



National
Qualifications
2019

2019 Applications of Mathematics

National 5 - Paper 1

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.

- (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 $6 \times 6 = 12$, 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"> •¹ Process: calculate limits •² Process: identify rejected candles (or accepted candles) •³ Process/communication: calculate percentage rejected ^{1,4} 	<ul style="list-style-type: none"> •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
<p>Notes:</p> <p>1. Correct answer with no working award 3/3</p> <p>2. Incorrect answer with no working, however see COR 1 award 0/3</p> <p>3. •¹ can be implied by subsequent working</p> <p>4. Where answer is incorrect, •³ can be awarded if there is evidence of where the percentage has come from</p> <p>5. Where answer is incorrect, •² can only be awarded if there is evidence of the limits used, however see COR 1</p>				
<p>Commonly Observed Responses:</p> <p>1. 60% with no working award 2/3 ✓✓x</p> <p>2. 20·5 and 24·5 leading to 0% or 100% award 1/3 x✓x</p>				
2.	(a)	<ul style="list-style-type: none"> •¹ Process: calculate basic pay •² Strategy: know how to calculate overtime pay •³ Process: calculate total gross pay 	<ul style="list-style-type: none"> •¹ $30 \times 12\cdot50 = 375$ •² $1\cdot5 \times 12\cdot50 \times 7$ •³ $375 + 131\cdot25 = 506\cdot25$ 	3
<p>Notes:</p> <p>1. •³ is only available for candidates who have multiplied by 1·5 or 0·5 or 2·5 or equivalent in •²</p> <p>2. For candidates who calculate double time •² and •³ are not available</p>				
<p>Commonly Observed Responses:</p> <p>1. $37 \times 12\cdot50 + 7 \times 6\cdot25 = 506\cdot25$ award 3/3 ✓✓✓</p> <p>2. $375 + 7 \times 6\cdot25 = 418\cdot75$ award 2/3 ✓x✓</p> <p>3. $30 \times 12\cdot50 + 0\cdot5 \times 375 = 562\cdot50$ award 2/3 ✓x✓</p> <p>4. $30 \times 12\cdot50 + 7 \times 12\cdot50 = 462\cdot50$ award 1/3 ✓xx</p> <p>5. $30 \times 12\cdot50 + 7 \times 2 \times 12\cdot50 = 550$ award 1/3 ✓xx</p>				

Question		Generic scheme	Illustrative scheme	Max mark
	(b)	<ul style="list-style-type: none"> •⁴ Process: calculate the deposit •⁵ Process: calculate amount still payable •⁶ Process: calculate how much each monthly payment is 	<ul style="list-style-type: none"> •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. $(825 - (165 + 100)) \div 8 = 70$			award 2/3 ✓x✓	
2. $(825 - 165) \div 8 = 82 \cdot 50$			award 2/3 ✓x✓	
3. $(845 \cdot 80 - 165) \div 8 = 85 \cdot 10$			award 2/3 ✓x✓	
4. $(845 \cdot 80 + 100 - 165) \div 8 = 97 \cdot 60$			award 2/3 ✓x✓	
5. $845 \cdot 80 \div 5$ leading to $(845 \cdot 80 - (169 \cdot 16 + 100)) \div 8 = 72 \cdot 08$			award 2/3 x✓✓	
6. $845 \cdot 80 \div 5$ leading to $(845 \cdot 80 - 169 \cdot 16) \div 8 = 84 \cdot 58$			award 1/3 xx✓	
7. $845 \cdot 80 \div 8$ leading to 8 payments of 105·72 or 105·73			award 1/3 xx✓	
8. $825 \div 8$ leading to 8 payments of 103·12 or 103·13			award 0/3 xxx	
3.	(a)	• ¹ Process: calculate the number of employees	• ¹ 6	1
Notes:				
Commonly Observed Responses:				
	(b)	<ul style="list-style-type: none"> •² Strategy/process: evidence of 240° or 48 employees •³ Communication: state probability 	<ul style="list-style-type: none"> •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 x✓	

