National
Qualifications
2023

# 2023 Mathematics

# Paper 1 – (Non-calculator)

# National 5

# Finalised Marking Instructions



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



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**Marking Instructions for each question**

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **1.** | •1 convert to improper fraction and multiply by the reciprocal<br>•2 consistent answer | •1 $\frac{13}{6}\times\frac{9}{8}$<br>•2 $\frac{39}{16}$ or $2\frac{7}{16}$ | **2** |

**Notes:**

1. Correct answer without working — award 0/2
2. Final answer must be in simplest form, eg $\frac{13}{6}\times\frac{9}{8}=\frac{117}{48}$ — award 1/2 ✓✓2
3. •2 is only available where simplifying is required.
4. Do not penalise incorrect conversion of $\frac{39}{16}$ to a mixed number.

**Commonly Observed Responses:**

1. $\frac{13}{6}\times\frac{8}{9}=\frac{52}{27}$ — award 1/2 ×✓1
2. $\frac{6}{13}\times\frac{8}{9}=\frac{16}{39}$ — award 1/2 ×✓1
3. (a) $\frac{13}{6}\times\frac{9}{8}\rightarrow\frac{6}{13}\times\frac{9}{8}=\frac{27}{52}$ — award 1/2 ✓×
   (b) $\frac{6}{13}\times\frac{9}{8}=\frac{27}{52}$ — award 1/2 ×✓1
4. $2\frac{1}{6}\times\frac{9}{8}\rightarrow 2\frac{1}{2}\times\frac{3}{8}\rightarrow 2\frac{3}{16}$ — award 0/2

| | | | |
|---|---|---|---|
| **2.** | •1 start expansion<br>•2 complete expansion<br>•3 collect like terms (see Note 2) | •1 $x^2 + 7x + 7x + 49$ or $6x^2 - 60$<br>•2 $x^2 + 7x + 7x + 49 + 6x^2 - 60$<br>•3 $7x^2 + 14x - 11$ | **3** |

**Notes:**

1. Correct answer without working — award 3/3
2. For the award of •3, the evidence at •2 must include an $x^2$ term. At least one negative term must be collected with another term.
3. For subsequent incorrect working, the final mark is not available.

**Commonly Observed Responses:**

1. $x^2 + 49 + 6x^2 - 60 = 7x^2 - 11$ — award 2/3 ✓×✓1

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **3.** | | | •[1] correct scaling | •[1] eg $10x+15y=40$, $10x+4y=-4$<br>**OR** $4x+6y=16$, $15x+6y=-6$ | **3** |
| | | | •[2] value for one variable | •[2] $x=-2$ or $y=4$ | |
| | | | •[3] value for other variable | •[3] $y=4$ or $x=-2$ | |

**Notes:**

1. Correct answers without working — award 0/3
2. Answers obtained by repeated substitution — award 0/3
3. Following an earlier error, accept rounded answers given to at least 1 decimal place.

**Commonly Observed Responses:**

| | | | | | |
|---|---|---|---|---|---|
| **4.** | (a) | (i) | •[1] state value of $a$ | •[1] $-3$ | **1** |
| | | (ii) | •[2] state value of $b$ | •[2] 2 | **1** |

**Notes:**

1. Where the values of $a$ and $b$ are not stated explicitly, for a final answer of $y = (x - 3)^2 + 2$ — award 1/1 for (i) and 1/1 for (ii)
2. For an answer of $a = 2$, $b = -3$ — award 0/1 mark for (i) and 1/1 for (ii) ×✓1

**Commonly Observed Responses:**

1. $y=(x-3)^2+2 \rightarrow a=3,\ b=2$ — award 0/1 mark for (i) and 1/1 for (ii) ×✓1
2. $y=(x+3)^2+2 \rightarrow a=-3,\ b=2$ — award 1/1 mark for (i) and 1/1 for (ii)

| | | | | | |
|---|---|---|---|---|---|
| | (b) | | •[3] find value of $c$ | •[3] 11 | **1** |

**Notes:**

1. Answer must be consistent with answers to (a).
2. Accept (0,11) or $y = 11$.

**Commonly Observed Responses:**

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **5.** | $\bullet^1$ calculate discriminant<br><br>$\bullet^2$ state nature of roots | $\bullet^1$ 52<br><br>$\bullet^2$ 2 real (and) distinct roots | **2** |

**Notes:**

1. Correct answer without working award 0/2

2. For $36-(-16)>0$ or $36+16>0 \rightarrow$ 2 real (and) distinct roots award 2/2

3. For the award of $\bullet^2$ accept "2 real unequal roots".

4. Do not accept "2 real roots" or "2 distinct roots" or "real and distinct roots".

5. Expected answers for the award of $\bullet^2$, when
   (a) $b^2 - 4ac < 0$ : "no real roots".
   (b) $b^2 - 4ac = 0$ : "1 repeated real root" or "2 equal real roots".

6. Accept $\sqrt{52}$ as evidence for $\bullet^1$ in a quadratic formula or alone.

**Commonly Observed Responses:**

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **6.** | •1 correct substitution into cosine rule<br>•2 calculate $AB^2$<br>•3 calculate AB | •1 $6^2+5^2-2\times6\times5\times\frac{1}{5}$<br>•2 49<br>•3 7 | **3** |

**Notes:**

1. Correct answer without working — award 0/3

2. (a) $6^2+5^2-2\times6\times5\times\cancel{\cos}\frac{1}{5}=61-60\times\cancel{\cos}\frac{1}{5}=49\rightarrow7$

   where cos is scored out in **each line** of working — award 3/3

   (b) For $6^2+5^2-2\times6\times5\times\cos\frac{1}{5}=49\rightarrow7$ — award 2/3 ×✓✓

3. For the award of •1 accept eg $\frac{1}{5}=\frac{6^2+5^2-AB^2}{2\times6\times5}$

4. •3 is **only** available where $AB^2$ has been obtained from a cosine rule calculation by:
   (a) calculating the square root of a perfect square (>4)

   **OR**

   (b) expressing a surd in its simplest form.

5. Where sine rule or area of triangle formula is used — award 0/3

**Commonly Observed Responses:**

1. $6^2+5^2+2\times6\times5\times\frac{1}{5}\rightarrow\sqrt{73}$ — award 1/3 ×✓1×
2. (a) $\sqrt{6^2+5^2}=\sqrt{61}$ — award 0/3

   (b) $\sqrt{6^2-5^2}=\sqrt{11}$ — award 0/3

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **7.** | (a) | | **Method 1**<br><br>•[1] calculate gradient<br><br>•[2] substitute gradient and a point into $y - b = m(x - a)$<br><br>•[3] determine the equation of the line in terms of $P$ and $T$ in simplest form<br><br>**Method 2**<br><br>•[1] calculate gradient<br><br>•[2] substitute gradient and a point into $y = mx + c$<br><br>•[3] determine the equation of the line in terms of $P$ and $T$ in simplest form | •[1] 1500<br><br>•[2] eg $y - 20000 = 1500\,(x - 5)$<br><br>•[3] $P = 1500T + 12500$<br><br>•[1] 1500<br><br>•[2] eg $20000 = 1500 \times 5 + c$<br><br>•[3] $P = 1500T + 12500$ | **3** |

