National Qualifications 2024

2024 Mathematics

National 5 – Paper 2

Question Paper 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 5 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.

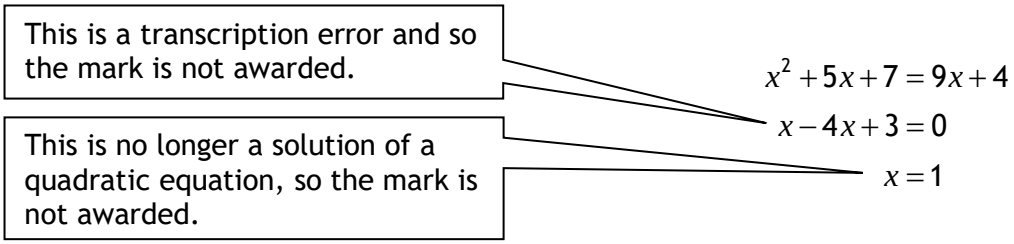
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(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.

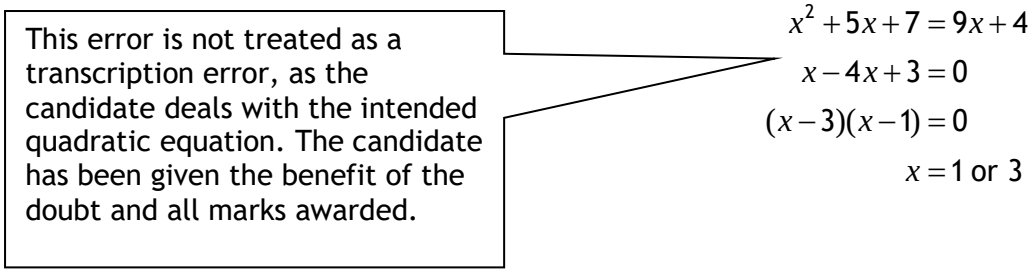
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(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) 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



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:

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

Horizontal: $\bigcirc^5$ $x=2$ and $x=-4$ Vertical: $\bigcirc^5$ $x=2$ and $y=5$
$\bigcirc^6$ $y=5$ and $y=-7$ $\bigcirc^6$ $x=-4$ 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 $\frac{4/5}{3}$ must be simplified to $\frac{4}{15}$

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

*The square root of perfect squares up to and including 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.	$\bullet^1$ know how to decrease by 26% $\bullet^2$ know how to calculate value $\bullet^3$ evaluate	$\bullet^1$ $\times 0.74$ $\bullet^2$ 460×0.74^3 $\bullet^3$ (£) 186.40	3

Notes:

1. Correct answer without working — award 3/3

2. For the award of $\bullet^3$ accept 186. However, do not accept 186.4 or 190.

3. For a year-by-year approach, accept
   eg $460\times 0.74=340.4(0)\rightarrow 340.4\times 0.74=251.9(0)$
   $\rightarrow 251.90\times 0.74(=186.406)=186.41$ or 186.40 or 186 — award 3/3

4. Disregard rounding subsequent to the correct answer.

5. Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3.
   eg $460\times 1.26^3=920.17$ or 920 — award 2/3 ×✓1✓1

6. Where an incorrect power (≥ 2) is used, the working must be followed through to give the possibility of awarding 2/3.
   eg $460\times 0.74^2=251.90$ or 252 — award 2/3 ✓×✓1

7. $\bullet^3$ is unavailable for incorrect working subsequent to correct answer
   eg $460\times 0.74^3=186.40\rightarrow 460-186.40=273.60$ — award 2/3 ✓✓×

8. Where division is used:
   (a) along with 0.74^3 $\bullet^1$ is not available.
   eg $460\div 0.74^3=1135.17$ or 1135 — award 2/3 ×✓1✓1
   (b) along with an incorrect percentage $\bullet^1$ and $\bullet^2$ are not available.
   eg $460\div 1.26^3=229.96$ or 230 — award 1/3 ××✓1

Commonly Observed Responses:

1. (a) $460\times 0.74^3=186.40304$ — award 2/3 ✓✓✓2
   (b) $460\times 0.74^3=186.403$ — award 2/3 ✓✓×
2. $460\times 0.74=340.40$ or 340 — award 1/3 ✓×✓2
3. $460\times 0.74\times 3=1021.20$ or 1021 — award 1/3 ✓×✓2
4. (a) $460\times 0.26=119.60\rightarrow 460-3\times 119.60=101.20$ — award 1/3 ✓×✓2
   (b) $460\times 0.26=120\rightarrow 460-3\times 120=100$ — award 1/3 ✓×✓2
5. $460\times 0.26\times 3=358.80$ or 359 — award 0/3 ××✓2

Question			Generic scheme	Illustrative scheme	Max mark
2.			$\bullet^1$ correct method $\bullet^2$ evaluate and write in scientific notation	$\bullet^1$ $1.22\times10^6\times250$ or equivalent $\bullet^2$ 3.05×10^8	**2**

Notes:

