National Qualifications 2017

2017 Mathematics Paper 1 (Non-calculator)

N5

Finalised Marking Instructions

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General marking principles for National 5 Mathematics

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For each question the marking instructions are generally in two sections, namely Illustrative Scheme and Generic Scheme. The illustrative scheme covers methods which are commonly seen throughout the marking. The generic scheme indicates the rationale for which each mark is awarded. In general, markers should use the illustrative scheme and only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

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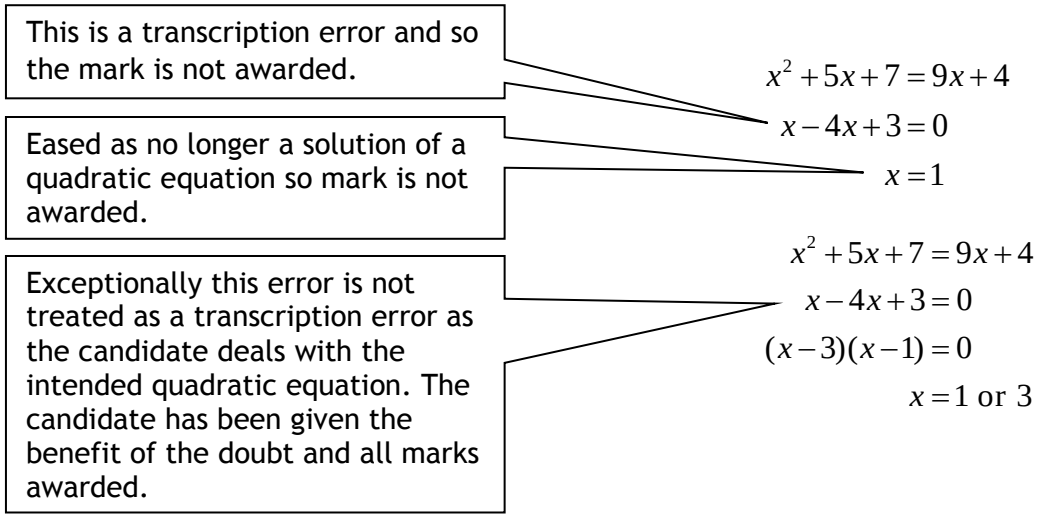

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Example:

	•5	•6
•5	$x=2$	$x=-4$
•6	$y=5$	$y=-7$

Horizontal: •5 $x=2$ and $x=-4$ Vertical: •5 $x=2$ and $y=5$
•6 $y=5$ and $y=-7$ •6 $x=-4$ and $y=-7$

Markers should choose whichever method benefits the candidate, but **not** a combination of both.

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

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Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Detailed marking instructions for each question.

Question			Generic scheme	Illustrative scheme	Max mark
1.			**Ans: 10** •[1] substitute into x^2+3x •[2] evaluate x^2+3x	•[1] $(-5)^2+3\times(-5)$ •[2] 10	**2**
Notes: 1. Correct answer without working award 0/2 2. Accept $-5^2+3\times-5$ for •[1] 3. For subsequent incorrect working, •[2] is not available					
Commonly Observed Responses: 1. (a) For $-5=(-5)^2+3\times(-5)\rightarrow -5=10$ award 2/2 (b) For $-5=(-5)^2+3\times(-5)\rightarrow -5=10 \rightarrow x=15$ award 1/2 ✓× 2. For $5^2+3\times5=40$ award 0/2 3. For $5^2+3\times(-5)=10$ award 0/2					
2.			**Ans:** 16 •[1] find quartiles •[2] calculate semi-interquartile range	•[1] 218, 250 •[2] 16	**2**
Notes: 1. Correct answer without working award 0/2 2. Accept quartiles indicated in the list or on a diagram for •[1]					
Commonly Observed Responses: 1. For $\frac{267-198}{2}=34\cdot5$ award 0/2					

Question	Generic scheme	Illustrative scheme	Max mark
3.	**Ans:** $\frac{22}{9}$ •[1] start simplification and know how to divide fractions •[2] consistent answer	 •[1] $\frac{11}{6}\times\frac{4}{3}$ •[2] $\frac{22}{9}$ or $2\frac{4}{9}$	**2**

