



National
Qualifications
2023

2023 Applications of Mathematics

National 5 - Paper 1

Finalised Marking Instructions

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General marking principles for 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) below.
- (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.

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

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

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

$$x = 1$$

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

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

$\frac{15}{0.3}$ must be simplified to 50 $\frac{4\cancel{5}}{3}$ must be simplified to $\frac{4}{15}$

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

*The square root of perfect squares up to and including 144 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.

Marking Instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			<ul style="list-style-type: none"> •¹ Process: calculate savings per week •² Process/communication: calculate number of weeks 	<ul style="list-style-type: none"> •¹ 50 •² 28 	2
Notes <ol style="list-style-type: none"> 1. Correct answer without working award 0/2 2. •² is only available for calculations involving 1366 (with the exception of COR 2 and 5). 3. •² is available for an incomplete calculation eg $1366 \div 50 = 27$ or $27... \rightarrow 28$. 4. Ignore errors in calculations after the decimal point or in remainder. 					
Commonly Observed Responses: <ol style="list-style-type: none"> 1. $1366 \div 50 = 28$ award 2/2 ✓✓ 2. $1400 \div 50 = 28$ award 2/2 ✓✓ 3. $1366 \div 50 \rightarrow 27 \text{ r } 16 \rightarrow 28$ award 2/2 ✓✓ 4. $136.6 \div 5 \rightarrow 27 \text{ r } 1 \rightarrow 28$ award 2/2 ✓✓ 5. $566 \div 50 + 800 \div 50 \rightarrow 28$ award 2/2 ✓✓ 					
2.			<ul style="list-style-type: none"> •¹ Communication: speed in mph marked •² Communication: state speed in km/h 	<ul style="list-style-type: none"> •¹ 56 marked on mph scale •² 90 (km/h) 	2
			Alternative Strategy <ul style="list-style-type: none"> •¹ Communication: state equivalent speeds from speedometer •² Process: calculate speed in km/h 	<ul style="list-style-type: none"> •¹ 100 (mph) = 160 (km/h) or equivalent •² $\left(\frac{8}{5} \times 56 =\right) 89.6$ (km/h) 	
Notes: <ol style="list-style-type: none"> 1. Correct answer without working award 2/2 2. In original strategy accept answers from 88 to 92 inclusive. 3. In original strategy if 56 mph is marked incorrectly •² is available for consistent conversion ± 2 km/h. 					
Commonly Observed Responses: <ol style="list-style-type: none"> 1. 56 mph marked $\rightarrow 85$ (km/h) award 1/2 ✓✗ 2. 56 km/h marked $\rightarrow 35 \pm 2$ (mph) award 1/2 ✗✓ 3. 85 (km/h) with no working award 0/2 ✗✗ 					

Question			Generic scheme	Illustrative scheme	Max mark
3.			<ul style="list-style-type: none"> •¹ Process: evidence of common denominator •² Process: consistent numerators and add fractions •³ Process: calculate fraction of neutral supporters 	<ul style="list-style-type: none"> •¹ evidence of 35 or equivalent •² $\frac{29}{35}$ •³ $\frac{6}{35}$ 	3
			Alternative Strategy <ul style="list-style-type: none"> •¹ Process: convert to decimal fractions •² Process: add decimal fractions •³ Process: calculate decimal fraction of neutral supporters 	<ul style="list-style-type: none"> •¹ 0.428... and 0.4 •² 0.828... •³ 0.171 or 0.172 	
Notes: <ol style="list-style-type: none"> Correct answer without working award 3/3 The final answer does not need to be in its simplest form. Do not penalise incorrect simplification of final answer. In alternative strategy, for candidates working to 1 decimal place, only •¹ and •² are available. 					
Commonly Observed Responses: <ol style="list-style-type: none"> 17.1% or 17.2% award 3/3 ✓✓✓ $\frac{15}{30} + \frac{14}{30} = \frac{29}{30} \rightarrow \frac{1}{30}$ award 2/3 ✗✓✓ $\frac{3}{35} + \frac{2}{35} = \frac{5}{35} \rightarrow \frac{30}{35}$ award 2/3 ✓✗✓ $\frac{2}{5} \times \frac{3}{7} = \frac{6}{35}$ award 1/3 ✓✗✗ $\frac{15}{12} + \frac{14}{12} = \frac{29}{12} \rightarrow$ any final answer award 1/3 ✗✓✗ $\frac{3}{12} + \frac{2}{12} = \frac{5}{12} \rightarrow \frac{7}{12}$ award 1/3 ✗✗✓ 					