**Notes:**

1. Correct answer without working — award 0/3
2. Accept $\frac{30000}{20}$ or equivalent for the award of •[1].
3. •[1] is not available for using points other than (5, 20 000), (15, 35 000) and (25, 50 000) to find the gradient.
4. For an incorrect simplification of a gradient, a mark is **not** awarded at the point where the error occurs, eg
   (a) $\frac{30000}{20} = 15000 \rightarrow y - 20000 = 15000(x - 5) \rightarrow P = 15000T - 55000$ — award 2/3 ×✓1✓1
   (b) $\frac{30000}{20} \rightarrow y - 20000 = 15000(x - 5) \rightarrow P = 15000T - 55000$ — award 2/3 ✓×✓1
   (c) $\frac{30000}{20} \rightarrow y - 20000 = \frac{30000}{20}(x - 5) \rightarrow P = 15000T - 55000$ — award 2/3 ✓✓×

**Commonly Observed Responses:**

**Working must be shown**

1. $P = \frac{1500}{1}T + 12500$ — award 2/3 ✓✓×
2. Using (1,2) and (5,5): eg gradient = $\frac{3}{4} \rightarrow 2 = \frac{3}{4} \times 1 + c \rightarrow P = \frac{3}{4}T + \frac{5}{4}$ — award 2/3 ×✓1✓1
3. Using (5,20) and (25, 50): eg gradient = $\frac{3}{2} \rightarrow 20 = \frac{3}{2} \times 5 + c \rightarrow P = \frac{3}{2}T + \frac{25}{2}$ — award 2/3 ×✓1✓1

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **7.** | (b) | | $\bullet^4$ calculate salary | $\bullet^4$ (£)24,500 | **1** |

**Notes:**

1. Consistent answer without working (but see note 2) award 1/1

2. Where an incorrect answer in (a) is followed through, $\bullet^4$ is not available where the answer is:
   (a) negative
   (b) expressed in fraction form eg $P = \frac{3}{4}T + \frac{5}{4} \rightarrow \frac{29}{4}$
   (c) given to one decimal place or more than two decimal places
   $P = 1.5T + 12.5 \rightarrow 24.5$

**Commonly Observed Responses:**

1. $P = \frac{3}{4}T + \frac{5}{4}$ in (a) leading to (£) 7.25 award 1/1

2. $P = \frac{3}{2}T + \frac{25}{2}$ in (a) leading to (£) 24.50 award 1/1

| | | | | | |
|---|---|---|---|---|---|
| **8.** | | | $\bullet^1$ express as equivalent fraction with rational denominator<br>$\bullet^2$ express in simplest form | $\bullet^1 \frac{12\sqrt{15}}{15}$<br>$\bullet^2 \frac{4\sqrt{15}}{5}$ | **2** |

**Notes:**

1. Correct answer without working award 0/2

2. Accept $0.8\sqrt{15}$.

3. For subsequent incorrect working, $\bullet^2$ is not available
   eg $\frac{12\sqrt{15}}{15} = \frac{4\sqrt{15}}{5} = 4\sqrt{3}$ award 1/2 ✓×

**Commonly Observed Responses:**

1. (a) $\frac{12}{3\sqrt{5}} = \frac{4}{\sqrt{5}} = \frac{4\sqrt{5}}{5}$ award 1/2 $\bullet^2$ × $\bullet^1$✓1

   (b) $\frac{12}{3\sqrt{5}} = \frac{4}{\sqrt{5}}$ award 0/2

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **9.** | (a) | | $\bullet^1$ calculate median<br>$\bullet^2$ find quartiles<br>$\bullet^3$ calculate IQR | $\bullet^1$ 39.5<br>$\bullet^2$ 35 and 42<br>$\bullet^3$ 7 | **3** |

**Notes:**

1. (a) Correct median without working award $\bullet^1$.
   (b) Correct IQR without working, do **not** award $\bullet^2$ or $\bullet^3$.

2. Accept quartiles indicated in the list or on a diagram for $\bullet^2$.

3. If 'correct' IQR is found from an
   (a) ordered list with one missing term or one extra number — award 2/3 ×✓1✓1
   (b) unordered list [median = 38.5, IQR = 41 – 38 =3] — award 1/3 ××✓1

4. $\bullet^2$ and $\bullet^3$ are not available for finding the range ie 55 – 31 = 24.

5. Where a candidate has calculated SIQR= 3.5, $\bullet^3$ can only be awarded where the candidate has **explicitly** stated "IQR = 7" eg
   (a) median = 39.5, quartiles = 35 and 42, **IQR = 7**, SIQR = 3.5 — award 3/3
   (b) median = 39.5, quartiles = 35 and 42 $\rightarrow$ (IQR =) 3.5 — award 2/3 ✓✓×

6. Where a candidate has calculated the IQR but stated SIQR = 7, $\bullet^3$ is available
   eg median = 39.5, quartiles = 35 and 42, **SIQR** = 7 — award 3/3

**Commonly Observed Responses:**

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **9.** | (b) | | $\bullet^4$ valid comment comparing medians<br><br>$\bullet^5$ valid comment comparing IQRs | $\bullet^4$ eg on average the ages of the newspaper readers are higher<br><br>$\bullet^5$ eg ages of the newspaper readers are more varied | **2** |

**Notes:**

1. Answers must be consistent with answers to part (a).
   eg If in part (a) the calculated median is 41 then award $\bullet^4$ for 'on average the ages are the same for the newspaper and the magazine' or equivalent.
   If in part (a) the calculated IQR is 9 then award $\bullet^5$ for 'the spread of ages is the same for the newspaper and the magazine' or equivalent.

2. Comments must involve reference to ages **and** include newspaper readers and/or magazine readers.
   (a) **Accept** eg On average the **newspaper readers' ages** are higher and less consistent.
   (b) **Do not accept** eg On average the **ages** are higher and less consistent.

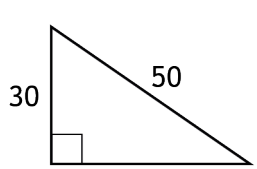
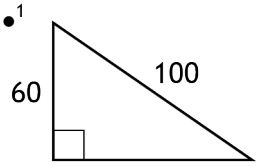
3. For the award of $\bullet^4$
   (a) Accept eg
   - On average the magazine readers are younger.

   (b) **Do not accept** eg
   - The **median** age of the magazine readers is less
   - The ages of the newspaper readers are more **(this implies that all ages are more)**
   - On average the newspaper readers' **results/scores/data** are higher.

4. For the award of $\bullet^5$
   (a) Accept eg
   - The spread of newspaper readers' ages is more.
   - The magazine readers' ages are less varied.

   (b) **Do not accept** eg
   - The **IQR** of the newspaper readers' ages is more.
   - The **range** of the magazine readers' ages is less.
   - **On average** the newspaper readers' ages are more varied.
   - The **IQR** of the newspaper readers' ages is less consistent.
   - The newspaper readers' **results/scores/data** are less consistent.

**Commonly Observed Responses:**

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **10.** | | | **Method 1** | **Method 1** | **4** |
| | | | •[1] marshal facts and recognise right angled triangle | •[1]   | |
| | | | •[2] consistent Pythagoras statement | •[2] $50^2 - 30^2$ | |
| | | | •[3] calculate third side | •[3] 40 | |
| | | | •[4] calculate width | •[4] 90 | |
| | | | **Method 2** | **Method 2** | |
| | | | •[1] marshal facts and recognise right angled triangle | •[1]   | |
| | | | •[2] consistent Pythagoras statement | •[2] $100^2 - 60^2$ | |
| | | | •[3] calculate third side | •[3] 80 | |
| | | | •[4] calculate width | •[4] 90 | |

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|

**10. (continued)**

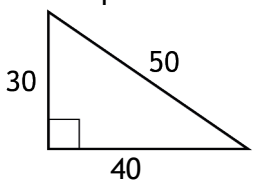
**Notes:**

1. Correct answer without working — award 0/4

2. In the absence of a diagram accept $50^2 - 30^2$ or $100^2 - 60^2$ as evidence for the award of $\bullet^1$ and $\bullet^2$.

