National
Qualifications
2019

2019 Applications of Mathematics

National 5 - Paper 1

Finalised Marking Instructions

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.

(a) 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.

(b) 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.

(c) One mark is available for each •. There are no half marks.

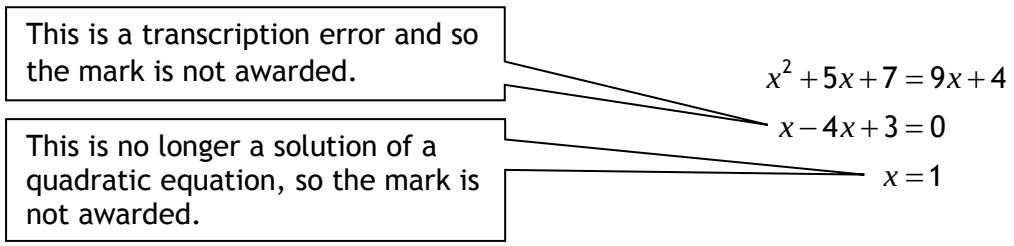
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(e) 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.

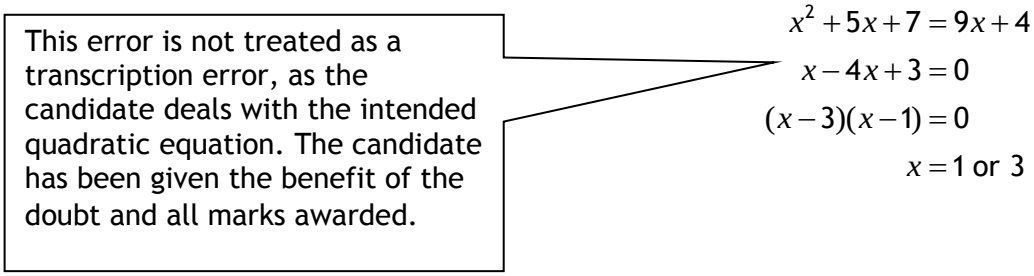
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example 6 x 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



The following example is an exception to the above



(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:

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

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

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

$\frac{15}{0{\cdot}3}$ must be simplified to 50 $\frac{\frac{4}{5}}{3}$ must be simplified to $\frac{4}{15}$

$\sqrt{64}$ 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

  $(x^3 + 2x^2 + 3x + 2)(2x + 1)$ 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.			•[1] Process: calculate limits •[2] Process: identify rejected candles (or accepted candles) •[3] Process/communication: calculate percentage rejected [1,4]	•[1] 22·3 and 22·7 •[2] 22·2, 22·9, 21·6, 22·8 (or 22·6, 22·5, 22·3, 22·6, 22·4, 22·7) •[3] 40%	**3**
Notes: 1. Correct answer with no working — award 3/3 2. Incorrect answer with no working, however see COR 1 — award 0/3 3. •[1] can be implied by subsequent working 4. Where answer is incorrect, •[3] can be awarded if there is evidence of where the percentage has come from 5. Where answer is incorrect, •[2] can only be awarded if there is evidence of the limits used, however see COR 1					
Commonly Observed Responses: 1. 60% with no working — award 2/3 ✓✓× 2. 20·5 and 24·5 leading to 0% or 100% — award 1/3 × ✓×					
2.	(a)		•[1] Process: calculate basic pay •[2] Strategy: know how to calculate overtime pay •[3] Process: calculate total gross pay	•[1] 30 × 12·50 = 375 •[2] 1·5 × 12·50 × 7 •[3] 375 + 131·25 = 506·25	**3**
Notes: 1. •[3] is only available for candidates who have multiplied by 1·5 or 0·5 or 2·5 or equivalent in •[2] 2. For candidates who calculate double time •[2] and •[3] are not available					
Commonly Observed Responses: 1. 37 × 12·50 + 7 × 6·25 = 506·25 — award 3/3 ✓✓✓ 2. 375 + 7 × 6·25 = 418·75 — award 2/3 ✓×✓ 3. 30 × 12·50 + 0·5 × 375 = 562·50 — award 2/3 ✓×✓ 4. 30 × 12·50 + 7 × 12·50 = 462·50 — award 1/3 ✓×× 5. 30 × 12·50 + 7 × 2 × 12·50 = 550 — award 1/3 ✓××					

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•4 Process: calculate the deposit •5 Process: calculate amount still payable •6 Process: calculate how much each monthly payment is	•4 $\frac{1}{5} \times 825 = 165$ •5 $845{\cdot}80 - (165 + 100) = 580{\cdot}80$ •6 $580{\cdot}80 \div 8 = 72{\cdot}60$	**3**
Notes: 1. Correct answer with no working award 0/3					
Commonly Observed Responses: 1. (825 – (165 +100)) ÷ 8 = 70 award 2/3 ✓×✓ 2. (825 – 165) ÷ 8 = 82·50 award 2/3 ✓×✓ 3. (845·80 – 165) ÷ 8 = 85·10 award 2/3 ✓×✓ 4. (845·80 + 100 – 165)÷ 8 = 97·60 award 2/3 ✓×✓ 5. 845·80 ÷ 5 leading to (845·80 – (169·16 + 100))÷ 8 = 72·08 award 2/3 ×✓✓ 6. 845·80 ÷ 5 leading to (845·80 - 169·16) ÷ 8 = 84·58 award 1/3 ××✓ 7. 845·80 ÷ 8 leading to 8 payments of 105·72 or 105·73 award 1/3 ××✓ 8. 825 ÷ 8 leading to 8 payments of 103·12 or 103·13 award 0/3 ×××					
3.	(a)		•1 Process: calculate the number of employees	•1 6	1
Notes:					
Commonly Observed Responses:					
	(b)		•2 Strategy/process: evidence of 240° or 48 employees •3 Communication: state probability	•2 evidence •3 $\frac{240}{360}$ or $\frac{48}{72}$ or $\frac{2}{3}$ or equivalent	2
Notes: 1. Correct answer with no working award 2/2 2. The final answer does not need to be in its simplest form 3. •2 can be implied in subsequent working 4. With the exception of the answers listed in COR 1, if answer is incorrect, •3 can only be awarded if there is evidence of where the numerator has come from 5. For answers given in ratio form •3 cannot be awarded 6. •3 incorrect simplification can be ignored					
Commonly Observed Responses: 1. $\frac{6}{72}$ or $\frac{12}{72}$ or $\frac{18}{72}$ or $\frac{36}{72}$ or their equivalents award 1/2 ×✓					

Question			Generic scheme	Illustrative scheme	Max mark
4.			•[1] Strategy/communication: one temperature marked correctly on scale •[2] Communication: other temperature marked on scale and consistent conclusion	•[1] evidence •[2] eg Gillian is correct with justification	**2**
			Alternative Strategy •[1] Strategy/communication: substitute into formula •[2] Communication: temperature conversion and consistent conclusion	•[1] $F=\frac{9}{5}\times(-3)+32$ or equivalent •[2] 26·6°F or -4·4°C with consistent conclusion	
Notes:					
Commonly Observed Responses: For candidates who convert using the thermometer shown (need not be marked on the thermometer) 1. -3°C is equivalent to approximately 26°F and correct conclusion award 2/2 ✓✓ 2. 24°F is equivalent to approximately -4·5°C and correct conclusion award 2/2 ✓✓					
5.			•[1] Strategy: know how to find monthly payment •[2] Process: calculate interest and fee •[3] Process: calculate monthly payment	•[1] evidence of finding a percentage, adding to 4500 and dividing by 9 •[2] 7·5% of 4500 = 337·50 •[3] (4500 + 337·50) ÷ 9 = 537·50	**3**
			Alternative Strategy •[1] Strategy: know how to find monthly payment •[2] Process: calculate amount owed •[3] Process: calculate monthly payment	•[1] evidence of multiplying by 1·075 and dividing by 9 •[2] 4837·50 •[3] 4837·50 ÷ 9 = 537·50	
Notes: 1. •[3] must be rounded or truncated to two decimal places unless the answer is a whole number of pounds 2. In original strategy, •[3] is only available for calculations of the form $(4500\pm f)\div 9$ or $(4500\pm f)\times 9$ where f is the answer to •[2]					
Commonly Observed Responses: 1. (4500 - 337·50) ÷ 9 = 462·50 award 2/3 ×✓✓					