Notes:

1. Correct answer without working award 0/2

2. Do not penalise incorrect conversion of $\frac{22}{9}$ to a mixed number

Commonly Observed Responses:

1. $\frac{11}{6}\times\frac{4}{3}=\frac{44}{18}$ award 1/2 ✓×

2. $\frac{11}{6}\times\frac{3}{4}=\frac{11}{8}$ award 1/2 ×✓

3. $\frac{6}{11}\times\frac{3}{4}=\frac{9}{22}$ award 1/2 ×✓

Question	Generic scheme	Illustrative scheme	Max mark
4.	**Ans:** $2x^3-5x^2-10x+3$		**3**
	$\bullet^1$ start to expand	$\bullet^1$ evidence of any 3 correct terms eg $2x^3-8x^2+2x$	
	$\bullet^2$ complete expansion	$\bullet^2$ $2x^3-8x^2+2x+3x^2-12x+3$	
	$\bullet^3$ collect like terms which must include a term in x^3 and a negative coefficient	$\bullet^3$ $2x^3-5x^2-10x+3$	

Notes:

1. Correct answer with no working — award 3/3
2. For subsequent incorrect working, the final mark is not available

Commonly Observed Responses:

1. For eg $2x^3-8x^2+2x+3x^2+12x+3=2x^3-5x^2+14x+3$ — award 2/3 ✓×✓
2. For eg $2x^3+2x-12x+3=2x^3-10x+3$ — award 2/3 ✓×✓
3. For $2x^3+8x^2+2x+3x^2+12x+3=2x^3+11x^2+14x+3$ — award 1/3 ✓××

Question			Generic scheme	Illustrative scheme	Max mark
5.			**Ans:** $B(0,6,6), C(3,3,9)$ $\bullet^1$ Coordinate B $\bullet^2$ Coordinate C	$\bullet^1$ (0,6,6) $\bullet^2$ (3,3,9)	**2**

Notes:

1. The maximum mark available is 1/2 where
   (a) brackets are omitted
   (b) answers are given in component form

2. For (6,6,0) **and** (9,3,3) [repeated error] award 1/2 ×✓

Commonly Observed Responses:

1. For 0,6,6 and 3,3,9 award 1/2 ×✓
2. For $\begin{pmatrix}0\\6\\6\end{pmatrix}$ and $\begin{pmatrix}3\\3\\9\end{pmatrix}$ award 1/2 ×✓
3. For eg $\begin{pmatrix}0\\6\\0\end{pmatrix}$ and $\begin{pmatrix}3\\3\\9\end{pmatrix}$ award 0/2

Question	Generic scheme	Illustrative scheme	Max mark
6.	**Ans:** $y=-2x+4$ **Method 1:** $y-b=m(x-a)$ •[1] find gradient •[2] substitute gradient and a point into $y-b=m(x-a)$ •[3] state equation in simplest form **Method 2:** $y=mx+c$ •[1] find gradient •[2] substitute gradient and a point into $y=mx+c$ •[3] state equation in simplest form	•[1] $-\frac{8}{4}$ or equivalent •[2] eg $y-(-2)=-\frac{8}{4}(x-3)$ •[3] $y=-2x+4$ **or equivalent** •[1] $-\frac{8}{4}$ •[2] eg $-2=-\frac{8}{4}\times 3+c$ •[3] $y=-2x+4$ or equivalent	**3**

Notes:

1. Correct answer without working award 3/3

2. BEWARE •[1] is not available for $\frac{-2-6}{3-(-1)}=\frac{8}{-4}$ or $\frac{6-(-2)}{-1-3}=\frac{-8}{4}$

Commonly Observed Responses:

1. For a final answer of $y=-\frac{2}{1}x+4$ award 2/3 ✓✓×
2. $y=2x+8$ $[m=\frac{8}{4}\ (-1,6)]$ award 2/3 ×✓✓
3. $y=2x-8$ $[m=\frac{8}{4}\ (3,-2)]$ award 2/3 ×✓✓
4. $m=\frac{4}{4}=1\rightarrow y-6=1(x-(-1))\rightarrow y=1x+7$ award 2/3 ×✓✓