3. **BEWARE**
   Where a diagram is shown, working must be consistent with the diagram; $\bullet^2$ is not available for an **incorrect** diagram leading to $50^2 - 30^2$ or $100^2 - 60^2$.

4. $\bullet^4$ is only available following a Pythagoras calculation within a **valid** right-angled triangle except in the examples outlined in note 5
   eg $d = 100 \rightarrow 100 - 60 = 40 \rightarrow 40 + 50 = 90$ — award 0/4

5. Where a candidate demonstrates recognition of 3,4,5 Pythagorean triple, for the award of $\bullet^1$, $\bullet^2$ and $\bullet^3$ accept:
   (a)
   
   
   (b) 40, since 3, 4, 5 triangle or Pythagorean triple.

6. Where a candidate uses 60 and 50 or 50 and 50 within a Pythagorean statement, $\bullet^1$ and $\bullet^4$ are not available eg
   (a) consistent with their diagram: $60^2 - 50^2 \rightarrow 10\sqrt{11} \rightarrow 50 + 10\sqrt{11}$ — award 2/4 ×✓1✓1×
   (b) no diagram: $60^2 - 50^2 \rightarrow 10\sqrt{11} \rightarrow 50 + 10\sqrt{11}$ — award 1/4 ××✓1×

7. Where a candidate's Pythagoras statement leads to an invalid solution, do not award $\bullet^3$ but $\bullet^4$ is still available eg $30^2 - 50^2 \rightarrow \sqrt{\pm 1600} \rightarrow 40 \rightarrow 90$ $\bullet^3$ × $\bullet^4$✓1

**Commonly Observed Responses:**

1. $40 \rightarrow 90$ — award 0/4 ^^^✓2

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **11.** | | | $\bullet^1$ state value | $\bullet^1$ $-0.5$ | **1** |
| **Notes:** | | | | | |
| **Commonly Observed Responses:** | | | | | |
| **12.** | | | **Method 1**<br>$\bullet^1$ start to simplify (one correct application of law of indices)<br>$\bullet^2$ complete simplification<br>$\bullet^3$ express with a positive power<br>**Method 2**<br>$\bullet^1$ express with a positive power<br>$\bullet^2$ start to simplify (one correct application of law of indices)<br>$\bullet^3$ express with a positive power | $\bullet^1$ $\frac{5c^{-2}}{c^7}$ or $\frac{5c^{-5}}{c^4}$ or $\frac{5c^{-6}}{c^3}$<br>$\bullet^2$ $5c^{-9}$<br>$\bullet^3$ $\frac{5}{c^9}$<br>$\bullet^1$ $\frac{5}{c^3\times c^4\times c^2}$<br>$\bullet^2$ $\frac{5}{c^3\times c^6}$ or $\frac{5}{c^7\times c^2}$ stated or implied by $\bullet^3$<br>$\bullet^3$ $\frac{5}{c^9}$ | **3** |
| **Notes:** | | | | | |
| 1. Correct answer without working | | | | | award 3/3 |
| **Commonly Observed Responses:** | | | | | |
| 1. $\frac{5c^{-2}}{c^7}\to 5c^{-9}\to\frac{1}{5c^9}$ | | | | | award 2/3 ✓✓× |
| 2. (a) $\frac{5c^{-2}}{c^7}\to 5c^{-5}\to\frac{5}{c^5}$ | | | | | award 2/3 ✓×✓1 |
| (b) $\frac{5c^{-2}}{c^7}\to\frac{5}{c^5}$ | | | | | award 1/3 ✓×× |
| 3. $\frac{5c^{-2}}{c^{12}}\left(\to 5c^{-14}\right)\to\frac{5}{c^{14}}$ | | | | | award 2/3 ×✓1✓1 |
| 4. (a) $\frac{5c^{-2}}{c^{12}}\to 5c^{-10}\to\frac{5}{c^{10}}$ | | | | | award 1/3 ××✓1 |
| (b) $\frac{5c^{-2}}{c^{12}}\to\frac{5}{c^{10}}$ | | | | | award 0/3 |

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **13.** | (a) | | •[1] state value of $a$ | •[1] −30 or 330 | **1** |
| **Notes:** | | | | | |
| 1. For $y = \cos(x - 30) + \ldots$ | | | | award 1/1 | |
| 2. For $a = 1$ in (a) and $b = -30$ in (b) | | | | award 0/1 in (a) and award 1/1 in (b)✓1 | |
| **Commonly Observed Responses:** | | | | | |
| | (b) | | •[2] state value of $b$ | •[2] 1 | **1** |
| **Notes:** | | | | | |
| 1. For $y = \cos(x \pm \ldots) + 1$ | | | | award 1/1 | |
| 2. For $a = 1$ in (a) and $b = -30$ in (b) | | | | award 0/1 in (a) and award 1/1 in (b)✓1 | |
| **Commonly Observed Responses:** | | | | | |

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **14.** | | | **Method 1**<br>•[1] eliminate denominators<br>•[2] rearrange into the form $ax > b$ or $b > ax$<br>•[3] solve for $x$<br>**Method 2**<br>•[1] collect algebraic terms and express as a fraction in simplest form<br>•[2] rearrange into the form $ax > b$ or $b > ax$<br>•[3] solve for $x$<br>**Method 3**<br>•[1] express left hand side as a fraction in simplest form<br>•[2] rearrange into the form $ax > b$ or $b > ax$<br>•[3] solve for $x$ | **Method 1**<br>•[1] $5(x+1)-30 > 9x$ or equivalent<br>•[2] $-4x > 25$ or $-25 > 4x$<br>•[3] $x < -\frac{25}{4}$ or $-\frac{25}{4} > x$<br>**Method 2**<br>•[1] $\frac{5-4x}{15} > 2$ or equivalent<br>•[2] $-4x > 25$ or $-25 > 4x$<br>•[3] $x < -\frac{25}{4}$ or $-\frac{25}{4} > x$<br>**Method 3**<br>•[1] $\frac{x-5}{3} > \frac{3x}{5}$ or equivalent<br>•[2] $-4x > 25$ or $-25 > 4x$<br>•[3] $x < -\frac{25}{4}$ or $-\frac{25}{4} > x$ | **3** |

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|

**14. (continued)**

**Notes:**

1. Correct answer without working — award 0/3
   Treat repeated substitution as invalid working.
2. For the award of •³ accept eg $x < -6\frac{1}{4}$, $-6.25 > x$, $x < \frac{25}{-4}$
3. For the award of •³ the answer must be a non-integer value.
   Do not award •³ for a decimal approximation of $-\frac{25}{4}$, but do not penalise incorrect conversion to a mixed number or decimal approximation following an answer of $-\frac{25}{4}$

   (a) $5(x+1)-30>9x \rightarrow -4x>25 \rightarrow x<-\frac{25}{4} \rightarrow x<-6.3$ — award 3/3

   (b) $5(x+1)-30>9x \rightarrow -4x>25 \rightarrow x<-6.3$ — award 2/3 ✓✓×

4. (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 •³
   eg $5(x+1)-30>9x \rightarrow -4x>25 \rightarrow x<-\frac{25}{4}$ — award 3/3

