2024 Applications of Mathematics

National 5 – Paper 1

Question Paper Finalised Marking Instructions

General marking principles for National 5 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.
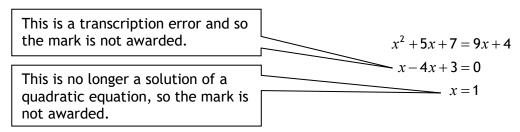
For each question, the marking instructions are generally in two sections:

generic scheme — this indicates why each mark is awarded
illustrative scheme — this covers methods which are commonly seen throughout the marking
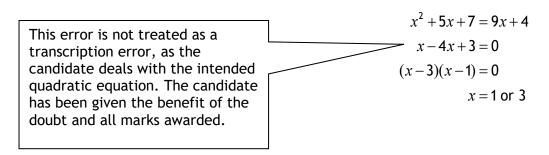
In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

(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:

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

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

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

$\dfrac{15}{0\cdot3}$ must be simplified to 50 $\dfrac{\frac{4}{5}}{3}$ must be simplified to $\dfrac{4}{15}$

$\sqrt{64}$ 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:

a) working subsequent to a correct answer
b) correct working in the wrong part of a question
c) legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
d) omission of units
e) 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

f) 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.			•^{1} Strategy/communication: mark one temperature correctly on scale •^{2} Communication: mark other temperature on scale and conclusion consistent with working	•^{1} 37.5 or 98 •^{2} 98 or 37.5 and Wednesday	2

Notes:
1. Any mark between 37 and 38 can be accepted for 37.5.

Commonly Observed Responses:
1. Wednesday   award 0/2 ✗✗
2. $98 = 36.5$, Wednesday, with no marks or only one mark on diagram   award 1/2 ✗✓
3. $37.5 = 100$, Wednesday, with no marks or only one mark on diagram   award 1/2 ✗✓

Question			Generic scheme	Illustrative scheme	Max mark
2.			•^{1} Process: state limits •^{2} Process: identify unsuitable foals •^{3} Process/communication: calculate percentage that are not suitable	•^{1} 47.5 and 51.5 •^{2} 46.9, 47.0, 47.4, 51.6, 51.8 •^{3} 25%	3

Notes:
1. Correct answer without working   award 0/3
2. •^{2} can be awarded where the weights have been marked on the list.
3. •^{3} is only available for expressing their identified number of foals as a percentage of 20.

Commonly Observed Responses:
1. 47.5 and 51.5 ® no weights identified ® 25%   award 2/3 ✓✗✓
2. No limits stated ® 46.9, 47.0, 47.4, 51.6, 51.8 ® 25%   award 2/3 ✗✓✓
3. No limits stated ® no weights identified ® $\dfrac{5}{20} = 25\%$ award 1/3 ✗✗✓
4. No limits stated →46.9, 47.0, 47.4, 47.5, 51.5, 51.6, 51.8 → 35%   award 1/3 ✗✗✓
5. No limits stated ® no weights identified ® $\dfrac{5}{20}$ award 0/3 ✗✗✗

Question			Generic scheme	Illustrative scheme	Max mark
3.			•^{1} Process: calculate gross pay	•^{1} 345	**3**
			•^{2} Process: calculate left over money	•^{2} 270	
			•^{3} Process: calculate number of weeks	•^{3} $\left(470 \div 90 = 5.2...\right)$ leading to 6 weeks.	

Notes:
1. Correct answer without working   award 0/3
2. •^{3} is only available for calculations involving 470 with the exception of COR 2, COR 3 and COR 5.
3. •^{3} is available for an incomplete calculation eg $470 \div 90 = 5$ or $5... \rightarrow 6$.
4. Ignore errors in division calculations after the decimal point or in remainder.

Commonly Observed Responses:
1. $470 \div 90 = 6$ award 3/3 ✓✓✓
2. $540 \div 90 = 6$ award 3/3 ✓✓✓
3. $90 \times 6 = 540 \rightarrow 6$ award 3/3 ✓✓✓
4. $470 \div 90 \rightarrow 5 \text{ r } 20 \rightarrow 6$ award 3/3 ✓✓✓
5. $47 \div 9 \rightarrow 5 \text{ r } 2 \rightarrow 6$ award 3/3 ✓✓✓

Question			Generic scheme	Illustrative scheme	Max mark
4.			•^{1} Process: consistent units for numerator and denominator	•^{1} 850 and 1650 **OR** •^{1} 85 and 165	**2**
			•^{2} Process/communication: state gradient and give answer as fraction in simplest form	•^{2} $\dfrac{17}{33}$	

Notes:
1. Correct answer without working   award 2/2
2. •^{2} is not available when an attempt is made to further simplify a fraction already in its simplest form eg $\dfrac{17}{33} = \dfrac{1}{2}$
3. •^{2} is not available where candidates only give their answer as a decimal or a percentage.