1. Correct answer without working — award 2/2

2. (a) For 305 000 000 — award 1/2 ✓✓2
   (b) For 305×10^6 — award 1/2 ✓×

3. For the award of $\bullet^2$
   (a) $\left(1.22\times10^6\times250=\right)3.05\times10^8=3.1\times10^8$ or 3×10^8 — award 2/2
   (b) $\left(1.22\times10^6\times250=\right)3.1\times10^8$ or 3×10^8 — award 1/2 ✓×

4. For subsequent incorrect working, $\bullet^2$ is not available.
   eg $250\div\left(1.22\times10^6\right)=2.049180328\times10^{-4}=2.05\times10^{-9}$ — award 0/2 ××

Commonly Observed Responses:

1. $1.22\times10^6\div250=4.88\times10^3$ — award 1/2 ×✓1

2. (a) $250\div\left(1.22\times10^6\right)=2.05\times10^{-4}$ or $2.049\ldots\times10^{-4}$ — award 1/2 ×✓1
   (b) $250\div\left(1.22\times10^6\right)=2.05\times10^8$ or $2.049\ldots\times10^8$ — award 0/2 ××

Question			Generic scheme	Illustrative scheme	Max mark
3.			$\bullet^1$ correct substitution into cosine rule	$\bullet^1$ $\dfrac{18^2+25^2-34^2}{2\times18\times25}$ stated or implied by $\bullet^2$	**3**
			$\bullet^2$ evaluate $\cos A$	$\bullet^2$ $-\dfrac{23}{100}$ or $\dfrac{-207}{900}$ or -0.23	
			$\bullet^3$ calculate angle	$\bullet^3$ $103(.29\ldots)$	

Notes:

1. Correct answer without working — award 0/3

2. Degree sign is not required.

3. For the award of $\bullet^1$ accept eg $34^2 = 18^2 + 25^2 - 2\times18\times25\times\cos A$

4. For the award of $\bullet^3$ accept $\cos A = 103(.29\ldots)$

5. Where wrong angle has been calculated correctly
   (a) $\dfrac{34^2+25^2-18^2}{2\times34\times25} = \dfrac{1457}{1700} \rightarrow 31(.01\ldots)$ — award 2/3 ×✓1✓1
   (b) $\dfrac{34^2+18^2-25^2}{2\times34\times18} = \dfrac{855}{1224} \rightarrow 46$ or $45.69\ldots$ — award 2/3 ×✓1✓1

6. **BEWARE** $180-(18+25+34)=103$ — award 0/3

7. Where more than one **final** angle is stated, $\bullet^3$ is not available
   eg $\dfrac{18^2+25^2-34^2}{2\times18\times25} \rightarrow -0.23 \rightarrow 103.3$ **and** 256.7 — award 2/3 ✓✓×

8. Inappropriate use of RAD or GRAD should only be penalised once in Qu3, Qu11 or Qu13
   (a) 2 or 1.80… RAD
   (b) 115 or 114.77… GRAD

Commonly Observed Responses:

1. $\dfrac{18^2+25^2-34^2}{2\times18\times25} \rightarrow -0.23 \rightarrow \cos^{-1}(0.23) = 76.7 \rightarrow 180-76.7 = 103.3$ — award 3/3

Question	Generic scheme	Illustrative scheme	Max mark
4.	$\bullet^1$ start to process left hand side $\bullet^2$ rearrange (collect constants on one side and variables on the other side) $\bullet^3$ solve for x	$\bullet^1$ $5x-10+4$ $\bullet^2$ $-14<2x$ or $-2x<14$ $\bullet^3$ $-7<x$ or $x>-7$	**3**

Notes:

1. Correct answer without valid working — award 0/3
   Treat repeated substitution as invalid working.

2. (a) There must be evidence that the candidate has dealt with the negative coefficient of x on the LHS of the inequation by either:
   (i) reversing the direction of the inequality sign at $\bullet^3$
   eg $5x-10+4<7x+8 \rightarrow -2x<22 \rightarrow x>-11$ — award 2/3 ✓×✓1
   OR (ii) collecting the x term(s) on the RHS of the inequation at $\bullet^2$
   eg $5x-10+4<7x+8 \rightarrow 2<2x \rightarrow 1<x$ — award 2/3 ✓×✓1
   (b) Where a candidate requires to do neither of the above, then $\bullet^3$ is not available
   eg $5x-10+4<7x+8 \rightarrow 2x<14 \rightarrow x<7$ — award 1/3 ✓××

3. For subsequent incorrect working, $\bullet^3$ is not available.
   eg (a) $-7<x \rightarrow x<-7$ — award 2/3 ✓✓×
   (b) $-7<x \rightarrow x=-7$ — award 2/3 ✓✓×

Commonly Observed Responses:

1. $5x-2+4<7x+8 \rightarrow -2x<6 \rightarrow x>-3$ — award 2/3 ×✓1✓1

2. (a) $5x-10+4=7x+8 \rightarrow -2x=14 \rightarrow x=-7 \rightarrow x>-7$ — award 3/3
   (b) $5x-10+4=7x+8 \rightarrow -2x=14 \rightarrow x=-7$ — award 2/3 ✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
5.			•[1] know that $116\% = 278.40$ •[2] begin valid strategy •[3] complete calculation within valid strategy	•[1] $116\% = 278.40$ •[2] eg $(1\% =)\dfrac{278.40}{116}$ •[3] (£) 240	**3**