   **OR**

   (ii) collecting the $x$ term(s) on the RHS of the inequation at •²
   eg $5(x+1)-30>9x \rightarrow -25>4x \rightarrow -\frac{25}{4}>x$ — award 3/3

   (b) Where a candidate requires to do neither of the above, then •³ does not gain a mark

   eg $5(x+1)-30>9x \rightarrow 4x>25 \rightarrow x>\frac{25}{4}$ — award 1/3 ✓×✓2

5. For subsequent incorrect working •³ is not available
   eg $-\frac{25}{4}>x \rightarrow x>-\frac{25}{4}$ — award 2/3 ✓✓×

**Commonly Observed Responses:**

1. $5(x+1)-2>9x \rightarrow -4x>-3 \rightarrow x<\frac{3}{4}$ — award 2/3 ×✓1✓1
2. (a) $5(x+1)-30=9x \rightarrow -4x=25 \rightarrow x=-\frac{25}{4} \rightarrow x<-\frac{25}{4}$ — award 3/3

   (b) $5(x+1)-30=9x \rightarrow -4x=25 \rightarrow x=-\frac{25}{4}$ — award 2/3 ✓✓×

**[END OF MARKING INSTRUCTIONS]**

National
Qualifications
2023

# 2023 Mathematics

# Paper 2

# National 5

# Finalised Marking Instructions



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

**Marking Instructions for each question**

| Question | | | Generic Scheme | Illustrative Scheme | Max Mark |
|---|---|---|---|---|---|
| **1.** | | | $\bullet^1$ know how to decrease by 11% and 6%<br><br>$\bullet^2$ know how to calculate value of caravan<br><br>$\bullet^3$ evaluate | $\bullet^1$ $\times$ 0.89 **and** $\times$ 0.94<br><br>$\bullet^2$ $20\,000 \times 0.89 \times 0.94^2$<br><br>$\bullet^3$ (£) 15,728.08 | **3** |

**Notes:**

1. Correct answer without working — award 3/3
2. Accept 15 728 or 15 728.10. However, do not accept 15 728.1
3. Disregard rounding subsequent to correct answer.
4. Where incorrect percentages are used, the working must be followed through to give the possibility of awarding 2/3.
5. Where a single repeated percentage change is applied, $\bullet^1$ and $\bullet^2$ are not available
   eg $20\,000 \times 0.83^3 = 11435.74$ — award 1/3 ××✓1
6. Where division is used:
   (a) along with 0.89 **and** $0.94^2$ $\bullet^1$ is not available.
   (b) along with incorrect percentage $\bullet^1$ and $\bullet^2$ are not available.

**Commonly Observed Responses:**

1. $20\,000 \times 0.89 \times 0.94 = 16732$ — award 2/3 ✓×✓1
2. (a) $20\,000 \times 0.89 \times 0.83^2 = 12\,262.42$ — award 2/3 ×✓1✓1
   (b) $20\,000 \times 0.89 \times 0.83 \times 0.77 = 11\,375.98$ — award 2/3 ×✓1✓1
3. $20\,000 \times 0.11 \times 0.06^2 = 792$ — award 2/3 ×✓1✓1
4. $20\,000 \times 1.11 \times 1.06^2 = 24\,943.92$ — award 2/3 ×✓1✓1
5. (a) $20\,000 \times 0.83^3 = 11\,435.74$ — award 1/3 ××✓1
   (b) $20\,000 \times 0.83^2 = 13\,778$ — award 1/3 ××✓1
6. (a) $20\,000 \times 0.77^3 = 9130.66$ — award 1/3 ××✓1
   (b) $20\,000 \times 0.77^2 = 11\,858$ — award 1/3 ××✓1
7. $20\,000 \times 0.89 \times (1 - 0.06 \times 2) = 15\,664$ — award 1/3 ✓×✓2

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **2.** | | | $\bullet^1$ correct method<br><br>$\bullet^2$ evaluate<br><br>$\bullet^3$ express in scientific notation rounded to 3 significant figures | $\bullet^1$ $300 \div (6.64 \times 10^{-24})$<br><br>$\bullet^2$ $4.51(8\ldots) \times 10^{25}$ or equivalent<br><br>$\bullet^3$ $4.52 \times 10^{25}$ | **3** |

**Notes:**

1. Correct answer without working — award 3/3
2. (a) For the award of $\bullet^1$ accept $300 \div 6.64 \times 10^{-24}$
3. (b) However, **BEWARE** of incorrect use of calculator using power button

   $300 \div 6.64 \times 10^{-24} = 4.51(8\ldots) \times 10^{-23} = 4.52 \times 10^{-23}$ — award 2/3 ✓×✓1
4. If "$\times 10$" is omitted at $\bullet^2$, the final mark is available for rounding to 3 significant figures with consistent power

   eg $300 \div \left(6.64 \times 10^{-24}\right) \rightarrow 4.51(8\ldots)^{25} \rightarrow 4.52^{25}$ — award 2/3 ✓×✓1

**Commonly Observed Responses:**

Brackets not required

1. $(6.64 \times 10^{-24}) \div 300 = 2.21\ (3\ldots) \times 10^{-26}$ — award 2/3 ×✓1✓1
2. $(6.64 \times 10^{-24}) \times 300 = 1.992 \times 10^{-21} = 1.99 \times 10^{-21}$ — award 2/3 ×✓1✓1
3. $300 \div \left(6.64 \times 10^{-24}\right) \rightarrow 4.51(8\ldots) \times 10^{25} \rightarrow 4.52$ — award 2/3 ✓✓×
4. (a) $300 \div \left(6.64 \times 10^{-24}\right) \rightarrow 4.51(8\ldots)^{25} \rightarrow 4.52^{25}$ — award 2/3 ✓×✓1

   (b) $\left(6.64 \times 10^{-24}\right) \times 300 = 1.992^{-21} = 1.99^{-21}$ — award 1/3 ××✓1

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **3.** | **Method 1**<br>$\bullet^1$ appropriate fraction<br>$\bullet^2$ consistent substitution into arc length formula (must involve a fraction)<br>$\bullet^3$ calculate arc length<br>**Method 2**<br>$\bullet^1$ appropriate fraction<br>$\bullet^2$ consistent substitution into arc length ratio<br>$\bullet^3$ calculate arc length | **Method 1**<br>$\bullet^1$ $\frac{106}{360}$<br>$\bullet^2$ $\frac{106}{360}\times 2\times\pi\times 9.15$<br>$\bullet^3$ 16.9(27…) or 17 (m)<br>**Method 2**<br>$\bullet^1$ $\frac{106}{360}$<br>$\bullet^2$ $\frac{106}{360}=\frac{\text{arc}}{2\times\pi\times 9.15}$<br>$\bullet^3$ $16.9(27\ldots)$ or 17 (m) | **3** |

**Notes:**

1. Correct answer without working — award 0/3
2. Do not penalise variations in $\pi$.
   eg $\frac{106}{360}\times 2\times 3.14\times 9.15=16.9(19\ldots)$ — award 3/3
3. Premature rounding: rounded working must be to at least 2 significant figures
   eg (a) $\frac{106}{360}\times 2\times\pi\times 9.15=0.29\quad 2\times\pi\times 9.15\quad 16.6(7\ldots),16.7$ or 17 — award 3/3
   (b) $\frac{106}{360}\times 2\times\pi\times 9.15=0.3\quad 2\times\pi\times 9.15\quad 17(.24\ldots)$ — award 2/3 ✓✓×
4. Accept $2\times\pi\times 9.15-\frac{254}{360}\times 2\times\pi\times 9.15=16.9(27\ldots)$ or 17 — award 3/3
5. For subsequent incorrect working, $\bullet^3$ is not available
   eg $2\times\pi\times 9.15-\frac{106}{360}\times 2\times\pi\times 9.15=40.5(6\ldots)$ or 41 — award 2/3 ✓✓×