Question			Generic scheme	Illustrative scheme	Max mark
6.			$\bullet^1$ Strategy/process: put decimals and percentage in correct order $\bullet^2$ Process/communication: convert $\frac{3}{8}$ correctly and put it in correct position	$\bullet^1$ 0·39, 0·388, 38·38% $\bullet^2$ $\frac{3}{8}$ = 0·375 or 37·5% $0\cdot39,\ 0\cdot388,\ 38\cdot38\%,\ \frac{3}{8}$	**2**

Notes:

1. Correct answer with no working — award 1/2
2. If $\bullet^1$ is not awarded, $\bullet^2$ is available if numbers are listed from smallest to largest with $\frac{3}{8}$ being converted correctly

Commonly Observed Responses:

1. 0·39, 0·388, $\frac{3}{8}$, 38·38% — award 1/2 ✓×

Question			Generic scheme	Illustrative scheme	Max mark
7.	(a)		$\bullet^1$ Strategy/process: put numbers into order and state the median $\bullet^2$ Process: find the lower quartile and upper quartile	$\bullet^1$ Median $= 26$ $\bullet^2$ $Q_1 = 20$, $Q_3 = 35$	**2**
Notes: 1. If the numbers are unordered $\bullet^2$ is still available 2. If one number is missed from an ordered list $\bullet^2$ is available 3. If more than one number is missed from an ordered list $\bullet^2$ is not available 4. If the answers for part (a) appear in part (b) $\bullet^1$ and $\bullet^2$ can be awarded					
Commonly Observed Responses:					
	(b)		$\bullet^3$ Strategy: correct end points $\bullet^4$ Strategy: correct box	$\bullet^3$ End points at 14 and 49 $\bullet^4$ Box showing Q_1, Q_2 and Q_3	**2**
Notes: 1. If the answers for part (a) appear in part (b) $\bullet^1$ and $\bullet^2$ can be awarded					
Commonly Observed Responses:					
	(c)		$\bullet^5$ Process: calculate interquartile range	$\bullet^5$ $35 - 20 = 15$	**1**
Notes:					
Commonly Observed Responses:					
	(d)		$\bullet^6$ Communication: valid comment	$\bullet^6$ eg In 2016, the number of passengers who failed to turn up was more varied.	**1**
Notes:					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		•[1] Process/communication: correct length drawn •[2] Process/communication: correct angles measured	•[1] 8($\pm$0·1cm) •[2] $12°(\pm1°)$; $90°(\pm1°)$	**2**
Notes:					
Commonly Observed Responses:					
	(b)		•[3] Strategy/communication: measure vertical height •[4] Process/communication: calculate gradient and simplify where appropriate	•[3] height consistent with scale drawing •[4] eg 0·2125 or $\frac{17}{80}$	**2**
Notes: 1. For •[4] do not accept fractions with decimals as either the numerator or denominator 2. If the gradient is given as a decimal it should be rounded or truncated to at least 2 decimal places unless it is a whole number or 1 decimal place exactly 3. For •[3], if the scale drawing is outwith tolerance, 8 can still be accepted as the denominator 4. •[3] can be implied by subsequent working					
Commonly Observed Responses:					
9.	(a)		•[1] Process: calculate time taken	•[1] 12 hours and 45 minutes	**1**
Notes:					
Commonly Observed Responses:					
	(b)		•[2] Process: calculate time difference •[3] Process/communication: conclusion consistent with working	•[2] 5 hours •[3] 23:15 − 5 hours = 18:15 Yes the call will be made at 18:15 in Miami	**2**
Notes: 1. •[2] can be implied in subsequent working 2. Do not penalise 18:15pm or similar					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
10.			•1 Process: evidence of common denominator •2 Process: consistent numerators and add fractions •3 Process: calculate fraction of flour needed	•1 $\frac{}{12}+\frac{}{12}+\frac{}{12}$ or equivalent •2 $\frac{2}{12}+\frac{4}{12}+\frac{3}{12}=\frac{9}{12}$ •3 $\frac{3}{12}$	**3**
			Alternative Strategy 1 •1 Process: add together two fractions •2 Process: add remaining fraction •3 Process: calculate fraction of flour needed	 •1 eg $\frac{1}{4}+\frac{1}{3}=\frac{7}{12}$ or equivalent •2 eg $\frac{7}{12}+\frac{1}{6}=\frac{9}{12}$ •3 $\frac{3}{12}$	
			Alternative Strategy 2 •1 Process: convert all fractions to a percentages •2 Process: add percentages •3 Process: calculate percentage of flour needed	 •1 16·6…, 33·3…, 25 •2 74·9… •3 25% or 25·1%	

Notes:

1. Correct answer with no working — award 0/3
2. •2 only available for an answer of $\frac{9}{12}$, 74·9… or equivalent
3. The final answer does not need to be in its simplest form
4. Candidates working in percentages must work to at least 1 decimal place for •2 to be awarded
5. Candidates working in decimals must work to at least 3 decimal places for •2 to be awarded
6. For •3 do not accept fractions with decimals as either the numerator or denominator

Commonly Observed Responses:

1. 0·25 or 0·251 — award 3/3 ✓✓✓
2. $\frac{1}{6}+\frac{1}{3}+\frac{1}{4}=\frac{3}{13}$ leading to an answer of $\frac{10}{13}$ — award 1/3 ×××

Question	Generic scheme	Illustrative scheme	Max mark
11.	$\bullet^1$ Strategy/process: find one share	$\bullet^1$ $1950 \div 6 = 325$	**3**
	$\bullet^2$ Process: add up ages	$\bullet^2$ $4 + 11 + 9 + 6 = 30$	
	$\bullet^3$ Process: find total amount	$\bullet^3$ $325 \times 30 = 9750$	
	Alternative Strategy 1		
	$\bullet^1$ Strategy/process: find one share	$\bullet^1$ $1950 \div 6 = 325$	
	$\bullet^2$ Process: calculate the amount for any niece other than Kate	$\bullet^2$ Jane 1300 or Heather 3575 or Laura 2925	
	$\bullet^3$ Process: calculate the amount for other two nieces and total amount	$\bullet^3$ 1300 + 3575 + 2925 + 1950 = 9750	

Notes:

1. In original strategy, $\bullet^1$ is not available if the candidate has also calculated $1950 \div 4$ and/or $1950 \div 11$ and/or $1950 \div 9$
2. In original strategy, $\bullet^3$ is only available where the candidate has multiplied their value of one share by 30
3. In alternative strategy, $\bullet^2$ is only available where the candidate has used their value of one share
4. $\bullet^3$ is only available for a final answer greater than 1950