Notes:

1. Correct answer without working — award 3/3

2. (a) $116\% = 278.40 \rightarrow 16\%$ of $278.40 = 44.54$ — award 1/3 ✓××
   (b) 16% of $278.40 = 44.54$ — award 0/3

3. (a) $116\% = 278.40 \rightarrow 116\%$ of $278.40 = 322.94$ — award 1/3 ✓××
   (b) 116% of $278.40 = 322.94$ — award 0/3

4. (a) $116\% = 278.40 \rightarrow 84\%$ of $278.40 = 233.86$ — award 1/3 ✓××
   (b) 84% of $278.40 = 233.86$ — award 0/3

Commonly Observed Responses:

1. $\dfrac{278.40}{1.16} = 240$ — award 3/3

2. $\dfrac{278.40}{84} = 3.31428\ldots \rightarrow 331.43$ — award 2/3 ×✓1✓1

Question			Generic scheme	Illustrative scheme	Max mark
6.	(a)		•1 factorise	•1 $y(y-6)$	1

Notes:

1. If part (a) is not attempted, accept correct answer to part (a) in part (b) (see COR 1).

Commonly Observed Responses:

1. $(y-6)(y\pm0)$ award 0/1 ✓2

2. See CORs in part (b).

	(b)		•2 factorise denominator •3 simplify	•2 $(y-6)(y+3)$ •3 $\frac{y}{y+3}$	2

Notes:

1. Correct answer without working award 2/2

2. For subsequent incorrect working •3 is not available eg $\frac{\cancel{y}}{\cancel{y}+3}=\frac{1}{1+3}=\frac{1}{4}$ award 1/2 ✓×

3. •3 is only available when both the numerator and denominator have at least two factors.

4. Do not penalise the use of $(y-6)(y\pm0)$ in part (b) if already penalised in part (a)

   ie (a) $(y-6)(y\pm0)$ (b) $\frac{(y-6)(y\pm0)}{(y-6)(y+3)}=\frac{y\pm0}{y+3}$ award 0/1 in (a) ✓2 and award 2/2 in (b) ✓✓1

5. Where the answer to part (a) and the numerator in part (b) are different, see CORs below.

Commonly Observed Responses:

For answers in parts (a) and (b) award as follows:

1. (a) No response (b) $\frac{y(y-6)}{(y-6)(y+3)}=\frac{y}{y+3}$ award 1/1 in (a) ✓ and award 2/2 in (b) ✓✓

2. (a) $y(y-6)$ (b) $\frac{(y-3)(y+3)}{(y-6)(y+3)}=\frac{y-3}{y-6}$ award 1/1 in (a) ✓ and award 1/2 in (b) ✓×

3. (a) $(y-3)(y+3)$ (b) $\frac{y(y-6)}{(y-6)(y+3)}=\frac{y}{y+3}$ award 0/1 in (a) × and award 2/2 in (b) ✓✓

4. (a) $(y-3)(y+3)$ (b) $\frac{(y-3)(y+3)}{(y-6)(y+3)}=\frac{y-3}{y-6}$ award 0/1 in (a) × and award 2/2 in (b) ✓✓1

5. (a) $(y-3)(y+3)$ (b) $\frac{(y-6)(y\pm0)}{(y-6)(y+3)}=\frac{y\pm0}{y+3}$ award 0/1 in (a) × and award 1/2 in (b) ✓×

6. (a) $(y-6)(y+2y)$ (b) $\frac{(y-6)(y+2y)}{(y-6)(y+3)}=\frac{y+2y}{y+3}$ award 0/1 in (a) × and award 1/2 in (b) ✓✓2

Question	Generic scheme	Illustrative scheme	Max mark
7.	$\bullet^1$ correct substitution into volume of **sphere** formula	$\bullet^1$ $\frac{4}{3}\times\pi\times3^3$	**4**
	$\bullet^2$ correct substitution into volume of cuboid formula and know to subtract volume of **hemisphere** from volume of cuboid	$\bullet^2$ $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3$ $(=196-56.54\ldots)$
	$\bullet^3$ consistent calculation (see Note 3)	$\bullet^3$ $139.45\ldots$
	$\bullet^4$ round final answer to 2 significant figures **and** state correct units	$\bullet^4$ $140\ \text{cm}^3$

Notes:

1. Correct answer without working — award 0/4

2. For the award of $\bullet^3$, the calculation must involve the sum or difference of a calculation involving a fraction, π and a power, and a calculation of a product of at least two numbers.