**Commonly Observed Responses:**

1. $\frac{106}{360}\times\pi\times 9.15=8(.46\quad)$ — award 2/3 ✓×✓1
2. $\frac{106}{360}\times\pi\times 9.15^2=77(.44\ldots)$ — award 2/3 ✓×✓1
3. $\frac{254}{360}\times 2\times\pi\times 9.15=41$ or $40(.56\ldots)$ — award 2/3 ×✓1✓1
4. $\frac{254}{360}\times\pi\times 9.15=20(.28\ldots)$ — award 1/3 ××✓1
5. $\frac{254}{360}\times\pi\times 9.15^2=186$ or $185(.57\ldots)$ — award 1/3 ××✓1
6. $2\times\pi\times 9.15=57(.49\ldots)$ — award 0/3

| Question | | | Generic Scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| 4. | | | •1 correct substitution into sine rule | •1 $\frac{\sin K}{10}=\frac{\sin 25}{7}$ or $\frac{10}{\sin K}=\frac{7}{\sin 25}$ | 3 |
| | | | •2 rearrange equation | •2 $\sin K=\frac{10\sin 25}{7}$ | |
| | | | •3 calculate angle JKL | •3 37 (.1…) | |

**Notes:**

1. Correct answer without working — award 0/3

2. Do not penalise omission of degrees sign.

3. Disregard premature rounding provided the final answer can be rounded to 37.
   eg
   (a) $\sin K=\frac{10\sin 25}{7}$ $0.6\rightarrow 36.869\ldots$ — award 3/3
   (b) $\sin K=\frac{10\sin 25}{7}$ $\frac{10\times 0.4}{7}\Rightarrow 34.849\ldots$ — award 2/3 ✓✓×

4. Where cosine rule or area of triangle formula is used — award 0/3

5. Inappropriate use of GRAD or RAD should only be penalised once in Qu's 4, 8, 11 or 15
   (a) $36(.8\ldots)$ (GRAD)
   (b) However, where RAD is used, $\frac{10\sin 25}{7}=-0.190\ldots$, so •3 is unavailable

**Commonly Observed Responses:**

1. $\frac{K}{\sin 10}\Rightarrow\frac{25}{\sin 7}$ $K=\frac{25\sin 10}{\sin 7}$ $35.6\ldots$ — award 1/3 ×✓1✓2

2. $\frac{10}{\sin K}=\frac{7}{\sin 25}$ $\rightarrow\sin K\ \frac{7\times 10}{\sin 25}$ $16.5.6\ldots$ — award 1/3 ✓××

3. $\frac{10}{K}=\frac{7}{25}$ $\rightarrow K\ \frac{25\times 10}{7}$ $35.71\ldots$ — award 0/3 ×✓2✓2

4. (a) $\frac{10}{\sin K}=\frac{7}{\sin 25}\rightarrow$ $\frac{10\sin 25}{7}\rightarrow$ $37(.1\ldots)$ — award 3/3
   (b) $\frac{10}{\sin K}=\frac{7}{\sin 25}$ $K\rightarrow\frac{10\sin 25}{7}$ $37(.1\ldots)\rightarrow$ — award 3/3
   (c) $\frac{10}{\sin K}=\frac{7}{\sin 25}$ $K\rightarrow\frac{7\sin 25}{10}$ $17(.2\ldots)\rightarrow$ — award 2/3 ✓×✓1
   (d) $\frac{10}{\sin K}=\frac{7}{\sin 25}$ $K\rightarrow\frac{10\sin 25}{7}$ $0.6(03\ldots)\rightarrow$ — award 1/3 ✓××

| Question | | | Generic Ssheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **5.** | | | •[1] calculate size of interior or exterior angle of the decagon<br><br>•[2] calculate size of shaded angle | •[1] interior angle = 144<br>or exterior angle = 36<br><br>•[2] 126 | **2** |

**Notes:**

1. Correct answer without relevant working award 0/2

2. Degrees signs are not required.

3. Full marks may be awarded for information marked on the diagram.

4. For the award of •[1]
   (a) the **exterior** angle of 36 must be clearly indicated on the diagram or explicitly stated outwith the diagram as "exterior angle = 36".
   (b) accept 72 + 72 or two 72 angles marked on the diagram (either adjacent or within the same triangle).

5. •[2] is only available where the exterior angle is acute and consistent with working at •[1]
   eg angles in triangle 40, 70, 70 (indicated on diagram) $\rightarrow$ exterior angle 40
   $\rightarrow$ shaded angle = 130 award 1/2 ✗✓1

6. Where the exterior angle is **not** indicated on diagram or explicitly stated as "exterior angle = 36", for: 90 + 36 = 126 award 1/2 ^ ✓1

7. Accept clear working outwith the diagram, but the final answer must be clearly indicated.

**Commonly Observed Responses:**

1. (a) 90 + (180 – 72 – 72) = 126 award 2/2
   (b) 90 + (360 −90 − 90 – 72 – 72) = 126 award 2/2

2. Angles in triangle 36, 72, 72 (indicated on diagram) $\rightarrow$ exterior angle 18
   $\rightarrow$ shaded angle = 108 award 1/2✓✗

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **6.** | | | $\bullet^1$ evidence that 108% is 94500<br><br>$\bullet^2$ start valid strategy<br><br>$\bullet^3$ complete calculation within a valid strategy | $\bullet^1$ $108\% = 94\ 500$<br><br>$\bullet^2$ $1\% = \frac{94\ 500}{108}$<br><br>$\bullet^3$ (£) 87,500 | **3** |

**Notes:**

1. Correct answer without working — award 3/3

2. (a) $108\% = 94\ 500 \rightarrow$ 8% of 94500 = 7560 — award 1/3 ✓××
   (b) 8% of 94 500 = 7560 — award 0/3

3. (a) $108\% = 94\ 500 \rightarrow$ 108% of 94500 = 102 060 — award 1/3 ✓××
   (b) 108% of 94 500 = 102 060 — award 0/3

4. (a) $108\% = 94\ 500 \rightarrow$ 92% of 94 500 = 86940 — award 1/3 ✓××
   (b) 92% of 94 500 = 86 940 — award 0/3

**Commonly Observed Responses:**

1. $\frac{94500}{1.08} = 87\ 500$ — award 3/3

2. $1\% = \frac{94500}{92} \rightarrow 102\ 717(.39)$ — award 2/3 ×✓1✓1

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **7.** | | | **Method 1**<br>•[1] add $r$<br>•[2] multiply by 3<br>•[3] divide by $n$<br>**Method 2**<br>•[1] multiply by 3<br>•[2] add $3r$<br>•[3] divide by $n$ | **Method 1**<br>•[1] $P+r=\frac{1}{3}mn$<br>•[2] $mn = 3(P + r)$<br>•[3] $m=\frac{3(P+r)}{n}$ or equivalent<br>**Method 2**<br>•[1] $3P = mn - 3r$<br>•[2] $mn = 3P + 3r$<br>•[3] $m=\frac{3P+3r}{n}$ or equivalent | **3** |

**Notes:**

1. Correct answer without working award 0/3

2. For subsequent incorrect working, •[3] is not available.

**Commonly Observed Responses:**

1. (a) $P+r=\frac{1}{3}mn \rightarrow \frac{P+r}{n} \rightarrow \frac{1}{3}m \rightarrow m \rightarrow \frac{P+r}{n} \rightarrow 3$ or $m=3\frac{P+r}{n}$ award 3/3