Commonly Observed Responses:

1. $1950 \div 30 \times 6 = 390$ leading to 1950 — award 1/3 ×✓×
2. $1950 \div 30 \times 4 = 260$ leading to 1950 — award 1/3 ×✓×
3. $1950 \div 30 \times 11 = 715$ leading to 1950 — award 1/3 ×✓×
4. $1950 \div 30 \times 9 = 585$ leading to 1950 — award 1/3 ×✓×

Question	Generic Scheme	Illustrative Scheme	Max mark
12.	$\bullet^1$ Strategy/communication: know to create fractions and state fractions $\bullet^2$ Strategy/process: knows how to compare fractions $\bullet^3$ Strategy/communication: state conclusion consistent with working	$\bullet^1$ $\frac{15}{42}$ and $\frac{21}{49}$ $\bullet^2$ eg $\frac{5}{14}$ and $\frac{6}{14}$ $\bullet^3$ Gemma (since $\frac{6}{14} > \frac{5}{14}$)	**3**

Notes:

1. $\bullet^2$ can only be awarded for two fractions with the same denominator, or the same numerator, or for two decimal fractions with the exception of COR 2
2. $\bullet^3$ can only be awarded where two fractions with the same denominator, or the same numerator, or for two decimal fractions have been compared with the exception of COR 2

Commonly Observed Responses:

1. $\frac{42}{15}$ and $\frac{49}{21}$ leading to an answer of Gemma since $2 \cdot 33 < 2 \cdot 8$ award 3/3 ✓✓✓
2. Fractions simplified to $\frac{5}{14}$ and $\frac{3}{7}$ leading to Gemma used a greater proportion award 3/3 ✓✓✓
3. Fractions simplified to $\frac{5}{14}$ and $\frac{3}{7}$ leading to Kieran used a greater proportion award 1/3 ✓××

Question	Generic Scheme	Illustrative Scheme	Max mark
13.	$\bullet^1$ Process: calculates time taken to travel 220 miles at 50 mph $\bullet^2$ Process: changes decimal hours into minutes $\bullet^3$ Strategy/process: evidence of adding on 30 minutes correctly $\bullet^4$ Process: calculate latest time of departure.	$\bullet^1$ $220 \div 50 = 4{\cdot}4$ hrs $\bullet^2$ $0{\cdot}4$ hrs $= 24$ min $\bullet^3$ 4 hrs 24 min + 30 min = 4 hrs 54 min $\bullet^4$ 06:51	**4**

Notes:

1. For $\bullet^4$ accept 6:51, 6:51am
2. $\bullet^4$ is not available for candidates who subtract a whole number of hours

Commonly Observed Responses:

1. 11:45 + 4 hours 54 minutes leading to 16:39 award 3/4 ✓✓✓×
2. 4·2 hours leading to 07:03 award 3/4 ×✓✓✓
3. 4·4 hours leading to 4 hours 40 minutes leading to 06:35 award 3/4 ✓×✓✓
4. 4·2 hours leading to 4 hours 20 minutes leading to 06:55 award 2/4 ××✓✓

[END OF MARKING INSTRUCTIONS]

Question	Generic scheme	Illustrative scheme	Max mark
4.	$\bullet^1$ Strategy: identify the price of gold	$\bullet^1$ 1210 and 1140	**3**
	$\bullet^2$ Strategy: know how to calculate the percentage loss	$\bullet^2 (1210-1140)\div 1210\times 100$	
	$\bullet^3$ Process/Communication: calculate percentage loss and round to 2 decimal places	$\bullet^3$ 5·79	

Notes:

1. Where $\bullet^2$ is not awarded, $\bullet^3$ 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 $\bullet^1$ or 100.
2. For $\bullet^3$ multiplication by 100 can be implied by the answer

Commonly Observed Responses:

1. $(1210-1140)\div 1210=0\cdot 06$ award 1/3 ✓××
2. $1210\div 1140=1\cdot 06$ award 1/3 ✓××

5.	$\bullet^1$ Strategy: know how to find arc length of quarter or semi-circle	$\bullet^1$ $\frac{20\pi}{4}$ or $\frac{20\pi}{2}$	**5**
	$\bullet^2$ Process: calculate curved edge of one quarter circle or semi-circle	$\bullet^2$ $15\cdot 7\ldots$ or $31\cdot 4\ldots$	
	$\bullet^3$ Process: calculate perimeter of swimming pool	$\bullet^3$ $2\times 15\cdot 7\ldots+2\times 10+2\times 36\cdot 5=124\cdot 4\ldots$	
	$\bullet^4$ Strategy: know how to calculate number of lengths	$\bullet^4 (\ldots-2\times 1\cdot 25)\div 3$	
	$\bullet^5$ Process: calculate number of lengths, appropriate rounding and calculate cost	$\bullet^5$ 40·6 leading to $41\times 11\cdot 49=471\cdot 09$	

Notes:

1. $\bullet^2$ is available for candidates who carry out a correct quarter circle or semi-circle calculation to find arc length or sector area
2. $\bullet^3$ is not available to candidates who use area in an attempt to find perimeter including the use of $A=\pi d$
3. $\bullet^5$ is only available for 11·49 multiplied by the appropriately rounded answer to $\bullet^4$
4. $\bullet^5$ is not available if the length of railing required is a multiple of 3
5. $\bullet^5$ is not available if there is no evidence of where the number of lengths come from
6. Accept legitimate variations of π

Commonly Observed Responses:

1. $\pi\times 10\div 4=7\cdot 85\ldots$ leading to 413·64 award 4/5 ✓×✓✓✓
2. $(2\times 15\cdot 7\ldots+2\times 36\cdot 5)=104\cdot 4\ldots$ leading to 390·66 award 4/5 ✓✓×✓✓
3. $124\cdot 4\ldots\div 3(=41\cdot 46\ldots)$ leading to 482·58 award 4/5 ✓✓✓×✓
4. $(124\cdot 4\ldots+2\times 1\cdot 25)\div 3(=42\cdot 3\ldots)$ leading to 494·07 award 4/5 ✓✓✓×✓

Question			Generic scheme	Illustrative scheme	Max mark
6.			•[1] Process: calculate total selling price •[2] Process: calculate 2·7% of total selling price •[3] Process: calculate profit	•[1] 375 × 5·20 = 1950 •[2] 1950 × 0·027 = 52·65 •[3] 1950 − (1687·50 + 52·65) = 209·85	**3**
			Alternative Strategy •[1] Process: calculate 97·3% of one share •[2] Process: calculate profit of one share •[3] Process: calculate profit	•[1] 5·20 × 0·973 = 5·0596 •[2] 5·0596 - 4·50 = 0·5596 •[3] 375 × 0·5596 = 209·85	

Notes:

1. Correct answer with no working — award 0/3
2. In original strategy, where •[2] is not awarded, •[3] is only available if a percentage of their total selling price or the total buying price is calculated
3. In alternative strategy, where •[1] is not awarded, •[3] is only available if a percentage of the selling price or buying price is calculated
4. For candidates who use alternative strategy accept a final answer of 210

Commonly Observed Responses:

1. 1950 × 1·027 leading to an answer of 315·15 — award 2/3 ✓✗✓
2. (1950 - 1687·50) × 0·973 = 255·41 — award 2/3 ✓✓✗
3. 1950 - 1687·50 = 262·50 — award 1/3 ✓✗✗