3. Accept variations in π to at least two decimal places

   eg $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times3.14\times3^3=139.48=140\,\text{cm}^3$

4. Disregard errors due to premature rounding provided there is evidence. However do not accept rounding of $\frac{4}{3}$ to fewer than 2 decimal places

eg (a) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=196-0.5\times1.33\times3.14\times3^3=196-56.38=139.62\rightarrow140\,\text{cm}^3$

award 4/4

(b) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=196-0.5\times1.3\times3.14\times3^3=196-55.1=140.9\rightarrow140\,\text{cm}^3$

award 3/4 ✓✓×✓1

(c) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=196-56.38=139.62\rightarrow140\,\text{cm}^3$ award 3/4 ✓✓×✓1

5. (a) In awarding $\bullet^3$ answers to intermediate calculations which are **whole numbers** should not be rounded

eg (i) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=196-57=139\rightarrow140\,\text{cm}^3$ award 4/4

(ii) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=200-57=143\rightarrow140\,\text{cm}^3$ award 3/4 ✓✓×✓1

(b) In awarding $\bullet^4$ intermediate calculations need not be shown

eg $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=140\,\text{cm}^3$ award 4/4

6. $\bullet^4$ is only available where the final answer requires rounding

eg $7\times7\times4-\frac{4}{3}\times\pi\times3^3=196-113=83\text{cm}^3$ award 2/4 ✓×✓1×

Question	Generic scheme	Illustrative scheme	Max mark

7. (continued)

Commonly Observed Responses:

1. $7\times7\times4-\frac{4}{3}\times\pi\times3^3=82.902\ldots=83\,\text{cm}^3$ award 3/4 ✓×✓1✓1

2. (a) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times6^3=-256.389\ldots=-260\,\text{cm}^3$ award 2/4 ×✓1✓1×

   (b) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times6^3=256.389\ldots=260\,\text{cm}^3$ award 2/4 ×✓1×✓1

   (c) $\frac{1}{2}\times\frac{4}{3}\times\pi\times6^3-7\times7\times4=256.389\ldots=260\,\text{cm}^3$ award 2/4 × ×✓1✓1

3. (a) $7\times7\times4+\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=252.5\ldots=250\,\text{cm}^3$ award 3/4 ✓×✓1✓1

   (b) $7\times7\times4+\frac{4}{3}\times\pi\times3^3=309.09\ldots=310\,\text{cm}^3$ award 3/4 ✓×✓1✓1

   (c) $7\times7\times4+\frac{1}{2}\times\frac{4}{3}\times\pi\times6^3=648.389\ldots=650\,\text{cm}^3$ award 2/4 ××✓1✓1

4. (a) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^2=177.15\ldots=180\,\text{cm}^3$ award 3/4 ×✓✓1✓1

   (b) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=177.15\ldots=180\,\text{cm}^3$ award 3/4 ✓✓×✓1

   (c) $7\times7\times4-\frac{1}{2}\times\frac{4}{3}\times\pi\times3=189.71\ldots=190\,\text{cm}^3$ award 2/4 ×✓✓2✓1

5. (a) $\frac{4}{3}\times\pi\times3^3=110\,\text{cm}^3$ award 2/4 ✓×✓2✓1

   (b) $\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3=57\,\text{cm}^3$ award 2/4 ✓×✓2✓1

6. (a) $\frac{4}{3}\times\pi\times6^3=900\,\text{cm}^3$ award 1/4 × ×✓2✓1

   (b) $\frac{1}{2}\times\frac{4}{3}\times\pi\times6^3=450\,\text{cm}^3$ award 1/4 ××✓2✓1

7. $7\times7\times4=200\ \text{cm}^3$ award 1/4 ××✓2✓1

Question	Generic scheme	Illustrative scheme	Max mark
8.	$\bullet^1$ correct substitution into quadratic formula $\bullet^2$ evaluate discriminant $\bullet^3$ calculate both roots correct to two decimal places	$\bullet^1$ $\frac{-8\pm\sqrt{8^2-4\times3\times1}}{2\times3}$ $\bullet^2$ 52 (stated or implied by $\bullet^3$) $\bullet^3$ $-0.13,\ -2.54$	**3**

Notes:

1. Correct answer without working — award 0/3

2. For a solution obtained by repeated substitution — award 0/3

3. $\bullet^2$ is available for $\frac{-4\pm\sqrt{13}}{3}$

4. For the award of $\bullet^2$ accept $\pm0.131\ldots$ or $\pm2.535\ldots$ (or rounded to two decimal places) as evidence of the discriminant.

5. $\bullet^3$ is only available when $b^2-4ac>0$ and the roots require rounding.

6. For subsequent incorrect working $\bullet^3$ is not available
   eg $\frac{-8\pm\sqrt{8^2-4\times3\times1}}{2\times3}\rightarrow-0.13,-2.54\rightarrow\mathbf{0.13},-2.54$ — award 2/3 ✓✓×

Commonly Observed Responses:

1. 52 $\left(b^2-4ac\right)$ — award 1/3 ×✓×

2. (a) $-8\pm\frac{\sqrt{8^2-4\times3\times1}}{2\times3}\rightarrow-8\frac{\pm\sqrt{52}}{6}\rightarrow-0.13,-2.54$ — award 3/3

   (b) $-8\pm\frac{\sqrt{8^2-4\times3\times1}}{2\times3}\rightarrow-8\frac{\pm\sqrt{52}}{6}\rightarrow-6.80,-9.20$ — award 2/3 ×✓✓1

3. (a) $\frac{-3\pm\sqrt{3^2-4\times8\times1}}{2\times8}\rightarrow\frac{-3\pm\sqrt{-23}}{2\times8}\rightarrow0.11,-0.49$ — award 1/3 ×✓1×