   (b) $P+r=\frac{1}{3}mn \rightarrow \frac{P+r}{n} \rightarrow \frac{1}{3}m \rightarrow m \rightarrow \frac{P+r}{n} \rightarrow 3 \rightarrow m\times \frac{3(P+r)}{3n}$ award 2/3 ✓✓×

   (c) $P+r=\frac{1}{3}mn \rightarrow \frac{P+r}{n} \rightarrow \frac{1}{3}m \rightarrow m \rightarrow \frac{P+r}{\frac{1}{3}n}$ award 2/3 ✓✓✓2

2. (a) $P+r=\frac{1}{3}mn \rightarrow mn \rightarrow 3P \rightarrow r+ \rightarrow m \rightarrow \frac{3P+r}{n}$ award 2/3 ✓×✓1

   (b) $3P=mn \rightarrow r \rightarrow mn \rightarrow 3P \rightarrow r+ \rightarrow m \rightarrow \frac{3P+r}{n}$ award 2/3 ×✓1✓1

3. $Pr=\frac{1}{3}mn \rightarrow 3Pr \rightarrow mn \rightarrow m \rightarrow \frac{3Pr}{n}$ award 1/3 ×✓2✓1

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **8.** | | | **Method 1**<br>•[1] valid strategy<br>•[2] evaluation<br>•[3] explicit comparison<br>•[4] conclusion with valid reason<br>**Method 2**<br>•[1] valid strategy<br>•[2] evaluation<br>•[3] explicit comparison<br>•[4] conclusion with valid reason<br>**Method 3**<br>•[1] valid strategy<br>•[2] evaluate $cos\ x$<br>•[3] calculate angle<br>•[4] conclusion with valid reason | **Method 1**<br>•[1] $4^2 + 7^2$ **and** $8^2$<br>•[2] $4^2 + 7^2 = 65$ **and** $8^2 = 64$<br>•[3] $4^2 + 7^2 \neq 8^2$<br>•[4] No, as angle is not a right angle<br>**Method 2**<br>•[1] $4^2 + 7^2 = 65$<br>•[2] $\sqrt{65} = 8.06\ldots$<br>•[3] $8 \neq 8.06$ …<br>•[4] No, as angle is not a right angle<br>**Method 3**<br>•[1] $\left(\cos x =\right)\dfrac{4^2+7^2-8^2}{2\times4\times7}$<br>•[2] $\left(\cos x =\right)\dfrac{1}{56}$<br>•[3] 88(.97)<br>•[4] No, as angle is not a right angle | **4** |

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|

**8. (continued)**

**Notes:**

1. **$\bullet^1$ is not available where a candidate starts by stating that $4^2 + 7^2 = 8^2$ or $4^2 + 7^2 \neq 8^2$**
   $4^2 + 7^2 = 8^2$ or $4^2 + 7^2 \neq 8^2$ $\times\bullet^1$
   $65 \neq 64$ $\checkmark\bullet^2\checkmark\bullet^3$
   No, as angle is not a right angle $\checkmark\bullet^4$ award 3/4 $\times\checkmark\checkmark\checkmark$

2. There must be an explicit comparison stated for the award of $\bullet^3$

3. For the award of $\bullet^3$ accept eg
   (a) $\sqrt{65} \neq \sqrt{64}$
   (b) $\sqrt{65} \neq 8$
   (c) $a^2 + b^2 \neq c^2$ or $AC^2 + CB^2 \neq AB^2$ (labelling consistent with diagram)
   (d) $65 > 64$

4. The conclusion must include reference to $90^\circ$ or a right angle.

5. Inappropriate use of RAD or GRAD should only be penalised once in Qu 4, 8, 11 or 15
   (a) 1.55… (RAD), no, as angle is not a right angle
   (b) 98 (.86…) (GRAD), no, as angle is not a right angle

**Commonly Observed Responses:**

1. (a) $4^2 + 7^2 = 65 \rightarrow 8.06\ldots$ ~~8~~; 8 ~~8~~ $\rightarrow$ yes, as angle is a right angle — award 3/4 $\checkmark\checkmark\times\checkmark1$
   (b) $4^2 + 7^2 = 65 \rightarrow 8$; 8 $8 \rightarrow$ yes, as angle is a right angle — award 3/4 $\checkmark\times\checkmark1\checkmark1$

2. **If** triangle is right-angled then $4^2 + 7^2 = 8^2 \rightarrow 65 \neq 64$; No, as angle is not a right angle — award 4/4

3. (a) $4^2 + 8^2$ **and** $7^2 \rightarrow 80, 49 \rightarrow 80 \neq 49 \rightarrow$ no, as angle is not a right angle — award 3/4 $\times\checkmark1\checkmark1\checkmark1$
   (b) $4^2 + 8^2 = 7^2 \rightarrow 80, 49 \rightarrow 80 \neq 49 \rightarrow$ no, as angle is not a right angle — award 3/4 $\times\checkmark1\checkmark1\checkmark1$

4. (a) $\frac{4^2 + 7^2 - 8^2}{2 \times 4 \times 7} = \frac{1}{56} = 0.017(\ldots)$ or ~~0~~ $0.0\text{~~1~~}7(\ldots)$ no, as angle is not a right angle — award 3/4 $\checkmark\checkmark\times\checkmark1$
   (b) $\frac{4^2 + 7^2 - 8^2}{2 \times 4 \times 7} = \frac{1}{56} = 0.017(\ldots)$ no, as angle is not a right angle — award 2/4 $\checkmark\checkmark\wedge\times$

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **9.** | $\bullet^1$ correct substitution into formula for volume of small pyramid | $\bullet^1$ $\frac{1}{3}\times 40\times 40\times 48$ $(=25600)$ | **4** |
| | $\bullet^2$ consistent substitution into formula for volume of large pyramid | $\bullet^2$ $\frac{1}{3}\times 90\times 90\times 108$ $(=291600)$ | |
| | $\bullet^3$ know to subtract volume of small pyramid from volume of large pyramid | $\bullet^3$ $\frac{1}{3}\times 90\times 90\times 108-\frac{1}{3}\times 40\times 40\times 48$ | |
| | $\bullet^4$ all calculations correct (must involve sum or difference of two different calculations both involving a fraction) **and** state correct units | $\bullet^4$ 266 000 $cm^3$ | |

**Notes:**

1. Correct answer without working — award 0/4
2. $\bullet^2$ is available for eg $\left(\frac{90}{40}\right)^3\times 25600$
3. Where a candidate substitutes 60 for the height of the larger pyramid, $\bullet^2$ is not available eg
   (a) $\frac{1}{3}\times 90\times 108-\frac{1}{3}\times 40\times 48=2600\ cm^3$ — award 3/4 ×✓1✓✓1
   (b) $\frac{1}{3}\times 90\times 60-\frac{1}{3}\times 40\times 48=1160\ cm^3$ — award 2/4 ××✓✓1