Question		Generic scheme	Illustrative scheme	Max mark
4.		<ul style="list-style-type: none"> •¹ Strategy/communication: one temperature marked correctly on scale •² Communication: other temperature marked on scale and consistent conclusion 	<ul style="list-style-type: none"> •¹ evidence •² eg Gillian is correct with justification 	2
		<p>Alternative Strategy</p> <ul style="list-style-type: none"> •¹ Strategy/communication: substitute into formula •² Communication: temperature conversion and consistent conclusion 	<ul style="list-style-type: none"> •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.		<ul style="list-style-type: none"> •¹ Strategy: know how to find monthly payment •² Process: calculate interest and fee •³ Process: calculate monthly payment 	<ul style="list-style-type: none"> •¹ evidence of finding a percentage, adding to 4500 and dividing by 9 •² 7.5% of 4500 = 337.50 •³ $(4500 + 337.50) \div 9 = 537.50$ 	3
		<p>Alternative Strategy</p> <ul style="list-style-type: none"> •¹ Strategy: know how to find monthly payment •² Process: calculate amount owed •³ Process: calculate monthly payment 	<ul style="list-style-type: none"> •¹ evidence of multiplying by 1.075 and dividing by 9 •² 4837.50 •³ $4837.50 \div 9 = 537.50$ 	
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. $(4500 - 337.50) \div 9 = 462.50$ award 2/3 ✗✓✓				

Question		Generic scheme	Illustrative scheme	Max mark
6.		<ul style="list-style-type: none"> •¹ Strategy/process: put decimals and percentage in correct order •² Process/communication: convert $\frac{3}{8}$ correctly and put it in correct position 	<ul style="list-style-type: none"> •¹ 0·39, 0·388, 38·38% •² $\frac{3}{8} = 0·375$ or 37·5% 0·39, 0·388, 38·38%, $\frac{3}{8}$ 	2
<p>Notes:</p> <p>1. Correct answer with no working award 1/2</p> <p>2. If •¹ is not awarded, •² is available if numbers are listed from smallest to largest with $\frac{3}{8}$ being converted correctly</p>				
<p>Commonly Observed Responses:</p> <p>1. 0·39, 0·388, $\frac{3}{8}$, 38·38% award 1/2 ✓✘</p>				