Question			Generic scheme	Illustrative scheme	Max mark
4.			<ul style="list-style-type: none"> •¹ Process: calculate the value of one share •² Process: calculate the amount for Ed or Lucy or their total •³ Process: calculate the amount for Ed or Lucy and total amount 	<ul style="list-style-type: none"> •¹ 472 •² 944 or 2832 or 3776 •³ 2832 or 944 → 7080 	3
			Alternative Strategy <ul style="list-style-type: none"> •¹ Process: calculate the value of one share •² Process: calculate total shares •³ Process: calculate total amount 	<ul style="list-style-type: none"> •¹ 472 •² 15 •³ 7080 	

Notes:

1. Correct answer without working award 0/3
2. In original strategy, •² is only available for multiplying their answer to •¹ by 2, 6 or 8, with the exception of COR 1.
3. In alternative strategy, •³ is only available for multiplying their answer to •¹ by their answer to •².

Commonly Observed Responses:

The following COR applies to the original strategy

- | | |
|---|---------------|
| 1. $3304 - 472 = 2832$ and $472 + 472 = 944 \rightarrow 7080$ | award 3/3 ✓✓✓ |
| 2. $3304 \div 2 = 1652 \rightarrow (1652 \times 7 =) 11564$ or $(1652 \times 6 =) 9912 \rightarrow 24780$ | award 2/3 ✗✓✓ |
| 3. $3304 \div 6 = 550.6... \rightarrow (550.6... \times 2 =) 1101.3...$ or $(550.6... \times 7 =) 3854.6... \rightarrow \square 8260$ | award 2/3 ✗✓✓ |
| 4. $3304 \times 7 \rightarrow$ final answer 18722.66 | award 1/3 ✗✗✓ |

The following CORs apply to the alternative strategy

- | | |
|--|---------------|
| 5. $3304 \div 15 \times 7 = 1541.86...$ with or without subsequent calculation | award 1/3 ✗✓✗ |
| 6. $3304 \div 15 \times 2 = 440.5...$ with or without subsequent calculation | award 1/3 ✗✓✗ |
| 7. $3304 \div 15 \times 6 = 1321.6$ with or without subsequent calculation | award 1/3 ✗✓✗ |

Question			Generic scheme	Illustrative scheme	Max mark
5.			<ul style="list-style-type: none"> •¹ Strategy/process: know to find total number of combinations •² Process: find the number of combinations not blue or green and even •³ Communication: state probability of not winning 	<ul style="list-style-type: none"> •¹ evidence of 25 combinations •² evidence of 21 •³ $\frac{21}{25}$ 	3

Notes:

1. Correct answer without working award 3/3
2. Where candidates attempt to add fractions award 0/3
3. The combinations need not be listed for award of •¹ and •².
4. Where the answer is incorrect, •³ can only be awarded if numerator **and** denominator are consistent with working.
5. The final answer does not need to be in its simplest form.
6. Do not award •³ for an answer written as a ratio.

Commonly Observed Responses:

1. $\frac{2}{5} \times \frac{2}{5} \rightarrow \frac{4}{25} \rightarrow \frac{21}{25}$ award 3/3 ✓✓✓
2. $\frac{4}{25}$ with or without working award 2/3 ✓✓×
3. $\frac{16}{20}$ award 2/3 ×✓✓
4. $\frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$ award 1/3 ✓××
5. $\frac{3}{5} \times \frac{3}{5} = \frac{9}{25} \rightarrow \frac{16}{25}$ award 1/3 ✓××