Question			Generic Scheme	Illustrative Scheme	Max mark
7.	(a)	(i)	•[1] Process: calculate mean	•[1] $(2{\cdot}5 + 4{\cdot}5 + 3{\cdot}7 + 3{\cdot}1 + 3{\cdot}8 + 3{\cdot}4) \div 6 = 3{\cdot}5$	**1**
Notes:					
Commonly Observed Responses:					
		(ii)	•[2] Process: calculate $(x - \bar{x})^2$ •[3] Strategy/process: substitute into formula •[4] Process: calculate standard deviation	•[2] 1,1,0·04,0·16,0·09,0·01 •[3] $\sqrt{\frac{2 \cdot 3}{6-1}}$ •[4] $0{\cdot}678\ldots$	**3**
			Alternative strategy •[2] Process: calculate $\sum x$ and $\sum x^2$ •[3] Strategy/process: substitute into formula •[4] Process: calculate standard deviation	•[2] 21 and 75·8 •[3] $\sqrt{\frac{75 \cdot 8 - \frac{21^2}{6}}{6-1}}$ •[4] $0{\cdot}678\ldots$	
Notes: 1. Correct answer with no working award 0/3 2. Accept rounding or truncation to at least one decimal place for final answer 3. •[4] can only be awarded for a calculation involving at least two-step including a division and a square root has taken place					
Commonly Observed Responses:					
	(b)		•[5] Communication: comment regarding mean •[6] Communication: comment regarding standard deviation	•[5] eg on average weights in 2017 are higher •[6] eg the weights in 2017 are more consistent	**2**
Notes:					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
7.	(c)	(i)	•[7] Communication: 4 points correct •[8] Communication: all 8 points correct	•[7] evidence •[8] evidence	**2**

Notes:

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

Commonly Observed Responses:

		(ii)	•[9] Strategy: consistent line of best fit	•[9] evidence	**1**

Notes:

Commonly Observed Responses:

		(iii)	•[10] Communication: answer consistent with line of best fit	•[10] evidence	**1**

Notes:

1. When the weight falls between 2 divisions accept either number or any value in between

Commonly Observed Responses:

	(d)		•[11] Strategy: identify correct row in table •[12] Process: calculate milk powder needed for 1 week or equivalent •[13] Communication: conclusion consistent with working	•[11] eg 8 (scoops) •[12] $4 \times 8 \times 7 \times 4 \cdot 5 = 1008$ OR $4 \cdot 5 \times 4 \times 8 = 144$ $900 \div 144 = 6 \cdot 25$ •[13] No, (as 1008g > 900g) OR No, (as 6·25 < 7 days)	**3**

Notes:

1. For •[13] the comparison has to be grams with grams, days with days or scoops with scoops

Commonly Observed Responses:

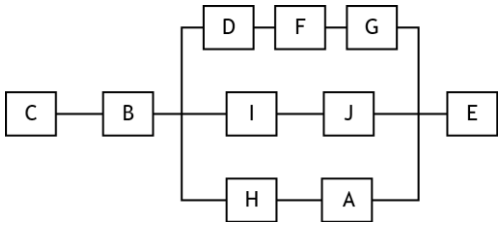
Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		•[1] Strategy/process: identify number of gaps •[2] Process: calculate length	•[1] 366 •[2] $366 \times 2 + 367 \times 4 = 2200$	**2**
Notes:					
Commonly Observed Responses: 1. $365\times2 + 367\times4 = 2198$ award 1/2 ×✓ 2. $367\times2 + 367\times4 = 2202$ award 1/2 ×✓ 3. $367 \times 4 \times 2 = 2936$ award 0/2 ×× 4. $367 \times 4 \div 2 = 734$ award 0/2 ××				
	(b)		•[3] Strategy/communication: correct substitution in Pythagoras' Theorem •[4] Process: calculate height or height^2 •[5] Strategy/communication: correct substitution in Pythagoras' Theorem •[6] Process/communication: calculate total length of cable	•[3] eg $300^2 - 295^2$ •[4] $h = 54{\cdot}5\ldots$ or $h^2 = 2975$ •[5] $600^2 + (54\cdot5\ldots)^2$ •[6] $300 + 602\cdot4\ldots = 902\cdot4\ldots$	**4**
Notes: 1. •[3] is not available if candidate writes $295^2 - 300^2$ 2. •[4] is available if candidate writes $295^2 - 300^2$ leading to 54·5 … 3. Do not penalise candidates who truncate or round to the nearest whole number throughout					
Commonly Observed Responses: 1. $\sqrt{(600+295)^2 - 300^2} + 300 = 1143\cdot2\ldots$ award 2/4 ××✓✓ 2. $295^2 + 300^2 = 177025$ award 1/4 ×✓××					

<table>
<tr><th colspan="3">Question</th><th>Generic scheme</th><th>Illustrative scheme</th><th>Max mark</th></tr>
<tr><td>9.</td><td>(a)</td><td></td><td>$\bullet^1$ Process: calculate total number of hours

$\bullet^2$ Process: calculate angles

$\bullet^3$ Communication: draw and label pie chart consistent with previous working</td><td>$\bullet^1$ $210 + 96 + 234 = 540$

$\bullet^2$
<table><tr><td>210 hours research</td><td>$\frac{210}{540} \times 360 = 140$</td></tr><tr><td>96 hours meetings</td><td>$\frac{96}{540} \times 360 = 64$</td></tr><tr><td>234 hours writing</td><td>$\frac{234}{540} \times 360 = 156$</td></tr></table>$\bullet^3$ diagram consistent with working</td><td>3</td></tr>
<tr><td colspan="6">Notes:
1. $\bullet^1$ and $\bullet^2$ can be implied in subsequent working
2. $\bullet^3$ is available if any 2 angles are within tolerance $\pm 1°$ leading to third angle being outwith tolerance
3. $\bullet^3$ is not available if the three calculated angles do not add to $360°$</td></tr>
<tr><td colspan="6">Commonly Observed Responses:</td></tr>
<tr><td></td><td>(b)</td><td></td><td>$\bullet^4$ Communication: any 5 in correct sequence

$\bullet^5$ Communication: remaining 4 in correct sequence</td><td> 
</td><td>2</td></tr>
<tr><td colspan="6">Notes:</td></tr>
<tr><td colspan="6">Commonly Observed Responses:</td></tr>
</table>

Question			Generic scheme	Illustrative scheme	Max mark
9.	(c)		•[6] Strategy: know to and starts to calculate the correct two ways of packing •[7] Process: calculate number of boxes for one arrangement •[8] Process/communication: calculate the second arrangement and state maximum number of books	•[6] evidence of the two **correct** ways of packing with the front cover facing upwards $100 \div 12 \cdot 5 = 8$ •[7,8] $50 \div 19 \cdot 5 = 2 \cdot 56...$ $20 \div 2 = 10$ $2 \times 8 \times 10 = 160$ and $100 \div 19 \cdot 5 = 5 \cdot 12...$ $50 \div 12 \cdot 5 = 4$ $20 \div 2 = 10$ $5 \times 4 \times 10 = 200$ Maximum - 200 books	**3**
Notes: 1. Where a candidate only considers volume award 0/3 2. Where a candidate considers more than two arrangements do not award •[6] 3. Where a candidate only considers one arrangement •[7] is still available 4. Where a candidate attempts more than two arrangements •[8] is only available where **all considered** arrangements have been calculated 5. Where •[7] is lost for an incorrect process, •[8] can be awarded for repeated incorrect process where there are no arithmetic errors in either calculation					
Commonly Observed Responses: 1. 100000 ÷ 487·5 = 205·12… award 0/3 ×××					
	(d)		•[9] Process: calculate cost of shop A •[10] Process: calculate cost of shop C •[11] Communication: conclusion consistent with working	•[9] 24 •[10] 22 •[11] Shop C	**3**
			Alternative Strategy •[9] Process: calculate discount for 1 shop •[10] Process: calculate discount for other two shops •[11] Communication: conclusion consistent with working	•[9] 6 or 7·01 or 8 •[10] remaining two •[11] Shop C	
Notes: 1. •[11] can only be awarded for comparing 3 costs or 3 discounts					
Commonly Observed Responses: 1. Shop A £6, Shop B £22·99, Shop C £22 leading to conclusion Shop A award 1/3 ✓××					