Question	Generic scheme	Illustrative scheme	Max mark
7.	**Ans:** 32 cm^2		**2**
	•^{1} correct substitution into area of triangle formula	•^{1} $\frac{1}{2}\times 12\times 8\times \frac{2}{3}$	
	•^{2} calculate area	•^{2} $32\left(\text{cm}^2\right)$	

Notes:

1. Correct answer without working — award 1/2

Commonly Observed Responses:

1. For $\frac{1}{2}\times 12\times 8\times \sin\frac{2}{3}=32$ — award 1/2 ×✓
2. For $\frac{1}{2}\times 12\times 8\times \sin\frac{2}{3}$ — award 0/2
3. For $\frac{1}{2}\times 12\times 8=48$ — award 0/2
4. For (a) $\frac{1}{2}\times 12\times 8\times 0\cdot\dot{6}=32$ or $\frac{1}{2}\times 12\times 8\times 0\cdot 666...=32$ — award 2/2
   (b) $\frac{1}{2}\times 12\times 8\times 0\cdot 67=32\cdot 16$ or $\frac{1}{2}\times 12\times 8\times 0\cdot 66=31\cdot 68$ — award 1/2 ×✓
   (c) $\frac{1}{2}\times 12\times 8\times 0\cdot 7=33\cdot 6$ or $\frac{1}{2}\times 12\times 8\times 0\cdot 6=28\cdot 8$ — award 0/2

Question	Generic scheme	Illustrative scheme	Max mark
8.	**Ans:** $x<5$		**3**
	•^{1} expand bracket	•^{1} $3x-6$	
	•^{2} collect like terms	•^{2} $-2x>-10$ or $10>2x$	
	•^{3} solve for x	•^{3} $x<5$ or $5>x$	

Notes:

1. Correct answer without valid working — award 0/3
   Treat guess and check as invalid working

Commonly Observed Responses

1. For $19+x>15+3x-6\rightarrow 2x>-10\rightarrow x>-5$ — award 1/3 ✓××
2. For $19+x>15+3x-2\rightarrow -2x>-6\rightarrow x<3$ — award 2/3 ×✓✓
3. For $19+x>18(x-2)\rightarrow 19+x>18x-36\rightarrow 55>17x\rightarrow \frac{55}{17}>x$ — award 2/3 ×✓✓
4. For (a) $19+x=15+3x-6\rightarrow -2x=-10\rightarrow x=5\rightarrow x<5$ — award 3/3
   (b) $19+x=15+3x-6\rightarrow -2x=-10\rightarrow x=5$ — award 2/3 ✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
9.			**Ans:** 26° **Method 1** $\bullet^1$ calculate size of angle OBD $\bullet^2$ calculate size of angle ODB (ODB = OBD) $\bullet^3$ calculate size of angle CAB **Method 2** $\bullet^1$ calculate size of angle ABC $\bullet^2$ calculate size of angle OCB (OCB = 90 − ABC) $\bullet^3$ calculate the size of angle CAB	 $\bullet^1$ OBD = 32 $\bullet^2$ ODB = 32 $\bullet^3$ CAB = 26 $\bullet^1$ ABC = 32 $\bullet^2$ OCB = 58 $\bullet^3$ CAB = 26	**3**

Notes:

1. Check both methods and award the higher mark.
2. Full marks may be awarded for information marked on the diagram.
3. Where information is not marked on the diagram then working must clearly attach calculations to **named** angles.
4. For an answer of 26° with no relevant working — award 0/3
5. Where candidate uses triangle ABO, $\bullet^3$ is available for ABO = 90 and answer to CAB = 90 − AOB
   eg OBD = 32; AOB = 32; ABO = 90 and CAB = 58 — award 2/3 ✓×✓

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
10.	**Ans:** $b = \frac{Fc - t^2}{4}$ **or equivalent**		**3**
	• 1 multiply by c	• 1 $Fc = t^2 + 4b$	
	• 2 subtract t^2	• 2 $4b = Fc - t^2$	
	• 3 divide by 4	• 3 $b = \frac{Fc - t^2}{4}$	

Notes:

1. Correct answer without working 3/3

Commonly Observed Responses:

