> <td>2. For <math>(920 + 920 \times 0 \cdot 07 \times 2) \times 0 \cdot 96</math> leading to 1010</td> <td style="text-align: right;">award 3/4 <math>\checkmark \times \checkmark \checkmark</math></td> </tr> <tr> <td>3. For <math>(920 \times 1 \cdot 07^2) \times 1 \cdot 04</math> leading to 1100</td> <td style="text-align: right;">award 3/4 <math>\checkmark \checkmark \times \checkmark</math></td> </tr> <tr> <td>4. For <math>(920 \times 0 \cdot 93^2) \times 1 \cdot 04</math> leading to 828</td> <td style="text-align: right;">award 2/4 <math>\times \checkmark \times \checkmark</math></td> </tr> </table>					1. For $(920 \times 0 \cdot 93^2) \times 0 \cdot 96$ leading to 764	award 3/4 $\times \checkmark \checkmark \checkmark$	2. For $(920 + 920 \times 0 \cdot 07 \times 2) \times 0 \cdot 96$ leading to 1010	award 3/4 $\checkmark \times \checkmark \checkmark$	3. For $(920 \times 1 \cdot 07^2) \times 1 \cdot 04$ leading to 1100	award 3/4 $\checkmark \checkmark \times \checkmark$	4. For $(920 \times 0 \cdot 93^2) \times 1 \cdot 04$ leading to 828	award 2/4 $\times \checkmark \times \checkmark$		
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Question		Generic Scheme	Illustrative Scheme	Max mark
2.		<ul style="list-style-type: none"> <li>•<sup>1</sup> Strategy: substitute correctly into cylinder formula</li> <li>•<sup>2</sup> Process: calculate the volume of the cylinder</li> <li>•<sup>3</sup> Process: calculate the volume of the cuboid</li> <li>•<sup>4</sup> Process/communication: find the total volume of the bottle</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\pi \times 1.5^2 \times 4</math></li> <li>•<sup>2</sup> <math>28 \cdot 27 \dots</math></li> <li>•<sup>3</sup> <math>4.5 \times 10 \times 8 = 360</math></li> <li>•<sup>4</sup> <math>360 + 28 \cdot 27 = 388 \cdot 27 \text{cm}^3</math></li> </ul>	4
<b>Notes:</b> <ul style="list-style-type: none"> <li>1. Correct answer with no working <span style="float: right;">award 0/4</span></li> <li>2. •<sup>1</sup> can be implied by subsequent working</li> <li>3. •<sup>2</sup> is only available for a calculation involving <math>\pi</math> and a power</li> <li>4. For •<sup>4</sup> the correct units must be stated</li> <li>5. •<sup>4</sup> is only available for the addition of two calculated volumes</li> <li>6. Accept legitimate variations of <math>\pi</math></li> <li>7. For the final answer accept any legitimate rounding or truncation to at least 2 significant figures</li> <li>8. Accept answers given in millilitres or litres</li> </ul>				
<b>Commonly Observed Responses:</b> <ul style="list-style-type: none"> <li>1. <math>3 \cdot 14 \times 1.5^2 \times 4 + 360 = 388 \cdot 26 \text{cm}^3</math> <span style="float: right;">award 4/4 ✓✓✓✓</span></li> <li>2. <math>\pi \times 3^2 \times 4 + 360 = 473 \cdot 10 \text{cm}^3</math> <span style="float: right;">award 3/4 ✗✓✓✓</span></li> <li>3. <math>3 \cdot 14 \times 3^2 \times 4 + 360 = 473 \cdot 04 \text{cm}^3</math> <span style="float: right;">award 3/4 ✗✓✓✓</span></li> </ul>				