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		$\bullet^1$ Process: calculate area of larger circle	$\bullet^1$ $\pi \times 45 \cdot 35^2 = 6461 \cdot 07\ldots$	**5**
			$\bullet^2$ Process: calculate area of smaller circle	$\bullet^2$ $\pi \times 36 \cdot 8^2 = 4254 \cdot 47\ldots$	
			$\bullet^3$ Process: subtract areas of circles	$\bullet^3$ $2206 \cdot 599\ldots$	
			$\bullet^4$ Process: calculate the area of the two rectangles	$\bullet^4$ $8 \cdot 55 \times 84 \cdot 4 \times 2 = 1443 \cdot 24$	
			$\bullet^5$ Process: calculate overall area	$\bullet^5$ $2206 \cdot 599\ldots + 1443 \cdot 24 = 3649 \cdot 839\ldots$	

Notes:

1. $\bullet^{1,2}$ are available for candidates who calculate the area of a semi-circle
2. For candidates who use πd $\bullet^2$ is still available, $\bullet^5$ is only available if it is clear that candidate used $A = \pi d$
3. $\bullet^5$ is not available for candidates who double the area of a whole circle
4. $\bullet^5$ is not available for candidates who add a semi-circle to a rectangle

Commonly Observed Responses:

1. $\pi \times 90 \cdot 7^2 - \pi \times 36 \cdot 8^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 23033 \cdot 05\ldots$ award 4/5 ×✓✓✓✓
2. $\pi \times 45 \cdot 35^2 - \pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 8418 \cdot 43\ldots$ award 4/5 ✓✓✓×✓
3. $\pi \times 90 \cdot 7^2 - \pi \times 73 \cdot 6^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 10269 \cdot 63\ldots$ award 4/5 ×✓✓✓✓
4. $\pi \times 73 \cdot 6^2 - \pi \times 45 \cdot 35^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 12000 \cdot 05\ldots$ award 3/5 ✓××✓✓
5. $\pi \times 8 \cdot 55^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 1672 \cdot 89\ldots$ award 3/5 ××✓✓✓
6. $\pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 10466 \cdot 3\ldots$ award 2/5 ×✓××✓

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		$\bullet^6$ Strategy: know to use inverse proportion $\bullet^7$ Process: calculate time for 1 worker $\bullet^8$ Process: calculate time for 7 workers	$\bullet^6$ evidence $\bullet^7$ $42 \times 5 = 210$ $\bullet^8$ $210 \div 7 = 30$	**3**

Notes:

1. Correct answer with no working — award 3/3
2. $\bullet^8$ is available for dividing 42 or 210 by 7
3. For an answer of eg "it takes 12 hours less" award $\bullet^8$
4. If a candidate subtracts 5 to find the number of days, $\bullet^8$ is not available

Commonly Observed Responses:

1. $5\times42\div2=105$ — award 2/3 ✓✓×
2. $5\div42\times7=0\cdot83...$ — award 2/3 ×✓✓
3. $7\div(42\div5)=0\cdot83...$ — award 2/3 ×✓✓
4. $5\div42\times2=0\cdot238...$ — award 1/3 ×✓×
5. $42\div5\times7=58\cdot8$ — award 1/3 ××✓
6. $42\div5\times2=16\cdot8$ — award 0/3 ×××

Question			Generic scheme	Illustrative scheme	Max mark
	(c)	(i)	•[9] Strategy/process: know to deal with 0% rate •[10] Process: calculate national insurance	•[9] 17108 – 8424 = 8684 •[10] 12% of 8684 = 1042·08	**2**
Notes:					
Commonly Observed Responses: 1. 12% of 8684 = 1042·08 leading to 16065·92 award 2/2 ✓✓ 2. 12% of 17108 = 2052·96 award 1/2 ×✓ 3. 12% of 17108 = 2052·96 leading to 15055·04 award 1/2 ×✓					
		(ii)	•[11] Process: calculate pension contribution •[12] Process: calculate annual net pay	•[11] 1197·56 •[12] $17108-1042\cdot08-1197\cdot56-1051\cdot60=13816\cdot76$	**2**
Notes: 1. •[12] is only available when the candidate subtracts three valid amounts from 17108					
Commonly Observed Responses: 1. $17108-(1197\cdot56+1051\cdot60+2052\cdot96)=12805\cdot88$ award 2/2 ✓✓ (using 2052·96 from (c)(i)) 2. $17108-(1051\cdot60+1197\cdot56)=14858\cdot84$ award 1/2 ✓× 3. $17108-(1042\cdot08+1197\cdot56)=14868\cdot36$ award 1/2 ✓× 4. $(17108-1042\cdot08)\times0\cdot93-1051\cdot60=13889\cdot71$ award 1/2 ×✓ 5. $17108-(1042\cdot08+1051\cdot60)=15014\cdot32$ award 0/2 ××					

[END OF MARKING INSTRUCTIONS]

National
Qualifications
2019

2019 Applications of Mathematics

National 5 - Paper 2

Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

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.

(a) 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.

(b) 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.

(c) One mark is available for each •. There are no half marks.

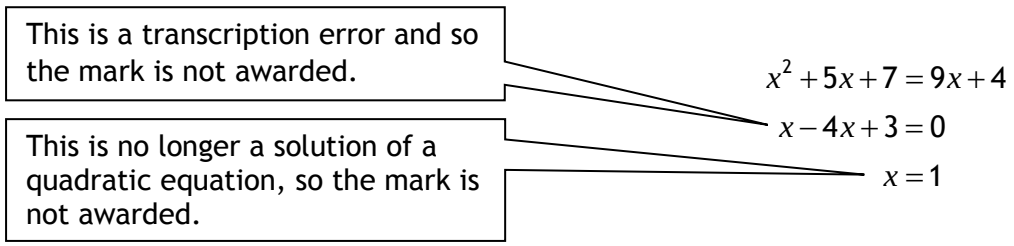
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(e) 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.