   (b) $\frac{-3\pm\sqrt{3^2-4\times8\times1}}{2\times8}\rightarrow\frac{-3\pm\sqrt{23}}{2\times8}\rightarrow0.11,-0.49$ — award 0/3 ×××

   (c) $\frac{-8\pm\sqrt{8-4\times3\times1}}{2\times3}\rightarrow\frac{-8\pm\sqrt{-4}}{6}\rightarrow-1.00,-1.67$ — award 0/3 ×✓2×

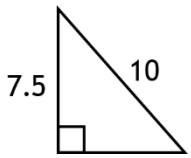
Question			Generic scheme	Illustrative scheme	Max mark
9.			•1 multiply by e •2 subtract 3 •3 divide by 2	•1 $ef = 2d + 3$ •2 $ef - 3 = 2d$ •3 $d = \frac{ef - 3}{2}$	**3**

Notes:

1. For a correct answer without working — award 0/3
2. For the award of •3 accept $d = \frac{e \times f - 3}{2}$ or $d = (ef - 3) \div 2$ or $d = \frac{ef}{2} - \frac{3}{2}$
3. **BEWARE** $ef = 2d + 3 \rightarrow \frac{ef}{2} = d + 3 \rightarrow d = \frac{ef - 3}{2}$ — award 1/3 ✓××

Commonly Observed Responses:

1. $ef = 2d + 3 \rightarrow ef - 3 = 2d \rightarrow d = ef - 3 \div 2$ — award 2/3 ✓✓×
2. $ef = 2d + 3 \rightarrow 3ef = 2d \rightarrow \frac{3ef}{2} = d$ — award 1/3 ✓×✓2

Question	Generic scheme	Illustrative scheme	Max mark
10.	$\bullet^1$ marshal facts and recognise right-angled triangle (diagram must include right angle)	$\bullet^1$ 	**4**
	$\bullet^2$ consistent Pythagoras statement	$\bullet^2$ $10^2 - 7.5^2$	
	$\bullet^3$ calculate third side	$\bullet^3$ $6.6\ldots$	
	$\bullet^4$ calculate width	$\bullet^4$ $33.2(\ldots\text{cm})$	

Notes:

1. Correct answer without working — award 0/4

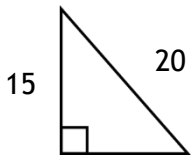
2. In the absence of a diagram or diagram with no right angle marked accept $10^2 - 7.5^2$ or $20^2 - 15^2$ as evidence for the award of $\bullet^1$ and $\bullet^2$.

3. For the award of $\bullet^2$ accept $10^2 = x^2 + 7.5^2$ or $20^2 = x^2 + 15^2$.

4. **BEWARE**
   (a) Where a diagram is shown, working must be consistent with the diagram.
   (b) $\bullet^2$ is not available for an **incorrect** diagram leading to $10^2 - 7.5^2$.

5. $\bullet^4$ is only available following a Pythagoras or trigonometric calculation within a **valid** right-angled triangle using side lengths of either 10 and 7.5 or 20 and 15.

6. Alternative method:

$\bullet^1$ 

$\bullet^2$ $20^2 - 15^2$
$\bullet^3$ $13.2\ldots$
$\bullet^4$ $33.2(\ldots\text{cm})$

Commonly Observed Responses:

1. $10^2 + 7.5^2 \rightarrow 12.5 \rightarrow 45$
   (a) working inconsistent with correct diagram — award 3/4 ✓×✓1✓1
   (b) working consistent with candidate's diagram — award 3/4 ×✓1✓1✓1
   (cosine rule may be used to calculate third side)
   (c) no diagram or diagram with no right angle marked — award 2/4 ××✓1✓1

2. $15^2 - 10^2 \rightarrow 11.18\ldots \rightarrow 42.36$ (see Note 5)
   (a) working consistent with candidate's diagram — award 2/4 ×✓1✓1×
   (b) no diagram or diagram with no right angle marked — award 1/4 ××✓1×

Question	Generic scheme	Illustrative scheme	Max mark
11.	$\bullet^1$ re-arrange equation $\bullet^2$ find one value of x $\bullet^3$ find second value of x	$\bullet^1$ $\sin x = \frac{8}{17}$ $\bullet^2$ $28(.07\ldots)$ $\bullet^3$ $151.9(2\ldots)$ or 152	**3**

Notes:

1. Correct answers
   (a) without working — award 1/3 ××✓1
   (b) by repeated substitution — award 1/3 ××✓1

2. Degree signs are not required.

3. Do not penalise premature or incorrect rounding provided given answers round to 28 and 152.

4. Where more than two **final** values are stated, $\bullet^3$ is not available
   eg $\sin x = \frac{8}{17} \rightarrow 28,\ 152,\ 208$ — award 2/3 ✓✓×

5. Inappropriate use of RAD or GRAD should only be penalised once in Qu3, Qu11 or Qu13
   (a) $\sin^{-1}\left(\frac{8}{17}\right) = 0{\cdot}4899\ldots \rightarrow 0{\cdot}5,\ 179{\cdot}5$ (RAD)
   (b) $\sin^{-1}\left(\frac{8}{17}\right) = 31{\cdot}19\ldots \rightarrow 31,\ 149$ (GRAD)