Question		Generic scheme	Illustrative scheme	Max mark
3.	(a)	<ul style="list-style-type: none"> <li>•<sup>1</sup> Communication: read rate of exchange from graph</li> <li>•<sup>2</sup> Process: calculate amount in pounds</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 0.852</li> <li>•<sup>2</sup> <math>0.852 \times 250 = 213</math></li> </ul>	2
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. If •<sup>1</sup> is incorrect •<sup>2</sup> is not available for candidates who truncate or round their answer to a whole number of pounds</li> <li>2. •<sup>2</sup> is only available for candidates who multiply 250 by any value <math>0.83 \leq x \leq 0.86</math></li> </ol>				
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li>1. <math>0.85 \times 250 = 212.50</math> award 1/2 ✗✓</li> <li>2. <math>0.842 \times 250 = 210.50</math> award 1/2 ✗✓</li> <li>3. <math>0.84 \times 250 = 210</math> award 1/2 ✗✓</li> <li>4. <math>0.837 \times 250 = 209.25</math> award 1/2 ✗✓</li> </ol>				
	(b)	<ul style="list-style-type: none"> <li>•<sup>3</sup> Strategy/process: calculate exchange rate</li> <li>•<sup>4</sup> Communication: state date consistent with working</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>3</sup> <math>334.80 \div 400 = 0.837</math> or <math>400 \times 0.837 = 334.80</math></li> <li>•<sup>4</sup> 9 December</li> </ul>	2
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. Correct answer with no working award 0/2</li> <li>2. •<sup>4</sup> is only available where calculated exchange rate is a marked point on the graph</li> <li>3. Where candidates choose to multiply, •<sup>4</sup> is only available if the answer to one of their calculations is 334.80 and date is consistent with the exchange rate</li> </ol>				
<b>Commonly Observed Responses:</b>				

Question		Generic scheme	Illustrative scheme	Max mark
4.		<ul style="list-style-type: none"> <li>•<sup>1</sup> Strategy: identify the price of gold</li> <li>•<sup>2</sup> Strategy: know how to calculate the percentage loss</li> <li>•<sup>3</sup> Process/Communication: calculate percentage loss and round to 2 decimal places</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 1210 and 1140</li> <li>•<sup>2</sup> <math>(1210 - 1140) \div 1210 \times 100</math></li> <li>•<sup>3</sup> 5.79</li> </ul>	3
<b>Notes:</b>				
1. Where • <sup>2</sup> is not awarded, • <sup>3</sup> can only be awarded for a calculation of the form $\frac{a}{b} \times c$ ( $a \neq b \neq c$ ), where a, b and c must either be a calculated loss, the values picked in • <sup>1</sup> or 100. 2. For • <sup>3</sup> multiplication by 100 can be implied by the answer				
<b>Commonly Observed Responses:</b>				
1. $(1210 - 1140) \div 1210 = 0.06$ <span style="float: right;">award 1/3 ✓ x x</span> 2. $1210 \div 1140 = 1.06$ <span style="float: right;">award 1/3 ✓ x x</span>				
5.		<ul style="list-style-type: none"> <li>•<sup>1</sup> Strategy: know how to find arc length of quarter or semi-circle</li> <li>•<sup>2</sup> Process: calculate curved edge of one quarter circle or semi-circle</li> <li>•<sup>3</sup> Process: calculate perimeter of swimming pool</li> <li>•<sup>4</sup> Strategy: know how to calculate number of lengths</li> <li>•<sup>5</sup> Process: calculate number of lengths, appropriate rounding and calculate cost</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{20\pi}{4}</math> or <math>\frac{20\pi}{2}</math></li> <li>•<sup>2</sup> 15.7... or 31.4...</li> <li>•<sup>3</sup> <math>2 \times 15.7... + 2 \times 10 + 2 \times 36.5 = 124.4...</math></li> <li>•<sup>4</sup> <math>(... - 2 \times 1.25) \div 3</math></li> <li>•<sup>5</sup> 40.6 leading to <math>41 \times 11.49 = 471.09</math></li> </ul>	5
<b>Notes:</b>				
1. • <sup>2</sup> is available for candidates who carry out a correct quarter circle or semi-circle calculation to find arc length or sector area 2. • <sup>3</sup> is not available to candidates who use area in an attempt to find perimeter including the use of $A = \pi d$ 3. • <sup>5</sup> is only available for 11.49 multiplied by the appropriately rounded answer to • <sup>4</sup> 4. • <sup>5</sup> is not available if the length of railing required is a multiple of 3 5. • <sup>5</sup> is not available if there is no evidence of where the number of lengths come from 6. Accept legitimate variations of $\pi$				
<b>Commonly Observed Responses:</b>				
1. $\pi \times 10 \div 4 = 7.85...$ leading to 413.64 <span style="float: right;">award 4/5 ✓ x ✓ ✓ ✓</span> 2. $(2 \times 15.7... + 2 \times 36.5) = 104.4...$ leading to 390.66 <span style="float: right;">award 4/5 ✓ ✓ x ✓ ✓</span> 3. $124.4... \div 3 (= 41.46...)$ leading to 482.58 <span style="float: right;">award 4/5 ✓ ✓ ✓ x ✓</span> 4. $(124.4... + 2 \times 1.25) \div 3 (= 42.3...)$ leading to 494.07 <span style="float: right;">award 4/5 ✓ ✓ ✓ x ✓</span>				