**Commonly Observed Responses:**

1. $\frac{1}{3}\times 90\times 90\times 60-\frac{1}{3}\times 40\times 40\times 48=136\ 400\ cm^3$ — award 3/4 ✓×✓✓1
2. $\frac{1}{3}\times 90\times 90\times 108+\frac{1}{3}\times 40\times 40\times 48=317\ 200\ cm^3$ — award 3/4 ✓✓×✓1
3. (a) $\frac{1}{3}\times 90\times 108\times 108-\frac{1}{3}\times 40\times 48\times 48=319\ 200\ cm^3$ — award 3/4 ×✓1✓✓1
   (b) $\frac{1}{3}\times 90\times 60\times 60-\frac{1}{3}\times 40\times 48\times 48=77\ 280\ cm^3$ — award 2/4 ××✓✓1
4. (a) $\frac{1}{3}\times \pi\times 90^2\times 108-\frac{1}{3}\times \pi\times 40^2\times 48\ (=266000)$ $83566(.6\ldots)\ cm^3$ — award 3/4 ×✓1✓✓1
   (b) $\frac{1}{3}\times \pi\times 90^2\times 60-\frac{1}{3}\times \pi\times 40^2\times 48\ (=136400)$ $42851(.2\ldots)\ cm^3$ — award 2/4 ××✓✓1
   (c) $\frac{1}{3}\times \pi\times 45^2\times 108-\frac{1}{3}\times \pi\times 20^2\times 48\ (=66500)$ $20915(.9\ldots)\ cm^3$ — award 3/4 ×✓1✓✓1
   (d) $\frac{1}{3}\times \pi\times 45^2\times 60-\frac{1}{3}\times \pi\times 20^2\times 48\ (=34100)$ $10728(.3\ldots)\ cm^3$ — award 2/4 ××✓✓1

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|
| **10.** | $\bullet^1$ correct denominator | $\bullet^1$ $\frac{\cdots}{x(x-3)}$ | **3** |
| | $\bullet^2$ correct numerator | $\bullet^2$ $\frac{7x-2(x-3)}{\cdots}$ | |
| | $\bullet^3$ remove brackets and collect like terms in numerator | $\bullet^3$ $\frac{5x+6}{x(x-3)}$ | |

**Notes:**

1. Correct answer without working — award 3/3

2. Accept $\frac{7x}{x(x-3)}-\frac{2(x-3)}{x(x-3)}$ for the award of $\bullet^1$ and $\bullet^2$

3. Do **not** accept $\frac{7x}{x-3}-\frac{2(x-3)}{x}$ for the award of $\bullet^2$

4. Where a candidate chooses to expand the brackets in the denominator, then $\bullet^3$ is only available for a correct expansion eg

   (a) $\frac{5x+6}{x(x-3)}=\frac{5x+6}{x^2-3x}$ — award 3/3

   (b) $\frac{5x+6}{x(x-3)}=\frac{5x+6}{x^2-3}$ — award 2/3 ✓✓×

   (c) $\frac{7x}{x^2-3}-\frac{2(x-3)}{x^2-3}=\frac{5x+6}{x^2-3}$ — award 2/3 ×✓1✓1

5. For subsequent incorrect working do not award $\bullet^3$

   eg $\frac{7x}{x(x-3)}-\frac{2(x-3)}{x(x-3)}=\frac{5x+6}{x(x-3)}=\frac{11}{x-3}$ — award 2/3 ✓✓×

**Commonly Observed Responses:**

1. $\frac{7x}{x(x-3)}-\frac{2(x-3)}{x(x-3)}=\frac{5x-6}{x(x-3)}$ — award 2/3 ✓✓×

2. $\frac{7x-2x-6}{x(x-3)}=\frac{5x-6}{x(x-3)}$ — award 2/3 ✓×✓1

3. $\frac{7x}{x(x-3)}-\frac{2x-3}{x(x-3)}=\frac{5x\pm 3}{x(x-3)}$ — award 1/3 ✓××

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **11.** | | | •[1] substitute $h$ = 150 into formula<br>•[2] rearrange equation<br>•[3] calculate one value of $x$<br>•[4] calculate second value of $x$ | •[1] 150 = 20 $cos\ x$ + 147<br>•[2] $\cos x = \frac{3}{20}$<br>•[3] 81<br>•[4] 279 | **4** |

**Notes:**

1. Correct answers
   (a) without working — award 1/4 ××✓2✓
   (b) by repeated substitution — award 1/4 ××✓2✓

2. Degree signs are not required

3. If $\cos x < 0$ then •[3] and •[4] are only available for consistent 2nd and 3rd quadrant angles eg
   (a) $150 = 20\cos x \quad 147 \rightarrow \cos x \quad \frac{3}{20} \rightarrow 99, 261$ — award 3/4 ✓×✓1✓1
   (b) $147 = 20\cos x \quad 150 \rightarrow \cos x \quad \frac{3}{20} \rightarrow 99, 261$ — award 3/4 ×✓1✓1✓1

4. Do not penalise incorrect rounding provided given answers round to 81 and 279.

5. Where more than two **final** values are stated, •[4] is not available
   eg $150 = 20\cos x \quad 147 \rightarrow \cos x \quad \frac{3}{20} \rightarrow 81, 99, 279$ — award 3/4 ✓✓✓×

6. Inappropriate use of RAD or GRAD should only be penalised once in Qu 4, 8, 11 or 15
   (a) 1.4(202...), 358.579 [RAD]
   (b) 90(.41...), 269.585 [GRAD]

**Commonly Observed Responses:**

1. (a) 20 cos 150 + 147 = 130 — award 0/4
   (b) 20 cos 150 + 147 = 130, 230 — award 1/4 ×××✓1

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **12.** | | | •1 factorise numerator<br><br>•2 factorise denominator<br><br>•3 cancel brackets correctly | •1 $(x - 4)\ (x + 4)$<br><br>•2 $(x + 5)\ (x - 4)$<br><br>•3 $\frac{x+4}{x+5}$ | **3** |

**Notes:**

1. Correct answer without working — award 0/3

2. For subsequent incorrect working •3 is not available

   eg $\frac{(x-4)(x+4)}{(x+5)(x-4)} = \frac{x+4}{x+5} \quad \frac{4}{5}$ — award 2/3 ✓✓×

**Commonly Observed Responses:**

| Question | Generic scheme | Illustrative scheme | Max Mark |
|---|---|---|---|
| **13.** | **Method 1**<br>•1 factorise<br><br>•2 substitute and simplify<br><br>**Method 2**<br>•1 expand<br><br>•2 substitute and simplify<br><br>**Method 3**<br>•1 substitute<br><br>•2 expand and simplify | **Method 1**<br>•1 $2(\sin^2 x + \cos^2 x)$<br><br>•2 2<br><br>**Method 2**<br>•1 $\sin^2 x + \cos^2 x + \sin^2 x + \cos^2 x$<br><br>•2 2<br><br>**Method 3**<br>•1 $2(1 - \cos^2 x) + 2\cos^2 x$ or $2\sin^2 x + 2(1-\sin^2 x)$<br><br>•2 $2 - 2\cos^2 x + 2\cos^2 x = 2$ or $2\sin^2 x + 2 - 2\sin^2 x = 2$ | **2** |

**Notes:**

1. Correct answer without working — award 0/2
2. Do not penalise omission of degrees signs.
3. For $2(\sin x^2 + \cos x^2) = 2$ — award 1/2 ×✓1
4. •1 is not available if there are no variables eg $2(\sin^2 + \cos^2) = 2$ — award 1/2 ×✓