Commonly Observed Responses:
1. $\dfrac{850}{165} \rightarrow \dfrac{170}{33}$ award 1/2 ✗✓
2. $\dfrac{850}{165}$ award 0/2 ✗✗
3. $\dfrac{165}{850} \rightarrow \dfrac{33}{170}$ award 0/2 ✗✗

	Question		Generic scheme	Illustrative scheme	Max mark
5.	(a)	(i)	$\bullet^1$ Process: determine the median	$\bullet^1$ 19	**2**
			$\bullet^2$ Process: find the upper and lower quartiles	$\bullet^2$ $Q_1 = 11$ $Q_3 = 24$	

Notes:

Ordered list: 7, 9, 10, 12, 13, 19, 19, 21, 22, 26, 34, 38.

1. The answers for (a)(i) can be inferred from the boxplot if not stated.
2. If the numbers are unordered, only $\bullet^2$ is available, see COR 1.
3. If **one** number is missed from or added to an **unordered** list, $\bullet^1$ and $\bullet^2$ are not available.
4. If **one** number is missed from or added to an **ordered** list,
   ➤ $\bullet^1$ is not available,
   ➤ $\bullet^2$ is only available when all three quartiles are consistent with candidate's list.
5. If **more than one** number is missed from or added to an **ordered** list, $\bullet^1$ and $\bullet^2$ are not available.

Commonly Observed Responses:
1. From unordered list: median = 23.5 and quartiles of 16 and 16.5.   award 1/2 ✗✓

			Generic scheme	Illustrative scheme	Max mark
		(ii)	$\bullet^3$ Communication: end points marked	$\bullet^3$ end points 7 and 38	**2**
			$\bullet^4$ Communication: Q_1, Q_2 and Q_3 marked and boxplot drawn	$\bullet^4$ box showing Q_1, Q_2 and Q_3	

Notes:
1. The answers for (a)(i) can be inferred from the boxplot if not stated.
2. If the candidate constructs a dot plot award 0/2.
3. $\bullet^4$ is not available for candidates who only mark the five figure summary using dots or crosses.
4. $\bullet^4$ cannot be awarded if more than 5 values are marked.
5. $\bullet^{3\&4}$ are still available when the calculated value of Q_2 does not lie between the calculated values of Q_1 and Q_3.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
5.	(b)	(i)	•⁵ Process: calculate interquartile range	•⁵ 13	**1**

Notes:
1. •⁵ must be consistent with quartiles from •².

Commonly Observed Responses:
1. IQR = 13, SIQR = 6.5   award 1/1 ✓
2. $13 \rightarrow 6.5$ award 0/1 ✗

		(ii)	•⁶ Communication: comment regarding consistency	•⁶ eg the number of films Tommy downloaded was more consistent	**1**

Notes:
1. Answer must be consistent with answer to (b)(i).
2. Numerical comparisons are not required but when used they must be accurate.
3. Comments **must** refer to films and/or downloads as well as Tommy and/or Megan.
4. For the award of •⁶

Accept eg
   a) Tommy's films are more consistent.
   b) The films Tommy downloads are less varied.
   c) Megan's number of films downloaded is more spread out.
   d) Megan's downloads are more varied.
   e) There was less variation in his number of films.

Do not accept eg
   f) **"On average"** contained in any statement.
   g) The **range** of Tommy's number of films is more consistent.
   h) Megan's **interquartile range** is more varied.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
6.			**Method 1** •^{1} Strategy: evidence of common denominator •^{2} Process: add fractions •^{3} Process: calculate the fraction of cake left over	•^{1} 12 or equivalent •^{2} $\dfrac{17}{12}$ •^{3} $\dfrac{7}{12}$ (or equivalent)	**3**
			Method 2 •^{1} Process: calculate the remaining fraction of each cake •^{2} Strategy: evidence of common denominator •^{3} Process: calculate the fraction of cake left over	•^{1} $\dfrac{1}{3}$ and $\dfrac{1}{4}$ •^{2} 12 or equivalent •^{3} $\dfrac{7}{12}$ (or equivalent)	

Notes:
1. Correct answer without working   award 0/3
2. In method 1, •^{2} can be implied by •^{3}.
3. In method 1, •^{3} is only available when the fraction is calculated by subtracting from 2.
4. In method 2, •^{3} is only available for adding the 2 fractions from •^{1}.
5. The final answer does not need to be in its simplest form.
6. Do not penalise incorrect simplification of final answer.
7. Candidates working in decimals must work to at least 3 decimal places for •^{2} to be awarded in method 1 or •^{3} in method 2.
8. Candidates working in percentages must work to at least 1 decimal place for •^{2} to be awarded in method 1 or •^{3} in method 2.