Question		Generic scheme	Illustrative scheme	Max mark
6.		<ul style="list-style-type: none"> <li>•<sup>1</sup> Process: calculate total selling price</li> <li>•<sup>2</sup> Process: calculate 2.7% of total selling price</li> <li>•<sup>3</sup> Process: calculate profit</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>375 \times 5.20 = 1950</math></li> <li>•<sup>2</sup> <math>1950 \times 0.027 = 52.65</math></li> <li>•<sup>3</sup> <math>1950 - (1687.50 + 52.65) = 209.85</math></li> </ul>	3
		<p><b>Alternative Strategy</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> Process: calculate 97.3% of one share</li> <li>•<sup>2</sup> Process: calculate profit of one share</li> <li>•<sup>3</sup> Process: calculate profit</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>5.20 \times 0.973 = 5.0596</math></li> <li>•<sup>2</sup> <math>5.0596 - 4.50 = 0.5596</math></li> <li>•<sup>3</sup> <math>375 \times 0.5596 = 209.85</math></li> </ul>	
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1. Correct answer with no working <span style="float: right;">award 0/3</span></li> <li>2. In original strategy, where •<sup>2</sup> is not awarded, •<sup>3</sup> is only available if a percentage of their total selling price or the total buying price is calculated</li> <li>3. In alternative strategy, where •<sup>1</sup> is not awarded, •<sup>3</sup> is only available if a percentage of the selling price or buying price is calculated</li> <li>4. For candidates who use alternative strategy accept a final answer of 210</li> </ol>				
<p><b>Commonly Observed Responses:</b></p> <ol style="list-style-type: none"> <li>1. <math>1950 \times 1.027</math> leading to an answer of 315.15 <span style="float: right;">award 2/3 ✓×✓</span></li> <li>2. <math>(1950 - 1687.50) \times 0.973 = 255.41</math> <span style="float: right;">award 2/3 ✓✓×</span></li> <li>3. <math>1950 - 1687.50 = 262.50</math> <span style="float: right;">award 1/3 ✓××</span></li> </ol>				

Question			Generic Scheme	Illustrative Scheme	Max mark
7.	(a)	(i)	<ul style="list-style-type: none"> <li>•<sup>1</sup> Process: calculate mean</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>(2 \cdot 5 + 4 \cdot 5 + 3 \cdot 7 + 3 \cdot 1 + 3 \cdot 8 + 3 \cdot 4) \div 6 = 3 \cdot 5</math></li> </ul>	1
<b>Notes:</b>					
<b>Commonly Observed Responses:</b>					
		(ii)	<ul style="list-style-type: none"> <li>•<sup>2</sup> Process: calculate <math>(x - \bar{x})^2</math></li> <li>•<sup>3</sup> Strategy/process: substitute into formula</li> <li>•<sup>4</sup> Process: calculate standard deviation</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>2</sup> 1,1,0·04,0·16,0·09,0·01</li> <li>•<sup>3</sup> <math>\sqrt{\frac{2 \cdot 3}{6 - 1}}</math></li> <li>•<sup>4</sup> 0·678...</li> </ul>	3
			<p><b>Alternative strategy</b></p> <ul style="list-style-type: none"> <li>•<sup>2</sup> Process: calculate <math>\sum x</math> and <math>\sum x^2</math></li> <li>•<sup>3</sup> Strategy/process: substitute into formula</li> <li>•<sup>4</sup> Process: calculate standard deviation</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>2</sup> 21 and 75·8</li> <li>•<sup>3</sup> <math>\sqrt{\frac{75 \cdot 8 - \frac{21^2}{6}}{6 - 1}}</math></li> <li>•<sup>4</sup> 0·678...</li> </ul>	
<b>Notes:</b>					
1. Correct answer with no working <span style="float: right;">award 0/3</span> 2. Accept rounding or truncation to at least one decimal place for final answer 3. • <sup>4</sup> can only be awarded for a calculation involving at least two-step including a division and a square root has taken place					
<b>Commonly Observed Responses:</b>					
	(b)		<ul style="list-style-type: none"> <li>•<sup>5</sup> Communication: comment regarding mean</li> <li>•<sup>6</sup> Communication: comment regarding standard deviation</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>5</sup> eg on average weights in 2017 are higher</li> <li>•<sup>6</sup> eg the weights in 2017 are more consistent</li> </ul>	2
<b>Notes:</b>					
<b>Commonly Observed Responses:</b>					