Commonly Observed Responses:

1. If $\sin x < 0$, $\bullet^2$ and $\bullet^3$ are only available for consistent 3rd and 4th quadrant angles
   eg $\sin x = -\frac{8}{17} \rightarrow 208,\ 332$ — award 2/3 ×✓1✓1

2. (a) $\sin x = \frac{10}{17} \rightarrow x = 36.03, 143.97\ (\rightarrow 36, 144)$ — award 2/3 ×✓1✓1
   (b) $\sin x = \frac{10}{17} \rightarrow \sin x = 0.59 \rightarrow x = 36.16, 143.84\ (\rightarrow 36, 144)$ — award 2/3 ×✓1✓1
   (c) $\sin x = \frac{10}{17} \rightarrow \sin x = 0.58 \rightarrow x = 35.45, 144.55\ (\rightarrow 35, 145)$ — award 1/3 ××✓1

Question	Generic scheme	Illustrative scheme	Max mark
12.	•1 correct denominator •2 correct numerator(s). •3 express in simplest form (remove brackets in numerator and collect like terms)	•1 $(x+5)(x-4)$ •2 $2(x-4)+3(x+5)$ •3 $\frac{5x+7}{(x+5)(x-4)}$	3

Notes:

1. Correct answer without working. award 3/3

2. Accept $\frac{2(x-4)}{(x+5)(x-4)}+\frac{3(x+5)}{(x+5)(x-4)}$ for the award of •1 and •2

3. Do not accept $x+5(x-4)$ or $(x+5)x-4$ or $x+5\times x-4$ for the award •1 unless the correct expansion or the brackets appear in the final answer.
   (a) $\frac{2(x-4)}{x+5\times x-4}+\frac{3(x+5)}{x+5\times x-4}\rightarrow\frac{5x+7}{x^2+x-20}$ or $\frac{5x+7}{(x+5)(x-4)}$ award 3/3
   (b) $\frac{2(x-4)}{x+5\times x-4}+\frac{3(x+5)}{x+5\times x-4}\rightarrow\frac{5x+7}{x+5\times x-4}$ award 2/3 ×✓✓1

4. Where a candidate chooses to expand the brackets in the denominator, then •3 is only available for a consistent expansion (unless incorrect expansion already appears at •1)
   eg
   (a) $\frac{2(x-4)}{(x+5)(x-4)}+\frac{3(x+5)}{(x+5)(x-4)}=\frac{5x+7}{x^2+x-20}$ award 3/3
   (b) $\frac{2(x-4)}{(x+5)(x-4)}+\frac{3(x+5)}{(x+5)(x-4)}=\frac{5x+7}{x^2-20}$ award 2/3 ✓✓×
   (c) $\frac{2(x-4)}{x^2-20}+\frac{3(x+5)}{x^2-20}=\frac{5x+7}{x^2-20}$ award 2/3 ×✓✓1

5. For subsequent incorrect working, •3 is not available
   eg
   $\frac{2(x-4)}{(x+5)(x-4)}+\frac{3(x+5)}{(x+5)(x-4)}=\frac{5x+7}{x^2+x-20}=\frac{5+7}{x^2-20}=\frac{12}{x^2-20}$ award 2/3 ✓✓×

Commonly Observed Responses:

1. $\frac{2x-8}{(x+5)(x-4)}+\frac{3x+15}{(x+5)(x-4)}=\frac{5x-23}{(x+5)(x-4)}$ award 2/3 ✓✓×

2. $\frac{2x-4}{(x+5)(x-4)}+\frac{3x+5}{(x+5)(x-4)}=\frac{5x+1}{(x+5)(x-4)}$ award 1/3 ✓××

Question			Generic scheme	Illustrative scheme	Max mark
13.			**Method 1** •^{1} correct substitution into sine rule	•^{1} $\frac{BC}{\sin 40} = \frac{22}{\sin 110}$	**5**
			•^{2} re-arrange formula	•^{2} $\frac{22\sin 40}{\sin 110}$	
			•^{3} calculate BC	•^{3} 15.0…	
			•^{4} consistent substitution into appropriate trig formula	•^{4} $\sin 30 = \frac{BD}{15.0\ldots}$ or $\frac{BD}{\sin 30} = \frac{15.0\ldots}{\sin 90}$	
			•^{5} calculate BD	•^{5} 7.5 (cm)	
			Method 2 •^{1} correct substitution into sine rule	•^{1} $\frac{AB}{\sin 30} = \frac{22}{\sin 110}$	
			•^{2} re-arrange formula	•^{2} $\frac{22\sin 30}{\sin 110}$	
			•^{3} calculate AB	•^{3} 11.7…	
			•^{4} consistent substitution into appropriate trig formula	•^{4} $\sin 40 = \frac{BD}{11.7\ldots}$ or $\frac{BD}{\sin 40} = \frac{11.7\ldots}{\sin 90}$	
			•^{5} calculate BD	•^{5} 7.5 (cm)	

Question	Generic scheme	Illustrative scheme	Max mark

13. (continued)