Commonly Observed Responses:
For candidates using method 1:

1. $\dfrac{2}{12}+\dfrac{3}{12}=\dfrac{5}{12}\rightarrow\dfrac{19}{12}$ award 2/3 ✓✗✓

2. $\dfrac{8}{12}+\dfrac{9}{12}=\dfrac{17}{24}\rightarrow\dfrac{31}{24}$ award 2/3 ✓✗✓

3. $\dfrac{8}{12}+\dfrac{9}{12}=\dfrac{17}{12}\rightarrow\dfrac{7}{24}$ award 2/3 ✓✓✗

4. $\dfrac{2}{12}+\dfrac{3}{12}=\dfrac{5}{12}\rightarrow\dfrac{7}{12}$ award 1/3 ✓✗✗

5. $\dfrac{8}{12}+\dfrac{9}{12}=\dfrac{17}{24}\rightarrow\dfrac{7}{24}$ award 1/3 ✓✗✗

6. $\dfrac{2}{3}+\dfrac{3}{4}=\dfrac{5}{7}\rightarrow\dfrac{9}{7}$ award 1/3 ✗✗✓

7. $\dfrac{2}{3}+\dfrac{3}{4}=\dfrac{5}{7}\rightarrow\dfrac{2}{7}$ award 0/3 ✗✗✗

For candidates using method 2:

8. $\dfrac{1}{3}+\dfrac{1}{4}=\dfrac{7}{12}\rightarrow\dfrac{5}{12}$ award 2/3 ✓✓✗

9. $\dfrac{1}{3}+\dfrac{1}{4}=\dfrac{7}{12}\rightarrow\dfrac{17}{12}$ award 2/3 ✓✓✗

	Question		Generic scheme	Illustrative scheme	Max mark
7.			**Method 1** $\bullet^1$ Process: calculate volume of triangular prism $\bullet^2$ Process: calculate volume of cuboid $\bullet^3$ Process: calculate total volume and convert to litres	$\bullet^1$ 1500 $\bullet^2$ 12 000 or 15 000 $\bullet^3$ 13.5 (litres)	**3**
			Method 2 $\bullet^1$ Process: calculate area of triangle $\bullet^2$ Process: calculate area of the cross section $\bullet^3$ Process: calculate total volume and convert to litres	$\bullet^1$ 75 $\bullet^2$ 675 $\bullet^3$ 13.5 (litres)	

Notes:
1. Correct answer without working   award 0/3
2. $\bullet^3$ is only available for converting a composite area or a composite volume to a volume in litres.

Commonly Observed Responses:

In method 1:
1. $1500 \rightarrow 1.5$ award 1/3 ✓✗✗
2. $12000 \rightarrow 12$ award 1/3 ✗✓✗
3. $15000 \rightarrow 15$ award 1/3 ✗✓✗

Question	Generic scheme	Illustrative scheme	Max mark
8.	$\bullet^1$ Process: calculate the number of boxes along the length and breadth of the van for one arrangement $\bullet^2$ Process: calculate the number of boxes along the length and breadth of the van for the other arrangement $\bullet^3$ Process/Communication: calculate the number of boxes in each arrangement and state maximum	$\bullet^1$ $(410 \div 60 =)\,6 \cdot \ldots$ $(190 \div 40 =)\,4 \cdot \ldots$ $\bullet^2$ $(410 \div 40 =)\,10 \cdot \ldots$ $(190 \div 60 =)\,3 \cdot \ldots$ $(220 \div 20 = 11)$ $\bullet^3$ $(6 \times 4 \times 11 =)\,264$ $(10 \times 3 \times 11 =)\,330$ Maximum: 330 boxes	**3**

Notes:
1. Correct answer without working   award 0/3
2. Where the candidate only considers volume   award 0/3
3. $\bullet^2$ can only be awarded where the 20 is consistent with the same dimension as $\bullet^1$.
4. $\bullet^3$ is still available if the candidate only states $6 \times 4 = 24$ instead of $6 \times 4 \times 11 = 264$.
5. Where the candidate considers more than two arrangements do not award $\bullet^3$.
6. Where the candidate only considers one arrangement a maximum of 1 mark is available.