Question			Generic scheme	Illustrative scheme	Max mark																		
7.	(c)	(i)	<ul style="list-style-type: none"> <li>•<sup>7</sup> Communication: 4 points correct</li> <li>•<sup>8</sup> Communication: all 8 points correct</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>7</sup> evidence</li> <li>•<sup>8</sup> evidence</li> </ul>	2																		
<b>Notes:</b>																							
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>L</td> <td>46</td> <td>47</td> <td>49</td> <td>51</td> <td>52</td> <td>52</td> <td>54</td> <td>55</td> </tr> <tr> <td>W</td> <td>2.7</td> <td>2.8</td> <td>3.5</td> <td>3.7</td> <td>3.4</td> <td>3.7</td> <td>4.0</td> <td>4.4</td> </tr> </table>						L	46	47	49	51	52	52	54	55	W	2.7	2.8	3.5	3.7	3.4	3.7	4.0	4.4
L	46	47	49	51	52	52	54	55															
W	2.7	2.8	3.5	3.7	3.4	3.7	4.0	4.4															
<b>Commonly Observed Responses:</b>																							
		(ii)	<ul style="list-style-type: none"> <li>•<sup>9</sup> Strategy: consistent line of best fit</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>9</sup> evidence</li> </ul>	1																		
<b>Notes:</b>																							
<b>Commonly Observed Responses:</b>																							
		(iii)	<ul style="list-style-type: none"> <li>•<sup>10</sup> Communication: answer consistent with line of best fit</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>10</sup> evidence</li> </ul>	1																		
<b>Notes:</b>																							
1. When the weight falls between 2 divisions accept either number or any value in between																							
<b>Commonly Observed Responses:</b>																							
	(d)		<ul style="list-style-type: none"> <li>•<sup>11</sup> Strategy: identify correct row in table</li> <li>•<sup>12</sup> Process: calculate milk powder needed for 1 week or equivalent</li> <li>•<sup>13</sup> Communication: conclusion consistent with working</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>11</sup> eg 8 (scoops)</li> <li>•<sup>12</sup> <math>4 \times 8 \times 7 \times 4.5 = 1008</math> OR <math>4.5 \times 4 \times 8 = 144</math> <math>900 \div 144 = 6.25</math></li> <li>•<sup>13</sup> No, (as <math>1008\text{g} &gt; 900\text{g}</math>) OR No, (as <math>6.25 &lt; 7</math> days)</li> </ul>	3																		
<b>Notes:</b>																							
1. For • <sup>13</sup> the comparison has to be grams with grams, days with days or scoops with scoops																							
<b>Commonly Observed Responses:</b>																							