Notes:

1. Correct answer without working award 0/5

2. Do not penalise omission of degree signs.

3. Disregard errors due to premature rounding provided there is evidence.
   However, do not accept sin40 or sin110 rounded to less than 2 decimal places.
   eg BC = $\frac{22\sin 40}{\sin 110} = \frac{22 \times 0.6}{0.9} = \frac{13.2}{0.9} = 14.7 \rightarrow BD = 14.7 \sin 30 = 7.35$ award 4/5 ✓✓×✓1✓1

4. (a) Where both AB and BC are calculated correctly and there is no further working
   award 3/5 ✓✓✓××
   (b) Where both AB and BC are calculated but one is calculated incorrectly, if there is:
   (i) further working, then apply the MIs based on the length used to calculate BD
   (ii) no further working, disregard incorrect length ie award 3/5 ✓✓✓××

5. Alternative strategies for •^{4}
   eg (a) •^{4} $\sin 60 = \frac{DC}{15.0\ldots}$ $(DC = 12.99\ldots) \rightarrow \sqrt{(15.0\ldots)^2 - DC^2}$
   (b) •^{4} Area = $\frac{1}{2} \times 22 \times 15(.048\ldots) \times \sin 30$ $(\text{Area} = 82.768\ldots) \rightarrow \frac{1}{2} \times 22 \times BD = \text{Area}$

6. Inappropriate use of GRAD or RAD should only be penalised once in Qu3, Qu11 or Qu13
   (a) 6 or 5.9(4…) (GRAD)
   (b) (RAD)
   (i) AB = 491 → BD = 366
   (ii) BC = ±371 → BD = 366 but •^{3} is not available due to the negative length of BC

Commonly Observed Responses:

1. (a) $\frac{x}{\sin 40} = \frac{22}{\sin 30} \rightarrow x = 28$ award 2/5 ×✓1✓1^^

   (b) $\frac{x}{\sin 30} = \frac{22}{\sin 40} \rightarrow x = 17$ award 2/5 ×✓1✓1^^

2. eg $\frac{AB}{30} = \frac{22}{110} \rightarrow AB = 6 \rightarrow BD = 6 \times \sin 40 = 3.9$ or 4 award 2/5 ×××✓1✓1

Question			Generic scheme	Illustrative scheme	Max mark
14.	(a)		$\bullet^1$ state vector	$\bullet^1$ $\mathbf{b}-\mathbf{a}$ or $-\mathbf{a}+\mathbf{b}$	**1**
Notes: 1. For the award of $\bullet^1$ accept $\mathbf{b}+-\mathbf{a}$.					
Commonly Observed Responses:					
	(b)		$\bullet^2$ valid pathway $\bullet^3$ Express $\overrightarrow{WM}$ in terms of $\mathbf{a}$ and $\mathbf{b}$ in simplest form	$\bullet^2$ $\mathbf{b}-\mathbf{a}-\frac{1}{2}\mathbf{a}$ **OR** $\overrightarrow{WX}+\frac{1}{2}\overrightarrow{XY}$ or equivalent $\bullet^3$ $\mathbf{b}-\frac{3}{2}\mathbf{a}$	**2**

Notes:

1. Correct answer with no working award 2/2

2. $\overrightarrow{WX}+\overrightarrow{XM}$ or $\overrightarrow{WZ}+\overrightarrow{ZX}+\overrightarrow{XM}$ is not enough for the award of $\bullet^2$

3. For the award of $\bullet^2$ accept:
   (a) $\overrightarrow{WZ}+\overrightarrow{ZX}+\frac{1}{2}\overrightarrow{XY}$
   (b) $\overrightarrow{WZ}+\overrightarrow{ZY}+\frac{1}{2}\overrightarrow{YX}$

4. For the award of $\bullet^3$ accept $\mathbf{b}+-\frac{3}{2}\mathbf{a}$, $\mathbf{b}-1\frac{1}{2}\mathbf{a}$ or $\mathbf{b}-1.5\mathbf{a}$.

5. Answer must be consistent with part (a) except in the case of Note 6.
   eg (i) (a) $\mathbf{a}-\mathbf{b}$ (b) $\mathbf{a}-\mathbf{b}+\frac{1}{2}\mathbf{a}=\frac{3}{2}\mathbf{a}-\mathbf{b}$ award 0/1 in (a) × and award 2/2 in (b) ✓1✓1
   (ii) (a) $\mathbf{a}-\mathbf{b}$ (b) $\mathbf{a}-\mathbf{b}-\frac{1}{2}\mathbf{a}=\frac{1}{2}\mathbf{a}-\mathbf{b}$ award 0/1 in (a) × and award 1/2 in (b) ×✓1
   (iii) (a) $\mathbf{a}+\mathbf{b}$ (b) $\mathbf{a}+\mathbf{b}+\frac{1}{2}\mathbf{a}=\frac{3}{2}\mathbf{a}+\mathbf{b}$ award 0/1 in (a) × and award 2/2 in (b) ✓1✓1
   (iv) (a) $\mathbf{a}+\mathbf{b}$ (b) $\mathbf{a}+\mathbf{b}-\frac{1}{2}\mathbf{a}=\frac{1}{2}\mathbf{a}+\mathbf{b}$ award 0/1 in (a) × and award 1/2 in (b) ×✓1