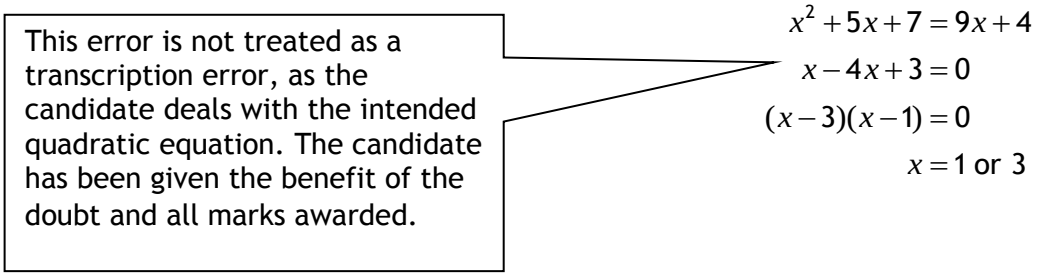
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example 6 x 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



The following example is an exception to the above



(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:

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

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

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

$\frac{15}{0{\cdot}3}$ must be simplified to 50 $\frac{\frac{4}{5}}{3}$ must be simplified to $\frac{4}{15}$

$\sqrt{64}$ 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

  $(x^3 + 2x^2 + 3x + 2)(2x + 1)$ 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.			•[1] Strategy: know how to calculate percentage increase •[2] Strategy: identify power •[3] Strategy: know how to calculate percentage decrease •[4] Process: calculate the value of the stamp after 3 years and round to 3 significant figures	•[1] Evidence of 1·07 or equivalent •[2] …[2] or equivalent •[3] Evidence of 0·96 or equivalent •[4] 1011·18 = 1010	**4**

Notes:

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. •[3] not available $0 \cdot 96^n$ where $n \neq 1$

Commonly Observed Responses:

1. For $\left(920 \times 0 \cdot 93^2\right) \times 0 \cdot 96$ leading to 764 — award 3/4 ×✓✓✓
2. For $\left(920 + 920 \times 0 \cdot 07 \times 2\right) \times 0 \cdot 96$ leading to 1010 — award 3/4 ✓×✓✓
3. For $\left(920 \times 1 \cdot 07^2\right) \times 1 \cdot 04$ leading to 1100 — award 3/4 ✓✓×✓
4. For $\left(920 \times 0 \cdot 93^2\right) \times 1 \cdot 04$ leading to 828 — award 2/4 ×✓×✓

Question			Generic Scheme	Illustrative Scheme	Max mark
2.			$\bullet^1$ Strategy: substitute correctly into cylinder formula $\bullet^2$ Process: calculate the volume of the cylinder $\bullet^3$ Process: calculate the volume of the cuboid $\bullet^4$ Process/communication: find the total volume of the bottle	$\bullet^1$ $\pi \times 1 \cdot 5^2 \times 4$ $\bullet^2$ $28 \cdot 27\ldots$ $\bullet^3$ $4 \cdot 5 \times 10 \times 8 = 360$ $\bullet^4$ $360 + 28 \cdot 27 = 388 \cdot 27 \text{cm}^3$	**4**

Notes:

1. Correct answer with no working — award 0/4
2. $\bullet^1$ can be implied by subsequent working
3. $\bullet^2$ is only available for a calculation involving π and a power
4. For $\bullet^4$ the correct units must be stated
5. $\bullet^4$ is only available for the addition of two calculated volumes
6. Accept legitimate variations of π
7. For the final answer accept any legitimate rounding or truncation to at least 2 significant figures
8. Accept answers given in millilitres or litres

Commonly Observed Responses:

1. $3 \cdot 14 \times 1 \cdot 5^2 \times 4 + 360 = 388 \cdot 26 \text{cm}^3$ — award 4/4 ✓✓✓✓
2. $\pi \times 3^2 \times 4 + 360 = 473 \cdot 10 \text{cm}^3$ — award 3/4 ×✓✓✓
3. $3 \cdot 14 \times 3^2 \times 4 + 360 = 473 \cdot 04 \text{cm}^3$ — award 3/4 ×✓✓✓

Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)		•[1] Communication: read rate of exchange from graph •[2] Process: calculate amount in pounds	•[1] 0·852 •[2] $0{\cdot}852 \times 250 = 213$	**2**

Notes:

1. If •[1] is incorrect •[2] is not available for candidates who truncate or round their answer to a whole number of pounds
2. •[2] is only available for candidates who multiply 250 by any value $0{\cdot}83 \le x \le 0{\cdot}86$

Commonly Observed Responses:

1. $0{\cdot}85 \times 250 = 212{\cdot}50$ award 1/2 ×✓
2. $0{\cdot}842 \times 250 = 210{\cdot}50$ award 1/2 ×✓
3. $0{\cdot}84 \times 250 = 210$ award 1/2 ×✓
4. $0{\cdot}837 \times 250 = 209{\cdot}25$ award 1/2 ×✓

	(b)		•[3] Strategy/process: calculate exchange rate •[4] Communication: state date consistent with working	•[3] $334{\cdot}80 \div 400 = 0{\cdot}837$ or $400 \times 0{\cdot}837 = 334{\cdot}80$ •[4] 9 December	**2**

Notes:

1. Correct answer with no working award 0/2
2. •[4] is only available where calculated exchange rate is a marked point on the graph
3. Where candidates choose to multiply, •[4] is only available if the answer to one of their calculations is 334·80 and date is consistent with the exchange rate

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
4.	$\bullet^1$ Strategy: identify the price of gold	$\bullet^1$ 1210 and 1140	**3**
	$\bullet^2$ Strategy: know how to calculate the percentage loss	$\bullet^2 (1210-1140)\div 1210\times 100$	
	$\bullet^3$ Process/Communication: calculate percentage loss and round to 2 decimal places	$\bullet^3$ 5·79	

Notes:

1. Where $\bullet^2$ is not awarded, $\bullet^3$ 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 $\bullet^1$ or 100.
2. For $\bullet^3$ multiplication by 100 can be implied by the answer

Commonly Observed Responses:

1. $(1210-1140)\div 1210=0\cdot 06$ award 1/3 ✓××
2. $1210\div 1140=1\cdot 06$ award 1/3 ✓××

5.	$\bullet^1$ Strategy: know how to find arc length of quarter or semi-circle	$\bullet^1$ $\frac{20\pi}{4}$ or $\frac{20\pi}{2}$	**5**
	$\bullet^2$ Process: calculate curved edge of one quarter circle or semi-circle	$\bullet^2$ $15\cdot 7\ldots$ or $31\cdot 4\ldots$	
	$\bullet^3$ Process: calculate perimeter of swimming pool	$\bullet^3$ $2\times 15\cdot 7\ldots+2\times 10+2\times 36\cdot 5=124\cdot 4\ldots$	
	$\bullet^4$ Strategy: know how to calculate number of lengths	$\bullet^4 (\ldots-2\times 1\cdot 25)\div 3$	
	$\bullet^5$ Process: calculate number of lengths, appropriate rounding and calculate cost	$\bullet^5$ 40·6 leading to $41\times 11\cdot 49=471\cdot 09$	

Notes:

1. $\bullet^2$ is available for candidates who carry out a correct quarter circle or semi-circle calculation to find arc length or sector area
2. $\bullet^3$ is not available to candidates who use area in an attempt to find perimeter including the use of $A=\pi d$
3. $\bullet^5$ is only available for 11·49 multiplied by the appropriately rounded answer to $\bullet^4$
4. $\bullet^5$ is not available if the length of railing required is a multiple of 3
5. $\bullet^5$ is not available if there is no evidence of where the number of lengths come from
6. Accept legitimate variations of π

Commonly Observed Responses:

1. $\pi\times 10\div 4=7\cdot 85\ldots$ leading to 413·64 award 4/5 ✓×✓✓✓
2. $(2\times 15\cdot 7\ldots+2\times 36\cdot 5)=104\cdot 4\ldots$ leading to 390·66 award 4/5 ✓✓×✓✓
3. $124\cdot 4\ldots\div 3(=41\cdot 46\ldots)$ leading to 482·58 award 4/5 ✓✓✓×✓
4. $(124\cdot 4\ldots+2\times 1\cdot 25)\div 3(=42\cdot 3\ldots)$ leading to 494·07 award 4/5 ✓✓✓×✓