Question		Generic scheme	Illustrative scheme	Max mark								
8.	(a)	<ul style="list-style-type: none"> <li>•<sup>1</sup> Strategy/process: identify number of gaps</li> <li>•<sup>2</sup> Process: calculate length</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 366</li> <li>•<sup>2</sup> <math>366 \times 2 + 367 \times 4 = 2200</math></li> </ul>	2								
<b>Notes:</b>												
<b>Commonly Observed Responses:</b>												
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">1. <math>365 \times 2 + 367 \times 4 = 2198</math></td> <td style="width: 30%; text-align: right;">award 1/2 x✓</td> </tr> <tr> <td>2. <math>367 \times 2 + 367 \times 4 = 2202</math></td> <td style="text-align: right;">award 1/2 x✓</td> </tr> <tr> <td>3. <math>367 \times 4 \times 2 = 2936</math></td> <td style="text-align: right;">award 0/2 xx</td> </tr> <tr> <td>4. <math>367 \times 4 \div 2 = 734</math></td> <td style="text-align: right;">award 0/2 xx</td> </tr> </table>					1. $365 \times 2 + 367 \times 4 = 2198$	award 1/2 x✓	2. $367 \times 2 + 367 \times 4 = 2202$	award 1/2 x✓	3. $367 \times 4 \times 2 = 2936$	award 0/2 xx	4. $367 \times 4 \div 2 = 734$	award 0/2 xx
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4. $367 \times 4 \div 2 = 734$	award 0/2 xx											
	(b)	<ul style="list-style-type: none"> <li>•<sup>3</sup> Strategy/communication: correct substitution in Pythagoras' Theorem</li> <li>•<sup>4</sup> Process: calculate height or height<sup>2</sup></li> <li>•<sup>5</sup> Strategy/communication: correct substitution in Pythagoras' Theorem</li> <li>•<sup>6</sup> Process/communication: calculate total length of cable</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>3</sup> eg <math>300^2 - 295^2</math></li> <li>•<sup>4</sup> <math>h = 54.5...</math> or <math>h^2 = 2975</math></li> <li>•<sup>5</sup> <math>600^2 + (54.5...)^2</math></li> <li>•<sup>6</sup> <math>300 + 602 \cdot 4... = 902 \cdot 4...</math></li> </ul>	4								
<b>Notes:</b>												
<ol style="list-style-type: none"> <li>1. •<sup>3</sup> is not available if candidate writes <math>295^2 - 300^2</math></li> <li>2. •<sup>4</sup> is available if candidate writes <math>295^2 - 300^2</math> leading to <math>54.5...</math></li> <li>3. Do not penalise candidates who truncate or round to the nearest whole number throughout</li> </ol>												
<b>Commonly Observed Responses:</b>												
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">1. <math>\sqrt{(600 + 295)^2 - 300^2} + 300 = 1143.2...</math></td> <td style="width: 30%; text-align: right;">award 2/4 xx✓✓</td> </tr> <tr> <td>2. <math>295^2 + 300^2 = 177025</math></td> <td style="text-align: right;">award 1/4 x✓xx</td> </tr> </table>					1. $\sqrt{(600 + 295)^2 - 300^2} + 300 = 1143.2...$	award 2/4 xx✓✓	2. $295^2 + 300^2 = 177025$	award 1/4 x✓xx				
1. $\sqrt{(600 + 295)^2 - 300^2} + 300 = 1143.2...$	award 2/4 xx✓✓											
2. $295^2 + 300^2 = 177025$	award 1/4 x✓xx											

Question		Generic scheme	Illustrative scheme	Max mark						
9.	(a)	<ul style="list-style-type: none"> <li>•<sup>1</sup> Process: calculate total number of hours</li> <li>•<sup>2</sup> Process: calculate angles</li> <li>•<sup>3</sup> Communication: draw and label pie chart consistent with previous working</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>210 + 96 + 234 = 540</math></li> <li>•<sup>2</sup> <table border="1" style="margin-left: 20px;"> <tr> <td>210 hours research</td> <td><math>\frac{210}{540} \times 360 = 140</math></td> </tr> <tr> <td>96 hours meetings</td> <td><math>\frac{96}{540} \times 360 = 64</math></td> </tr> <tr> <td>234 hours writing</td> <td><math>\frac{234}{540} \times 360 = 156</math></td> </tr> </table> </li> <li>•<sup>3</sup> diagram consistent with working</li> </ul>	210 hours research	$\frac{210}{540} \times 360 = 140$	96 hours meetings	$\frac{96}{540} \times 360 = 64$	234 hours writing	$\frac{234}{540} \times 360 = 156$	3
210 hours research	$\frac{210}{540} \times 360 = 140$									
96 hours meetings	$\frac{96}{540} \times 360 = 64$									
234 hours writing	$\frac{234}{540} \times 360 = 156$									