Commonly Observed Responses:
1. $11 \times 4 \times 6 = 264$ and $20 \times 4 \times 5 = 400 \rightarrow 400$ boxes   award 2/3 ✓✗✓
2. $6 \times 4 \times 11 = 264$ and $6 \times 5 \times 9 = 270 \rightarrow 270$ boxes   award 2/3 ✓✗✓
3. $10 \times 3 \times 11 = 330$ and $10 \times 9 \times 3 = 270 \rightarrow 330$ boxes   award 2/3 ✗✓✓
4. $10 \times 3 \times 11 = 330$ and $20 \times 3 \times 5 = 300 \rightarrow 330$ boxes   award 2/3 ✗✓✓
5. $7, 5$ and $11, 4 \rightarrow 385$ and $484 \rightarrow 484$ boxes   award 2/3 ✗✓✓
6. $7, 5$ and $11, 4$ with incorrect or no total number of boxes   award 1/3 ✗✓✗

	Question		Generic scheme	Illustrative scheme	Max mark
9.			$\bullet^1$ Process: calculate arc length of one semi-circle or two quarter circles	$\bullet^1$ 62.8 or $31.4 + 31.4$	**2**
			$\bullet^2$ Process: calculate perimeter	$\bullet^2$ 422.8 (cm)	

Notes:
1. Correct answer without working   award 0/2
2. For candidates who use πr^2 award 0/2
3. BE AWARE
   62.8 can be calculated from a range of invalid methods.
4. $\bullet^1$ is not available where there is evidence that an incorrect diameter is used.
5. $\bullet^1$ is not available when the answer is a whole number eg $125.6 \div 2 = 63$.
6. $\bullet^2$ can only be awarded for $160 + 160 + 40$ added to the candidates calculated arc length.

Commonly Observed Responses:
1. $125.6 \div 2 = 62.8 \rightarrow 63 + 160 + 160 + 40 = 423$ award 2/2 ✓✓
2. $140 + 140 + 40 + 62.8 \rightarrow 382.8$ award 1/2 ✓✗
3. 360   award 0/2 ✗✗
4. 400   award 0/2 ✗✗

Question			Generic scheme	Illustrative scheme	Max mark
10.			**Method 1** •¹ Strategy/communication: identify fraction of N5 in 2023	•¹ $\dfrac{50}{120}$ or equivalent	**3**
			•² Strategy/process: express both N5 fractions in comparable form	•² $\dfrac{150}{360}$ and $\dfrac{144}{360}$ **OR** •² 0.416... and 0.4 or equivalent	
			•³ Communication: state conclusion consistent with working	•³ Yes, with evidence of 2 values in comparable form indicated	
			Method 2 •¹ Strategy/communication: identify fraction of N5 in 2023 or state the angle per pupil	•¹ $\dfrac{50}{120}$ or $3(°)$ or equivalent	
			•² Process: calculate angle for N5 in 2023	•² 150	
			•³ Communication: state conclusion consistent with working	•³ Yes, with evidence of 150 and 144 indicated	
			Method 3 •¹ Strategy/communication: identify fraction of N5 in 2022	•¹ $\dfrac{144}{360}$ or equivalent	
			•² Process: calculate fraction of 120	•² 48	
			•³ Communication: state conclusion consistent with working	•³ Yes, with evidence of 50 and 48 indicated	

Notes:
1. For all methods •¹ can be implied by •².
2. Where candidate selects the incorrect angle from the pie chart •³ is still available.
3. •³ can be awarded where a candidate states an increase of 6 when using method 2, or an increase of 2 when using method 3.

Commonly Observed Responses:

	Question		Generic scheme	Illustrative scheme	Max mark
11.	(a)		•^{1} Process: calculate scale distances	•^{1} 6 cm 4.5 cm	**3**
			•^{2} Process/communication: measure correct bearing from start	•^{2} Bearing of $227°(\pm1°)$ measured correctly from start point	
			•^{3} Process/communication: draw correct length from start, measure correct bearing, and draw correct length from first location	•^{3} $6cm(\pm0.1cm)$ drawn and a bearing of $152°(\pm1°)$ measured and $4.5cm(\pm0.1cm)$ drawn	

Notes:
1. •^{1} can be implied by drawing 2 lines of the correct length.
2. Candidates who draw 2 lines from the start point can receive a maximum mark of 2/3.
3. Bearing for both legs must be $\pm1°$ relative to the original North line.

Commonly Observed Responses:
1. 6 cm line with bearing of $227°$ and 4.5 cm line with bearing of $152°$ both drawn from start point   award 2/3 ✓✓✗

	Question		Generic scheme	Illustrative scheme	Max mark
	(b)		•^{4} Process/communication: state bearing consistent with diagram	•^{4} $016(°)$	**2**
			•^{5} Process/communication: state distance consistent with diagram	•^{5} 84 (km)	

Notes:
1. •^{4} and •^{5} are not available where a candidate has drawn both legs starting from the same start point in (a).
2. The third leg of the journey need not actually be drawn.
3. For •^{4} answer must be a **three** figure bearing.

Commonly Observed Responses:

[END OF MARKING INSTRUCTIONS]