Question			Generic scheme	Illustrative scheme			Max mark																					
6.			<ul style="list-style-type: none">•¹ Process: calculate sale price•² Strategy/process: calculate 2.5% of sale price•³ Process: calculate final price	<ul style="list-style-type: none">•¹ 520•² 13•³ 507			3																					
Notes: 1. Correct answer without working award 0/3 2. • ² can be implied by • ³ . 3. • ³ is only available for “sale price – 2.5% of sale price”, or equivalent. 4. Where final answer is not a whole number • ³ is only available where final answer is rounded or truncated to 2 decimal places.																												
Commonly Observed Responses: 1. $130 - 2.5\% \text{ of } 130 = 126.75$ award 2/3 x✓✓ 2. $650 - (130 + 2.5\% \text{ of } 650) = 503.75$ award 1/3 ✓xx 3. $2.5\% \text{ of } 130 = 3.25$ award 1/3 x✓x 4. $22.5\% \text{ of } 650 = 146.25$ award 0/3 xxx																												
7.			<ul style="list-style-type: none">•¹ Process: calculate correct number of tins per dimension for both boxes•² Process/communication: calculate number of tins for each box	<table><tr><td></td><td>•¹</td><td>•²</td></tr><tr><td>•¹</td><td>4, 5, 3</td><td>4, 7, 2</td></tr><tr><td>•²</td><td>60</td><td>56</td></tr><tr><td></td><td>or</td><td></td></tr><tr><td></td><td>•¹</td><td>•²</td></tr><tr><td>•¹</td><td>4, 7, 2</td><td>4, 5, 3</td></tr><tr><td>•²</td><td>56</td><td>60</td></tr></table>		• ¹	• ²	• ¹	4, 5, 3	4, 7, 2	• ²	60	56		or			• ¹	• ²	• ¹	4, 7, 2	4, 5, 3	• ²	56	60			2
	• ¹	• ²																										
• ¹	4, 5, 3	4, 7, 2																										
• ²	60	56																										
	or																											
	• ¹	• ²																										
• ¹	4, 7, 2	4, 5, 3																										
• ²	56	60																										
Notes: 1. Correct answer without working award 0/2 2. For candidates who add together the total number of tins in both boxes, • ² is still available, see COR 1. 3. Where the candidate only considers volume award 0/2 4. Where the candidate considers more than two distinct arrangements • ¹ is not available. 5. Where the candidate considers more than two arrangements all calculations must be correct for the award of • ² .																												
Commonly Observed Responses: 1. 56 and 60 → 116 award 2/2 ✓✓ 2. 56 and 60 with no indication of maximum award 2/2 ✓✓																												

Question			Generic scheme	Illustrative scheme	Max mark
8.			<ul style="list-style-type: none"> •¹ Process: calculate time to travel 136 miles at an average speed of 40 mph •² Process: convert decimal hours to hours and minutes •³ Process: calculate time of departure 	<ul style="list-style-type: none"> •¹ 3.4 •² 3 hours 24 minutes •³ 6:01am or 06:01 	3
Notes: 1. Correct answer without working award 0/3 2. • ¹ can be implied by • ² .					
Commonly Observed Responses: 1. 3.4 → 3 hours 24 minutes → 06:01am award 3/3 ✓✓✓ 2. 3.4 → 3 hours 24 minutes → 6:01 or 601 award 2/3 ✓✓✗ 3. 3.4 → 3 hours 4 minutes → 6:21am or 06:21 award 2/3 ✓✗✓ 4. 3.4 → 3 hours 40 minutes → 5:45am or 05:45 award 2/3 ✓✗✓ 5. 3.4 → 3.24(hrs) → 06:01 award 3/3 ✓✓✓ 6. 3.4 → 3.24(hrs) award 2/3 ✓✓✗ 7. 3.16 → 3 hours 16 minutes → 6:09am or 06:09 award 1/3 ✗✗✓					
9.			<ul style="list-style-type: none"> •¹ Process: state lower limit •² Strategy/process: calculate gradient •³ Process/communication: calculate gradient as decimal and state consistent conclusion with numerical comparison 	<ul style="list-style-type: none"> •¹ 0.34 •² $\frac{70}{210}$ or $\frac{0.7}{2.1}$ or equivalent •³ eg 0.34 → 0.33... < 0.34 not suitable 	3
Notes: 1. Where the candidate incorrectly calculates the gradient to be greater than 0.35, • ¹ can only be awarded when the upper limit of 0.36 is stated. 2. • ³ is only available where a candidate rounds or truncates to at least 2 decimal places. 3. • ³ is unavailable if no limit has been stated. 4. If the calculated gradient is 0.35, • ³ is not available.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		<ul style="list-style-type: none"> •¹ Strategy/communication: any 5 tasks and times in the correct boxes •² Strategy/communication: complete diagram 	<ul style="list-style-type: none"> •¹ •² <pre> graph LR F[F 2] --> A[A 1] F --> E[E 1] A --> B[B 1] A --> C[C 7] A --> H[H 5] E --> G[G 1] B --> J[J 3] C --> I[I 4] H --> D[D 2] G --> D J --> D I --> D </pre>	2

Notes:

1. If a candidate omits any numbers, all tasks **must** be correct to be awarded 1/2.
2. If a candidate omits letters award 0/2.
3. B J and C I are interchangeable.

Commonly Observed Responses:

	(b)		<ul style="list-style-type: none"> •³ Strategy: select critical path •⁴ Communication: calculate minimum time and state conclusion consistent with working 	<ul style="list-style-type: none"> •³ 2 + 1 + 7 + 4 + 2 or F, A, C, I, D •⁴ 16 minutes. No. 	2
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Notes:

1. A numerical comparison is not required.
2. •⁴ is only available for any complete path through the table, with the exception of COR 2.
3. For the award of •⁴

Accept “16” followed by these comments or equivalent:

- John is incorrect.
- The bike will not be ready.
- He is wrong.
- No, it won’t be done on time.
- No, it takes a minimum of 16 minutes to complete the bike.