**Notes:**

- <sup>1</sup> and •<sup>2</sup> can be implied in subsequent working
- <sup>3</sup> is available if any 2 angles are within tolerance  $\pm 1^\circ$  leading to third angle being outwith tolerance
- <sup>3</sup> is not available if the three calculated angles do not add to  $360^\circ$

**Commonly Observed Responses:**

	(b)	<ul style="list-style-type: none"> <li>•<sup>4</sup> Communication: any 5 in correct sequence</li> <li>•<sup>5</sup> Communication: remaining 4 in correct sequence</li> </ul>	<pre> graph LR   C[C] --- B[B]   B --- D[D]   B --- I[I]   B --- H[H]   D --- F[F]   F --- G[G]   I --- J[J]   H --- A[A]   G --- E[E]   J --- E[E]   A --- E[E] </pre>	2
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**Notes:**

**Commonly Observed Responses:**

Question		Generic scheme	Illustrative scheme	Max mark
9.	(c)	<ul style="list-style-type: none"> <li>•<sup>6</sup> Strategy: know to and starts to calculate the correct two ways of packing</li> <li>•<sup>7</sup> Process: calculate number of boxes for one arrangement</li> <li>•<sup>8</sup> Process/communication: calculate the second arrangement and state maximum number of books</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>6</sup> evidence of the two correct ways of packing with the front cover facing upwards               <math display="block">100 \div 12 \cdot 5 = 8</math> </li> <li>•<sup>7,8</sup> <math>50 \div 19 \cdot 5 = 2 \cdot 56 \dots</math> <math display="block">20 \div 2 = 10</math> <math display="block">2 \times 8 \times 10 = 160</math>               and               <math display="block">100 \div 19 \cdot 5 = 5 \cdot 12 \dots</math> <math display="block">50 \div 12 \cdot 5 = 4</math> <math display="block">20 \div 2 = 10</math> <math display="block">5 \times 4 \times 10 = 200</math> </li> </ul> <p>Maximum - 200 books</p>	3
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. Where a candidate only considers volume <span style="float: right;">award 0/3</span></li> <li>2. Where a candidate considers more than two arrangements do not award •<sup>6</sup></li> <li>3. Where a candidate only considers one arrangement •<sup>7</sup> is still available</li> <li>4. Where a candidate attempts more than two arrangements •<sup>8</sup> is only available where <b>all considered</b> arrangements have been calculated</li> <li>5. Where •<sup>7</sup> is lost for an incorrect process, •<sup>8</sup> can be awarded for repeated incorrect process where there are no arithmetic errors in either calculation</li> </ol>				
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li>1. <math>100000 \div 487 \cdot 5 = 205 \cdot 12 \dots</math> <span style="float: right;">award 0/3 <del>xxx</del></span></li> </ol>				
	(d)	<ul style="list-style-type: none"> <li>•<sup>9</sup> Process: calculate cost of shop A</li> <li>•<sup>10</sup> Process: calculate cost of shop C</li> <li>•<sup>11</sup> Communication: conclusion consistent with working</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>9</sup> 24</li> <li>•<sup>10</sup> 22</li> <li>•<sup>11</sup> Shop C</li> </ul>	3
		<p><b>Alternative Strategy</b></p> <ul style="list-style-type: none"> <li>•<sup>9</sup> Process: calculate discount for 1 shop</li> <li>•<sup>10</sup> Process: calculate discount for other two shops</li> <li>•<sup>11</sup> Communication: conclusion consistent with working</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>9</sup> 6 or 7.01 or 8</li> <li>•<sup>10</sup> remaining two</li> <li>•<sup>11</sup> Shop C</li> </ul>	
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. •<sup>11</sup> can only be awarded for comparing 3 costs or 3 discounts</li> </ol>				
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li>1. Shop A £6, Shop B £22.99, Shop C £22 leading to conclusion Shop A <span style="float: right;">award 1/3 ✓xx</span></li> </ol>				