Question		Generic scheme	Illustrative scheme	Max mark
7.	(a)	<ul style="list-style-type: none"> •¹ Strategy/process: put numbers into order and state the median •² Process: find the lower quartile and upper quartile 	<ul style="list-style-type: none"> •¹ Median = 26 •² $Q_1 = 20, Q_3 = 35$ 	2
Notes: <ol style="list-style-type: none"> 1. If the numbers are unordered •² is still available 2. If one number is missed from an ordered list •² is available 3. If more than one number is missed from an ordered list •² is not available 4. If the answers for part (a) appear in part (b) •¹ and •² can be awarded 				
Commonly Observed Responses:				
	(b)	<ul style="list-style-type: none"> •³ Strategy: correct end points •⁴ Strategy: correct box 	<ul style="list-style-type: none"> •³ End points at 14 and 49 •⁴ Box showing Q_1, Q_2 and Q_3 	2
Notes: <ol style="list-style-type: none"> 1. If the answers for part (a) appear in part (b) •¹ and •² can be awarded 				
Commonly Observed Responses:				
	(c)	<ul style="list-style-type: none"> •⁵ Process: calculate interquartile range 	<ul style="list-style-type: none"> •⁵ $35 - 20 = 15$ 	1
Notes:				
Commonly Observed Responses:				
	(d)	<ul style="list-style-type: none"> •⁶ Communication: valid comment 	<ul style="list-style-type: none"> •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)	<ul style="list-style-type: none"> •¹ Process/communication: correct length drawn •² Process/communication: correct angles measured 	<ul style="list-style-type: none"> •¹ $8(\pm 0.1\text{cm})$ •² $12^\circ(\pm 1^\circ); 90^\circ(\pm 1^\circ)$ 	2
Notes:				
Commonly Observed Responses:				
	(b)	<ul style="list-style-type: none"> •³ Strategy/communication: measure vertical height •⁴ Process/communication: calculate gradient and simplify where appropriate 	<ul style="list-style-type: none"> •³ height consistent with scale drawing •⁴ eg 0.2125 or $\frac{17}{80}$ 	2
Notes:				
<ol style="list-style-type: none"> 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)	<ul style="list-style-type: none"> •² Process: calculate time difference •³ Process/communication: conclusion consistent with working 	<ul style="list-style-type: none"> •² 5 hours •³ $23:15 - 5 \text{ hours} = 18:15$ Yes the call will be made at 18:15 in Miami 	2
Notes:				
<ol style="list-style-type: none"> 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.		<ul style="list-style-type: none"> •¹ Process: evidence of common denominator •² Process: consistent numerators and add fractions •³ Process: calculate fraction of flour needed 	<ul style="list-style-type: none"> •¹ $\frac{\quad}{12} + \frac{\quad}{12} + \frac{\quad}{12}$ or equivalent •² $\frac{2}{12} + \frac{4}{12} + \frac{3}{12} = \frac{9}{12}$ •³ $\frac{3}{12}$ 	3
		<p>Alternative Strategy 1</p> <ul style="list-style-type: none"> •¹ Process: add together two fractions •² Process: add remaining fraction •³ Process: calculate fraction of flour needed 	<ul style="list-style-type: none"> •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 $\frac{3}{12}$ 	
		<p>Alternative Strategy 2</p> <ul style="list-style-type: none"> •¹ Process: convert all fractions to a percentages •² Process: add percentages •³ Process: calculate percentage of flour needed 	<ul style="list-style-type: none"> •¹ 16·6..., 33·3..., 25 •² 74·9... •³ 25% or 25·1% 	
<p>Notes:</p> <ol style="list-style-type: none"> 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 				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 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.		<ul style="list-style-type: none"> •¹ Strategy/process: find one share •² Process: add up ages •³ Process: find total amount 	<ul style="list-style-type: none"> •¹ $1950 \div 6 = 325$ •² $4 + 11 + 9 + 6 = 30$ •³ $325 \times 30 = 9750$ 	3								
		<p>Alternative Strategy 1</p> <ul style="list-style-type: none"> •¹ Strategy/process: find one share •² Process: calculate the amount for any niece other than Kate •³ Process: calculate the amount for other two nieces and total amount 	<ul style="list-style-type: none"> •¹ $1950 \div 6 = 325$ •² Jane 1300 or Heather 3575 or Laura 2925 •³ $1300 + 3575 + 2925 + 1950 = 9750$ 									
<p>Notes:</p> <ol style="list-style-type: none"> 1. In original strategy, •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, •³ is only available where the candidate has multiplied their value of one share by 30 3. In alternative strategy, •² is only available where the candidate has used their value of one share 4. •³ is only available for a final answer greater than 1950 												
<p>Commonly Observed Responses:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 70%;">1. $1950 \div 30 \times 6 = 390$ leading to 1950</td> <td style="text-align: right;">award 1/3 x✓x</td> </tr> <tr> <td>2. $1950 \div 30 \times 4 = 260$ leading to 1950</td> <td style="text-align: right;">award 1/3 x✓x</td> </tr> <tr> <td>3. $1950 \div 30 \times 11 = 715$ leading to 1950</td> <td style="text-align: right;">award 1/3 x✓x</td> </tr> <tr> <td>4. $1950 \div 30 \times 9 = 585$ leading to 1950</td> <td style="text-align: right;">award 1/3 x✓x</td> </tr> </table>					1. $1950 \div 30 \times 6 = 390$ leading to 1950	award 1/3 x✓x	2. $1950 \div 30 \times 4 = 260$ leading to 1950	award 1/3 x✓x	3. $1950 \div 30 \times 11 = 715$ leading to 1950	award 1/3 x✓x	4. $1950 \div 30 \times 9 = 585$ leading to 1950	award 1/3 x✓x
1. $1950 \div 30 \times 6 = 390$ leading to 1950	award 1/3 x✓x											
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4. $1950 \div 30 \times 9 = 585$ leading to 1950	award 1/3 x✓x											