**Commonly Observed Responses:**

1. (a) $\sin^2 x + \cos^2 x = 1 \rightarrow 2\sin^2 x \quad 2\cos^2 x \quad 2$ — award 2/2
   (b) $2\sin^2 x + 2\cos^2 x = 2 \rightarrow \sin^2 x \quad \cos^2 x \quad 1$ — award 0/2
2. (a) $\sin^2 x + \sin^2 x + \cos^2 x + \cos^2 x = 1 + 1 = 2$ — award 2/2
   (b) $\sin^2 x + \cos^2 x + 1 = 1 + 1 = 2$ — award 2/2
   (c) $\sin^2 x \times \sin^2 x + \cos^2 x \times \cos^2 x = 1 + 1 = 2$ — award 0/2
3. $\sin^2 x + \cos^2 x = 1 \rightarrow 2 \quad 1 \quad 2$ — award 2/2
4. $\sin^2 x + \cos^2 x = 1$ — award 0/2

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **14.** | (a) | | $\bullet^1$ use the dimensions of the cuboid to find an expression for the volume<br><br>$\bullet^2$ construct equation and rearrange into required form | $\bullet^1$ $(x+7)\times x\times 2$ or equivalent<br><br>$\bullet^2$ $2x^2+14x=$<br>$45 \Rightarrow 2x^2+14x-45=0$ | **2** |

**Notes:**

1. Correct answer without working award 0/2

2. If solution to part (a) appears in (b) then both marks are available.

3. For the award of $\bullet^1$
   (a) accept $x$+7×$x$×2 with further evidence of ($x$ + 7)×$x$×2
   (b) do **not** accept $x$+7×$x$×2 with no further evidence

**Commonly Observed Responses:**

1. $2x^2+14x-45=0 \Rightarrow 2x(x \quad 7) \quad \cancel{45}$ award 0/2

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **14.** | (b) | | $\bullet^3$ correct substitution into quadratic formula<br>$\bullet^4$ evaluate discriminant<br>$\bullet^5$ solve for $x$<br>$\bullet^6$ select correct value of $x$, to one decimal place | $\bullet^3$ $\dfrac{-14 \pm \sqrt{(14)^2 - 4(2)(-45)}}{2(2)}$<br>$\bullet^4$ 556 (stated or implied by $\bullet^5$)<br>$\bullet^5$ 2.39(4…) and −9.39(4…)<br>$\bullet^6$ 2.4 | **4** |

**Notes:**

1. Correct answer without working — award 0/4

2. For a solution obtained by guess and check — award 0/4

3. $\bullet^4$ is available for $\dfrac{-7 \pm \sqrt{139}}{2}$

4. $\bullet^5$ is only available when $b^2 - 4ac > 0$

5. $\bullet^6$ is only available when the positive root is selected and it requires rounding.

6. If solution to part (b) appears in (a) then all four marks are available. However, if a different value of $x$ is stated in (b) then $\bullet^6$ is not available. General marking principle (l) should not be applied in this special case.

7. For:

   (a) $\dfrac{-14 + \sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \rightarrow 2.4$ — award 2/4 ✓✓××

   (b) $\dfrac{-14 + \sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \rightarrow 2.4$; with explicit justification of why second root has not been calculated eg 2nd substitution leads to a negative solution — award 4/4

| Question | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|

**14. (continued)**

**Commonly Observed Responses:**

1. 556 ($b^2 - 4ac$) award 1/4 ^✓^^

2. $\dfrac{-14 \pm \sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \left( \rightarrow \dfrac{-14 \pm \sqrt{-164}}{2(2)} \right) \rightarrow \dfrac{-14 \pm \sqrt{164}}{2(2)} \rightarrow -0.29(8\ldots), -6.70(1\ldots)$

award 1/4 ✓×××

3. $\dfrac{-14 \pm \sqrt{(14)^2 - 4(2)(45)}}{2(2)} \rightarrow \dfrac{-14 \pm \sqrt{-164}}{2(2)} \left( \rightarrow \dfrac{-14 \pm \sqrt{164}}{2(2)} \right) \rightarrow -0.29(8\ldots),\ -6.70(1\ldots)$

award 1/4 ×✓1××

4. $\dfrac{-14 \pm \sqrt{(14)^2 - 4(2)(45)}}{2(2)} \rightarrow \dfrac{-14 \pm \sqrt{164}}{2(2)} \rightarrow -0.29(8\ldots),\ -6.70(1\ldots)$ award 1/4 ××✓1×

5. (a) $-14 \pm \dfrac{\sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \rightarrow -14 \pm \dfrac{\sqrt{556}}{2(2)} \rightarrow 2.39(4\ldots), -9.39(4\ldots) \rightarrow 2.4$

award 4/4

(b) $-14 \pm \dfrac{\sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \rightarrow -14 \pm \dfrac{\sqrt{556}}{2(2)} \rightarrow -8.10(5\ldots), -19.89(4\ldots)$

award 2/4 ×✓✓1×

6. $\dfrac{-14 \pm \sqrt{(14)^2 - 4(2)(-45)}}{2(2)} \rightarrow \dfrac{-14 \pm \sqrt{556}}{2(2)} \rightarrow -8.10(5\ldots), -19.89(4\ldots)$ award 2/4 ✓✓××

| Question | | | Generic scheme | Illustrative scheme | Max mark |
|---|---|---|---|---|---|
| **15.** | | | •[1] correct trig. ratio<br>•[2] correct substitution into formula for area of triangle ADE<br>•[3] form equation<br>•[4] solve to find length of AE | •[1] $\sin A = \frac{8}{18}$ or equivalent<br>•[2] $\frac{1}{2}\times 24\times AE\times \sin A$ stated or implied by •[3]<br>•[3] $\frac{1}{2}\times 24\times AE\times \frac{8}{18} = 160$<br>•[4] 30 (cm) | **4** |

**Notes:**

1. Correct answer without working — award 0/4

2. For the award of •[1] accept $\sin A = \frac{8\sin 90}{18}$ or A = 26 (.38...) using a valid strategy involving a trigonometric calculation

3. Premature rounding must be to at least 2 significant figures eg

   (a) $\frac{1}{2}\times 24\times AE\times \sin 26 = 160 \rightarrow 30\,(.41...)$ — award 4/4

   (b) $\frac{1}{2}\times 24\times AE\times \frac{8}{18} = 160 \rightarrow 5.3 \times AE = 160 \rightarrow 30\,(.18...)$ — award 4/4

   (c) $\frac{1}{2}\times 24\times AE\times 0.4 = 160 \rightarrow 4.8 \times AE = 160 \rightarrow 33\,(.33...)$ — award 3/4 ✓✓✓✓2

4. Do not penalise incorrect rounding in the final answer

5. For subsequent incorrect working, the final mark is not available

6. Where candidate estimates the size of angle BAC, •[3] is only available if the angle is acute

   (a) $\frac{1}{2}\times 24\times AE\times \sin 30 = 160 \rightarrow 26.6\,(6...)$ — award 2/4 ××✓1✓1

   (b) $\frac{1}{2}\times 24\times AE\times \sin 90 = 160 \rightarrow 13.3\,(3...)$ — award 1/4 ×××✓1

7. Alternative method (similarity):

   •[1] identify scale factor — •[1] eg $\frac{24}{18}$

   •[2] find height of triangle ADE — •[2] $\frac{32}{3}$

   •[3] form equation — •[3] $\frac{1}{2}\times AE\times \frac{32}{3} = 160$

   •[4] solve to find length of AE — •[4] 30 (cm)

**Commonly Observed Responses:**

1. (a) $\sqrt{18^2-8^2} = 16\,(.12...)$ — award 0/4

   (b) $\sqrt{18^2-8^2} = 16\,(.12...) \rightarrow \frac{1}{2}\times 24\times AE\times \sin 16 = 160 \rightarrow 48\,(.37...)$ — award 2/4 ××✓1✓1

**[END OF MARKING INSTRUCTIONS]**