Question		Generic scheme	Illustrative scheme	Max mark												
10.	(a)	<ul style="list-style-type: none"> <li>•<sup>1</sup> Process: calculate area of larger circle</li> <li>•<sup>2</sup> Process: calculate area of smaller circle</li> <li>•<sup>3</sup> Process: subtract areas of circles</li> <li>•<sup>4</sup> Process: calculate the area of the two rectangles</li> <li>•<sup>5</sup> Process: calculate overall area</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\pi \times 45 \cdot 35^2 = 6461 \cdot 07 \dots</math></li> <li>•<sup>2</sup> <math>\pi \times 36 \cdot 8^2 = 4254 \cdot 47 \dots</math></li> <li>•<sup>3</sup> <math>2206 \cdot 599 \dots</math></li> <li>•<sup>4</sup> <math>8 \cdot 55 \times 84 \cdot 4 \times 2 = 1443 \cdot 24</math></li> <li>•<sup>5</sup> <math>2206 \cdot 599 \dots + 1443 \cdot 24 = 3649 \cdot 839 \dots</math></li> </ul>	5												
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. •<sup>1,2</sup> are available for candidates who calculate the area of a semi-circle</li> <li>2. For candidates who use <math>\pi d</math> •<sup>2</sup> is still available, •<sup>5</sup> is only available if it is clear that candidate used <math>A = \pi d</math></li> <li>3. •<sup>5</sup> is not available for candidates who double the area of a whole circle</li> <li>4. •<sup>5</sup> is not available for candidates who add a semi-circle to a rectangle</li> </ol>																
<b>Commonly Observed Responses:</b> <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 70%;">1. <math>\pi \times 90 \cdot 7^2 - \pi \times 36 \cdot 8^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 23033 \cdot 05 \dots</math></td> <td style="width: 30%;">award 4/5 *✓✓✓✓</td> </tr> <tr> <td>2. <math>\pi \times 45 \cdot 35^2 - \pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 8418 \cdot 43 \dots</math></td> <td>award 4/5 ✓✓✓*✓</td> </tr> <tr> <td>3. <math>\pi \times 90 \cdot 7^2 - \pi \times 73 \cdot 6^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 10269 \cdot 63 \dots</math></td> <td>award 4/5 *✓✓✓✓</td> </tr> <tr> <td>4. <math>\pi \times 73 \cdot 6^2 - \pi \times 45 \cdot 35^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 12000 \cdot 05 \dots</math></td> <td>award 3/5 ✓**✓✓</td> </tr> <tr> <td>5. <math>\pi \times 8 \cdot 55^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 1672 \cdot 89 \dots</math></td> <td>award 3/5 **✓✓✓</td> </tr> <tr> <td>6. <math>\pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 10466 \cdot 3 \dots</math></td> <td>award 2/5 *✓**✓</td> </tr> </tbody> </table>					1. $\pi \times 90 \cdot 7^2 - \pi \times 36 \cdot 8^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 23033 \cdot 05 \dots$	award 4/5 *✓✓✓✓	2. $\pi \times 45 \cdot 35^2 - \pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 8418 \cdot 43 \dots$	award 4/5 ✓✓✓*✓	3. $\pi \times 90 \cdot 7^2 - \pi \times 73 \cdot 6^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 10269 \cdot 63 \dots$	award 4/5 *✓✓✓✓	4. $\pi \times 73 \cdot 6^2 - \pi \times 45 \cdot 35^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 12000 \cdot 05 \dots$	award 3/5 ✓**✓✓	5. $\pi \times 8 \cdot 55^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 1672 \cdot 89 \dots$	award 3/5 **✓✓✓	6. $\pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 10466 \cdot 3 \dots$	award 2/5 *✓**✓
1. $\pi \times 90 \cdot 7^2 - \pi \times 36 \cdot 8^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 23033 \cdot 05 \dots$	award 4/5 *✓✓✓✓															
2. $\pi \times 45 \cdot 35^2 - \pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 8418 \cdot 43 \dots$	award 4/5 ✓✓✓*✓															
3. $\pi \times 90 \cdot 7^2 - \pi \times 73 \cdot 6^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 10269 \cdot 63 \dots$	award 4/5 *✓✓✓✓															
4. $\pi \times 73 \cdot 6^2 - \pi \times 45 \cdot 35^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 12000 \cdot 05 \dots$	award 3/5 ✓**✓✓															
5. $\pi \times 8 \cdot 55^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 1672 \cdot 89 \dots$	award 3/5 **✓✓✓															
6. $\pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 10466 \cdot 3 \dots$	award 2/5 *✓**✓															