6. An answer in part (b) which has been **clearly** found independently of part (a) may gain full or partial credit in part (b).
   eg (a) $\mathbf{a}-\mathbf{b}$ (b) $\mathbf{b}-\mathbf{a}-\frac{1}{2}\mathbf{a}=\mathbf{b}-\frac{3}{2}\mathbf{a}$ award 0/1 in (a) × and award 2/2 in (b) ✓✓

Commonly Observed Responses:

For answer in parts (a) and (b) award as follows:

1. (a) $\mathbf{b}-\mathbf{a}$ (b) $\mathbf{b}-\mathbf{a}+\frac{1}{2}\mathbf{a}=\mathbf{b}-\frac{1}{2}\mathbf{a}$ award 1/1 in (a) ✓ and award 1/2 in (b) ×✓1

Question	Generic scheme	Illustrative scheme	Max mark
15.	**Method 1** •1 correct fraction •2 know how to calculate sector area •3 calculate sector area **Method 2** •1 start strategy for finding angle •2 know how to calculate sector area •3 calculate sector area	**Method 1** •1 $\frac{15}{\pi\times 24}\quad(=0.198\ldots)$ •2 $\frac{15}{\pi\times 24}\times\pi\times 12^2$ •3 $90\left(\text{cm}^2\right)$ **Method 2** •1 $15=\frac{\text{angle}}{360}\times\pi\times 24$ •2 $\frac{15}{\pi\times 24}\times 360=\text{angle}$ $\rightarrow(\text{area}=)\frac{\text{angle}}{360}\times\pi\times 12^2$ •3 $90\left(\text{cm}^2\right)$	**3**

Notes:

1. Correct answer without working — award 0/3

2. •2 is not available for simply calculating the angle at the centre of the sector
   ie $\frac{15}{\pi\times 24}\times 360=71.6197\ldots$ — award 1/3 ✓✓2^

3. Accept variations and inconsistencies in the use of π provided there is evidence.

4. Do not penalise premature or incorrect rounding provided given answer rounds to 90 to the nearest whole number. However, see Note 5.

5. Where method 2 is used, accept angle calculations rounded to the nearest degree
   e.g $\frac{15}{\pi\times 24}\times 360=72\rightarrow\frac{72}{360}\times\pi\times 12^2=90.47\ldots$ or $90.5\left(\text{cm}^2\right)$ — award 3/3

6. Where an angle is assumed or calculated using an invalid strategy (eg cosine rule), •3 is not available
   eg $\frac{73}{360}\times\pi\times 12^2=91.7\ldots\left(\text{cm}^2\right)$ — award 0/3
   However, see CORs 1 and 2 for special cases.

7. For subsequent incorrect working, the final mark is not available
   e.g. $\pi\times 12^2-\frac{15\times\pi\times 12^2}{\pi\times 24}=362(.38\ldots.)$ — award 2/3 ✓✓×

Question	Generic scheme	Illustrative scheme	Max mark
15. (continued)			
Commonly Observed Responses: 1. $\frac{15}{\pi\times12^2}\times360=11.9\ldots\rightarrow\frac{11.9\ldots}{360}\times\pi\times24=2.5\left(\text{cm}^2\right)$ award 2/3 ×✓1✓1 **2.** $\frac{15}{\pi\times12^2}\times360=11.9\ldots\rightarrow\frac{11.9\ldots}{360}\times\pi\times12^2=15\left(\text{cm}^2\right)$ award 1/3 ××✓1 3. (a) $\frac{15}{360}\times\pi\times24=3.14\ldots\left(\text{cm}^2\right)$ award 0/3 (b) $\frac{15}{360}\times\pi\times12^2=18.8\ldots\left(\text{cm}^2\right)$ award 0/3			
16.	•1 valid substitution •2 express in the form $a+b\sin^2x^\circ$	•1 eg $3\left(1-\sin^2x\right)-1$ •2 $2-3\sin^2x$	**2**
Notes: 1. Correct answer without working award 0/2 2. Do not penalise omission of degree signs. 3. Accept $-3\sin^2x+2$ award 2/2 4. Do not accept $\sin x^2$ eg $3\left(1-\sin x^2\right)-1=2-3\sin x^2$ award 1/2 ×✓1 5. •1 is not available if there are no variables eg $3\left(1-\sin^2\right)-1=2-3\sin^2$ award 1/2 ×✓1 6. •1 is not available if the candidate simply states eg $\cos^2x=1-\sin^2x$ then proceeds no further. 7. •2 is not available if there is invalid subsequent working.			
Commonly Observed Responses: 1. (a) $3\cos^2x-\left(\sin^2x+\cos^2x\right)=2\cos^2x-\sin^2x$ award 0/2 ✓2 ^ (b) $3\cos^2x-\left(\sin^2x+\cos^2x\right)=2\cos^2x-\sin^2x=2\left(1-\sin^2x\right)-\sin^2x$ award 1/2 ✓ ^			

[END OF MARKING INSTRUCTIONS]