Question			Generic scheme	Illustrative scheme	Max mark
6.			•[1] Process: calculate total selling price •[2] Process: calculate 2·7% of total selling price •[3] Process: calculate profit	•[1] 375 × 5·20 = 1950 •[2] 1950 × 0·027 = 52·65 •[3] 1950 − (1687·50 + 52·65) = 209·85	**3**
			Alternative Strategy •[1] Process: calculate 97·3% of one share •[2] Process: calculate profit of one share •[3] Process: calculate profit	•[1] 5·20 × 0·973 = 5·0596 •[2] 5·0596 - 4·50 = 0·5596 •[3] 375 × 0·5596 = 209·85	

Notes:

1. Correct answer with no working — award 0/3
2. In original strategy, where •[2] is not awarded, •[3] is only available if a percentage of their total selling price or the total buying price is calculated
3. In alternative strategy, where •[1] is not awarded, •[3] is only available if a percentage of the selling price or buying price is calculated
4. For candidates who use alternative strategy accept a final answer of 210

Commonly Observed Responses:

1. 1950 × 1·027 leading to an answer of 315·15 — award 2/3 ✓✗✓
2. (1950 - 1687·50) × 0·973 = 255·41 — award 2/3 ✓✓✗
3. 1950 - 1687·50 = 262·50 — award 1/3 ✓✗✗

Question			Generic Scheme	Illustrative Scheme	Max mark
7.	(a)	(i)	•[1] Process: calculate mean	•[1] $(2{\cdot}5 + 4{\cdot}5 + 3{\cdot}7 + 3{\cdot}1 + 3{\cdot}8 + 3{\cdot}4) \div 6 = 3{\cdot}5$	**1**
Notes:					
Commonly Observed Responses:					
		(ii)	•[2] Process: calculate $(x - \bar{x})^2$ •[3] Strategy/process: substitute into formula •[4] Process: calculate standard deviation	•[2] 1,1,0·04,0·16,0·09,0·01 •[3] $\sqrt{\frac{2 \cdot 3}{6-1}}$ •[4] $0{\cdot}678\ldots$	**3**
			Alternative strategy •[2] Process: calculate $\sum x$ and $\sum x^2$ •[3] Strategy/process: substitute into formula •[4] Process: calculate standard deviation	•[2] 21 and 75·8 •[3] $\sqrt{\frac{75 \cdot 8 - \frac{21^2}{6}}{6-1}}$ •[4] $0{\cdot}678\ldots$	
Notes: 1. Correct answer with no working award 0/3 2. Accept rounding or truncation to at least one decimal place for final answer 3. •[4] can only be awarded for a calculation involving at least two-step including a division and a square root has taken place					
Commonly Observed Responses:					
	(b)		•[5] Communication: comment regarding mean •[6] Communication: comment regarding standard deviation	•[5] eg on average weights in 2017 are higher •[6] eg the weights in 2017 are more consistent	**2**
Notes:					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
7.	(c)	(i)	•[7] Communication: 4 points correct •[8] Communication: all 8 points correct	•[7] evidence •[8] evidence	**2**

Notes:

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

Commonly Observed Responses:

		(ii)	•[9] Strategy: consistent line of best fit	•[9] evidence	**1**

Notes:

Commonly Observed Responses:

		(iii)	•[10] Communication: answer consistent with line of best fit	•[10] evidence	**1**

Notes:

1. When the weight falls between 2 divisions accept either number or any value in between

Commonly Observed Responses:

	(d)		•[11] Strategy: identify correct row in table •[12] Process: calculate milk powder needed for 1 week or equivalent •[13] Communication: conclusion consistent with working	•[11] eg 8 (scoops) •[12] $4 \times 8 \times 7 \times 4 \cdot 5 = 1008$ OR $4 \cdot 5 \times 4 \times 8 = 144$ $900 \div 144 = 6 \cdot 25$ •[13] No, (as 1008g > 900g) OR No, (as 6·25 < 7 days)	**3**

Notes:

1. For •[13] the comparison has to be grams with grams, days with days or scoops with scoops

Commonly Observed Responses:

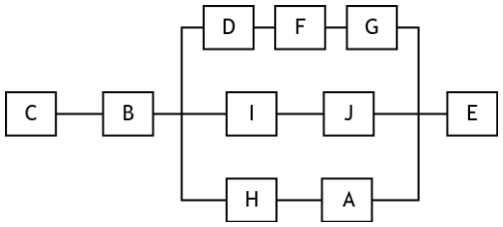
Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		•[1] Strategy/process: identify number of gaps •[2] Process: calculate length	•[1] 366 •[2] $366 \times 2 + 367 \times 4 = 2200$	**2**
Notes:					
Commonly Observed Responses: 1. $365\times2 + 367\times4 = 2198$ award 1/2 ×✓ 2. $367\times2 + 367\times4 = 2202$ award 1/2 ×✓ 3. $367 \times 4 \times 2 = 2936$ award 0/2 ×× 4. $367 \times 4 \div 2 = 734$ award 0/2 ××				
	(b)		•[3] Strategy/communication: correct substitution in Pythagoras' Theorem •[4] Process: calculate height or height^2 •[5] Strategy/communication: correct substitution in Pythagoras' Theorem •[6] Process/communication: calculate total length of cable	•[3] eg $300^2 - 295^2$ •[4] $h = 54{\cdot}5\ldots$ or $h^2 = 2975$ •[5] $600^2 + (54\cdot5\ldots)^2$ •[6] $300 + 602\cdot4\ldots = 902\cdot4\ldots$	**4**
Notes: 1. •[3] is not available if candidate writes $295^2 - 300^2$ 2. •[4] is available if candidate writes $295^2 - 300^2$ leading to 54·5 … 3. Do not penalise candidates who truncate or round to the nearest whole number throughout					
Commonly Observed Responses: 1. $\sqrt{(600+295)^2 - 300^2} + 300 = 1143\cdot2\ldots$ award 2/4 ××✓✓ 2. $295^2 + 300^2 = 177025$ award 1/4 ×✓××					

<table>
<tr><th colspan="3">Question</th><th>Generic scheme</th><th>Illustrative scheme</th><th>Max mark</th></tr>
<tr><td>9.</td><td>(a)</td><td></td><td>$\bullet^1$ Process: calculate total number of hours

$\bullet^2$ Process: calculate angles

$\bullet^3$ Communication: draw and label pie chart consistent with previous working</td><td>$\bullet^1$ $210 + 96 + 234 = 540$

$\bullet^2$
<table><tr><td>210 hours research</td><td>$\frac{210}{540} \times 360 = 140$</td></tr><tr><td>96 hours meetings</td><td>$\frac{96}{540} \times 360 = 64$</td></tr><tr><td>234 hours writing</td><td>$\frac{234}{540} \times 360 = 156$</td></tr></table>$\bullet^3$ diagram consistent with working</td><td>3</td></tr>
<tr><td colspan="6">Notes:
1. $\bullet^1$ and $\bullet^2$ can be implied in subsequent working
2. $\bullet^3$ is available if any 2 angles are within tolerance $\pm 1°$ leading to third angle being outwith tolerance
3. $\bullet^3$ is not available if the three calculated angles do not add to $360°$</td></tr>
<tr><td colspan="6">Commonly Observed Responses:</td></tr>
<tr><td></td><td>(b)</td><td></td><td>$\bullet^4$ Communication: any 5 in correct sequence