Question		Generic scheme	Illustrative scheme	Max mark
	(b)	<ul style="list-style-type: none"> <li>•<sup>6</sup> Strategy: know to use inverse proportion</li> <li>•<sup>7</sup> Process: calculate time for 1 worker</li> <li>•<sup>8</sup> Process: calculate time for 7 workers</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>6</sup> evidence</li> <li>•<sup>7</sup> <math>42 \times 5 = 210</math></li> <li>•<sup>8</sup> <math>210 \div 7 = 30</math></li> </ul>	<b>3</b>
<b>Notes:</b>				
1. Correct answer with no working			award 3/3	
2. • <sup>8</sup> is available for dividing 42 or 210 by 7				
3. For an answer of eg “it takes 12 hours less” award • <sup>8</sup>				
4. If a candidate subtracts 5 to find the number of days, • <sup>8</sup> is not available				
<b>Commonly Observed Responses:</b>				
1. $5 \times 42 \div 2 = 105$			award 2/3 ✓✓x	
2. $5 \div 42 \times 7 = 0.83\dots$			award 2/3 x✓✓	
3. $7 \div (42 \div 5) = 0.83\dots$			award 2/3 x✓✓	
4. $5 \div 42 \times 2 = 0.238\dots$			award 1/3 x✓x	
5. $42 \div 5 \times 7 = 58.8$			award 1/3 xx✓	
6. $42 \div 5 \times 2 = 16.8$			award 0/3 xxx	

Question		Generic scheme	Illustrative scheme	Max mark
(c)	(i)	<ul style="list-style-type: none"> <li>•<sup>9</sup> Strategy/process: know to deal with 0% rate</li> <li>•<sup>10</sup> Process: calculate national insurance</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>9</sup> <math>17108 - 8424 = 8684</math></li> <li>•<sup>10</sup> <math>12\% \text{ of } 8684 = 1042.08</math></li> </ul>	2
<b>Notes:</b>				
<b>Commonly Observed Responses:</b>				
1. $12\% \text{ of } 8684 = 1042.08$ leading to $16065.92$			award 2/2 ✓✓	
2. $12\% \text{ of } 17108 = 2052.96$			award 1/2 ✗✓	
3. $12\% \text{ of } 17108 = 2052.96$ leading to $15055.04$			award 1/2 ✗✓	
	(ii)	<ul style="list-style-type: none"> <li>•<sup>11</sup> Process: calculate pension contribution</li> <li>•<sup>12</sup> Process: calculate annual net pay</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>11</sup> <math>1197.56</math></li> <li>•<sup>12</sup> <math>17108 - 1042.08 - 1197.56 - 1051.60 = 13816.76</math></li> </ul>	2
<b>Notes:</b>				
1. • <sup>12</sup> is only available when the candidate subtracts three valid amounts from 17108				
<b>Commonly Observed Responses:</b>				
1. $17108 - (1197.56 + 1051.60 + 2052.96) = 12805.88$ (using 2052.96 from (c)(i))			award 2/2 ✓✓	
2. $17108 - (1051.60 + 1197.56) = 14858.84$			award 1/2 ✓✗	
3. $17108 - (1042.08 + 1197.56) = 14868.36$			award 1/2 ✓✗	
4. $(17108 - 1042.08) \times 0.93 - 1051.60 = 13889.71$			award 1/2 ✗✓	
5. $17108 - (1042.08 + 1051.60) = 15014.32$			award 0/2 ✗✗	

[END OF MARKING INSTRUCTIONS]