Do not accept “16” followed by these comments or equivalent:

- It takes a minimum of 16 minutes to complete the bike.
- It takes 16 minutes.

Commonly Observed Responses:

- | | |
|------------------------------------|--------------|
| 1. “16, no” with no working shown | award 2/2 ✓✓ |
| 2. $(2+1+1+1+5+7+4+1+3+2)=27$, no | award 1/2 ✕✓ |
| 3. “No”, with no working shown | award 0/2 ✕✕ |

Question			Generic scheme	Illustrative scheme	Max mark
11.			<ul style="list-style-type: none"> •¹ Process: calculate number of people •² Process: calculate any two angles •³ Communication: draw and label pie chart consistent with previous working 	<ul style="list-style-type: none"> •¹ $80 + 40 + 60 = 180$ •² 160, 80, 120 •³ diagram consistent with working 	3

Notes:

1. •¹ can be implied by •².
2. •¹ and •² can be implied by completing the pie chart correctly.
3. •³ is available if any 2 angles are within tolerance $\pm 1^\circ$ leading to third angle being outwith tolerance.
4. •³ is not available if the three calculated angles do not add up to 360° .

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
12.			<ul style="list-style-type: none"> •¹ Process: Calculate the cost of 5 (or 1) kiwi fruit for one option •² Process/communication: calculate the cost of 5 (or 1) kiwi fruit for remaining option and state consistent conclusion 	<ul style="list-style-type: none"> •¹ Option 1: 0.85 (or 0.17) or Option 2: 0.90 (or 0.18) •² Option 2: 0.90 (or 0.18) or Option 1: 0.85 (or 0.17) Option 1 	2
			Alternative Strategy <ul style="list-style-type: none"> •¹ Process: Calculate the cost of 5 (or 1) kiwi fruit for either option •² Process/communication: calculate the cost of 35 or 45 kiwi fruit and state consistent conclusion 	<ul style="list-style-type: none"> •¹ Option 1: 0.85 (or 0.17) or Option 2: 0.90 (or 0.18) •² (45 of option 1 =) 7.65 or (35 of option 2 =) 6.30 Option 1 	
Notes: <ol style="list-style-type: none"> 1. Do not penalise incorrect use of units eg 0.85p. 2. A numerical comparison is not required but when used they must be accurate. 3. •¹ and •² are available for any valid scaling strategy. 4. •² is only available for comparing equal numbers of kiwi. 					
Commonly Observed Responses: <ol style="list-style-type: none"> 1. $5.95 \times 45 = 267.75$ and $8.10 \times 35 = 283.50 \rightarrow$ option 1 award 2/2 ✓✓ 2. $5.95 \times 35 = 208.25$ and $8.10 \times 45 = 364.50$ and option 1 award 1/2 ✗✓ 					

Question			Generic scheme	Illustrative scheme	Max mark						
13.			<ul style="list-style-type: none">•¹ Process: find the expected number of vanilla candles•² Communication: consistent conclusion	<ul style="list-style-type: none">•¹ 63•² More	2						
			Alternative strategy <ul style="list-style-type: none">•¹ Process: find the percentage of Vanilla candles sold•² Communication: consistent conclusion	<ul style="list-style-type: none">•¹ 36. (1...)%•² More							
Notes: 1. If calculated expected sales exceed 180, • ² is not available. 2. A numerical comparison is not required for • ² but when used they must be accurate.											
Commonly Observed Responses: <table><tr><td>1. “more” without working</td><td>award 0/2 ✕✕</td></tr><tr><td>2. $\frac{65}{180} \rightarrow 35\% \rightarrow$ ”as expected” or equivalent</td><td>award 1/2 ✕✓</td></tr><tr><td>3. 35% with no working \rightarrow “as expected” or equivalent</td><td>award 0/2 ✕✕</td></tr></table>						1. “more” without working	award 0/2 ✕✕	2. $\frac{65}{180} \rightarrow 35\% \rightarrow$ ”as expected” or equivalent	award 1/2 ✕✓	3. 35% with no working \rightarrow “as expected” or equivalent	award 0/2 ✕✕
1. “more” without working	award 0/2 ✕✕										
2. $\frac{65}{180} \rightarrow 35\% \rightarrow$ ”as expected” or equivalent	award 1/2 ✕✓										
3. 35% with no working \rightarrow “as expected” or equivalent	award 0/2 ✕✕										

[END OF MARKING INSTRUCTIONS]