$\bullet^5$ Communication: remaining 4 in correct sequence</td><td> 
</td><td>2</td></tr>
<tr><td colspan="6">Notes:</td></tr>
<tr><td colspan="6">Commonly Observed Responses:</td></tr>
</table>

Question			Generic scheme	Illustrative scheme	Max mark
9.	(c)		•[6] Strategy: know to and starts to calculate the correct two ways of packing •[7] Process: calculate number of boxes for one arrangement •[8] Process/communication: calculate the second arrangement and state maximum number of books	•[6] evidence of the two **correct** ways of packing with the front cover facing upwards $100 \div 12 \cdot 5 = 8$ •[7,8] $50 \div 19 \cdot 5 = 2 \cdot 56...$ $20 \div 2 = 10$ $2 \times 8 \times 10 = 160$ and $100 \div 19 \cdot 5 = 5 \cdot 12...$ $50 \div 12 \cdot 5 = 4$ $20 \div 2 = 10$ $5 \times 4 \times 10 = 200$ Maximum - 200 books	**3**
Notes: 1. Where a candidate only considers volume award 0/3 2. Where a candidate considers more than two arrangements do not award •[6] 3. Where a candidate only considers one arrangement •[7] is still available 4. Where a candidate attempts more than two arrangements •[8] is only available where **all considered** arrangements have been calculated 5. Where •[7] is lost for an incorrect process, •[8] can be awarded for repeated incorrect process where there are no arithmetic errors in either calculation					
Commonly Observed Responses: 1. 100000 ÷ 487·5 = 205·12… award 0/3 ×××					
	(d)		•[9] Process: calculate cost of shop A •[10] Process: calculate cost of shop C •[11] Communication: conclusion consistent with working	•[9] 24 •[10] 22 •[11] Shop C	**3**
			Alternative Strategy •[9] Process: calculate discount for 1 shop •[10] Process: calculate discount for other two shops •[11] Communication: conclusion consistent with working	•[9] 6 or 7·01 or 8 •[10] remaining two •[11] Shop C	
Notes: 1. •[11] can only be awarded for comparing 3 costs or 3 discounts					
Commonly Observed Responses: 1. Shop A £6, Shop B £22·99, Shop C £22 leading to conclusion Shop A award 1/3 ✓××					

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		$\bullet^1$ Process: calculate area of larger circle	$\bullet^1$ $\pi \times 45 \cdot 35^2 = 6461 \cdot 07\ldots$	**5**
			$\bullet^2$ Process: calculate area of smaller circle	$\bullet^2$ $\pi \times 36 \cdot 8^2 = 4254 \cdot 47\ldots$	
			$\bullet^3$ Process: subtract areas of circles	$\bullet^3$ $2206 \cdot 599\ldots$	
			$\bullet^4$ Process: calculate the area of the two rectangles	$\bullet^4$ $8 \cdot 55 \times 84 \cdot 4 \times 2 = 1443 \cdot 24$	
			$\bullet^5$ Process: calculate overall area	$\bullet^5$ $2206 \cdot 599\ldots + 1443 \cdot 24 = 3649 \cdot 839\ldots$	

Notes:

1. $\bullet^{1,2}$ are available for candidates who calculate the area of a semi-circle
2. For candidates who use πd $\bullet^2$ is still available, $\bullet^5$ is only available if it is clear that candidate used $A = \pi d$
3. $\bullet^5$ is not available for candidates who double the area of a whole circle
4. $\bullet^5$ is not available for candidates who add a semi-circle to a rectangle

Commonly Observed Responses:

1. $\pi \times 90 \cdot 7^2 - \pi \times 36 \cdot 8^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 23033 \cdot 05\ldots$ award 4/5 ×✓✓✓✓
2. $\pi \times 45 \cdot 35^2 - \pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 8418 \cdot 43\ldots$ award 4/5 ✓✓✓×✓
3. $\pi \times 90 \cdot 7^2 - \pi \times 73 \cdot 6^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 10269 \cdot 63\ldots$ award 4/5 ×✓✓✓✓
4. $\pi \times 73 \cdot 6^2 - \pi \times 45 \cdot 35^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 12000 \cdot 05\ldots$ award 3/5 ✓××✓✓
5. $\pi \times 8 \cdot 55^2 + 8 \cdot 55 \times 84 \cdot 4 \times 2 = 1672 \cdot 89\ldots$ award 3/5 ××✓✓✓
6. $\pi \times 36 \cdot 8^2 + 73 \cdot 6 \times 84 \cdot 4 = 10466 \cdot 3\ldots$ award 2/5 ×✓××✓

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		$\bullet^6$ Strategy: know to use inverse proportion $\bullet^7$ Process: calculate time for 1 worker $\bullet^8$ Process: calculate time for 7 workers	$\bullet^6$ evidence $\bullet^7$ $42 \times 5 = 210$ $\bullet^8$ $210 \div 7 = 30$	**3**

Notes:

1. Correct answer with no working — award 3/3
2. $\bullet^8$ is available for dividing 42 or 210 by 7
3. For an answer of eg "it takes 12 hours less" award $\bullet^8$
4. If a candidate subtracts 5 to find the number of days, $\bullet^8$ is not available

Commonly Observed Responses:

1. $5\times42\div2=105$ — award 2/3 ✓✓×
2. $5\div42\times7=0\cdot83...$ — award 2/3 ×✓✓
3. $7\div(42\div5)=0\cdot83...$ — award 2/3 ×✓✓
4. $5\div42\times2=0\cdot238...$ — award 1/3 ×✓×
5. $42\div5\times7=58\cdot8$ — award 1/3 ××✓
6. $42\div5\times2=16\cdot8$ — award 0/3 ×××

Question			Generic scheme	Illustrative scheme	Max mark
	(c)	(i)	•[9] Strategy/process: know to deal with 0% rate •[10] Process: calculate national insurance	•[9] 17108 – 8424 = 8684 •[10] 12% of 8684 = 1042·08	**2**
Notes:					
Commonly Observed Responses: 1. 12% of 8684 = 1042·08 leading to 16065·92 award 2/2 ✓✓ 2. 12% of 17108 = 2052·96 award 1/2 ×✓ 3. 12% of 17108 = 2052·96 leading to 15055·04 award 1/2 ×✓					
		(ii)	•[11] Process: calculate pension contribution •[12] Process: calculate annual net pay	•[11] 1197·56 •[12] $17108-1042\cdot08-1197\cdot56-1051\cdot60=13816\cdot76$	**2**
Notes: 1. •[12] is only available when the candidate subtracts three valid amounts from 17108					
Commonly Observed Responses: 1. $17108-(1197\cdot56+1051\cdot60+2052\cdot96)=12805\cdot88$ award 2/2 ✓✓ (using 2052·96 from (c)(i)) 2. $17108-(1051\cdot60+1197\cdot56)=14858\cdot84$ award 1/2 ✓× 3. $17108-(1042\cdot08+1197\cdot56)=14868\cdot36$ award 1/2 ✓× 4. $(17108-1042\cdot08)\times0\cdot93-1051\cdot60=13889\cdot71$ award 1/2 ×✓ 5. $17108-(1042\cdot08+1051\cdot60)=15014\cdot32$ award 0/2 ××					

[END OF MARKING INSTRUCTIONS]