1. For $b = \frac{c \times f - t^2}{4}$ award 3/3
2. For $b = \frac{t^2 - Fc}{-4}$ award 3/3
3. For $b = \frac{Fc}{4} - \frac{t^2}{4}$ award 3/3

Question	Generic scheme	Illustrative scheme	Max mark
11.	**Ans:** $\frac{3-2a}{a^2}$ • [1] valid common denominator • [2] answer in simplest form	• [1] $\frac{}{a^2}$ or $\frac{}{a^3}$ or $\frac{}{a^2 \times a}$ • [2] $\frac{3-2a}{a^2}$	**2**

Notes:

1. Correct answer without working — award 2/2

2. For subsequent incorrect working, the final mark is not available
   eg $\frac{3-2\cancel{a}}{\cancel{a}^2}=\frac{3-2}{a}=\frac{1}{a}$ — award 1/2 ✓×

3. For $\frac{3}{a^2}-\frac{2}{a}=\frac{1}{a}$ — award 0/2

Commonly Observed Responses:

1. For $\frac{3a-2a^2}{a\times a^2}$ — award 1/2 ✓×

2. For $\frac{3}{a^2}-\frac{2a}{a^2}$ — award 1/2 ✓×

Question	Generic scheme	Illustrative scheme	Max mark
12.	**Ans:** $a=3, b=2$		**4**
	Method 1		
	$\bullet^1$ find $\overline{x}$	$\bullet^1$ $\overline{x}=4$	
	$\bullet^2$ find $\left(x-\overline{x}\right)^2$	$\bullet^2$ 9, 0, 4, 1, 4	
	$\bullet^3$ substitute into formula and start to evaluate	$\bullet^3$ $\sqrt{\frac{18}{4}}$	
	$\bullet^4$ find values of a and b	$\bullet^4$ $a=3, b=2$ or $\frac{3\sqrt{2}}{2}$	
	Method 2		
	$\bullet^1$ find $\sum x$ and $\sum x^2$	$\bullet^1$ $\sum x=20$ and $\sum x^2=98$	
	$\bullet^2$ substitute into formula	$\bullet^2$ $\sqrt{\frac{98-\frac{20^2}{5}}{5-1}}$	
	$\bullet^3$ start to evaluate	$\bullet^3$ $\sqrt{\frac{18}{4}}$	
	$\bullet^4$ find values of a and b	$\bullet^4$ $a=3, b=2$ or $\frac{3\sqrt{2}}{2}$	

Notes:

1. Correct answer without working — award 0/4
2. For $\frac{3\sqrt{2}}{2} \rightarrow a=3, b=\sqrt{2}$ with valid working — award 4/4
3. $\bullet^4$ is only available for simplifying $\sqrt{\frac{m}{n}}$ where m is **not** a perfect square

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
13.	**Ans:** (2·5, 5·5)		**3**
	•[1] evidence of scaling (match x or y coefficients)	•[1] eg $9x - 3y = 6$ $x + 3y = 19$	
	•[2] follow a valid strategy through to produce values for x and y	•[2] values for x and y	
	•[3] state correct x and y coordinates of P	•[3] $x = 2\cdot5, y = 5\cdot5$	

Notes:

1. Correct answer without working — award 0/3
2. For a solution obtained by guess and check — award 0/3

Commonly Observed Responses:

1. For $x = 2\cdot5, y = 5\cdot5 \rightarrow (5\cdot5, 2\cdot5)$ with valid working — award 3/3

Question			Generic scheme	Illustrative scheme	Max mark
14.	(a)		**Ans:** $a = 5$ •[1] state value of *a*	 •[1] 5	**1**
Notes: 1. Evidence may appear on the graph 2. Accept …$(x+5)^2$….. 3. Where **no answer** appears in (a), check (b) for evidence of $a=5$ eg $8 = (-3+5)^2 + b$					
Commonly Observed Responses:					
	(b)		**Ans:** $b = 4$ •[1] substitute (−3, 8) into equation •[2] state value of b	 •[1] $8 = (-3+5)^2 + b$ •[2] 4	**2**
Notes: 1. Correct answer without working award 2/2 1. Evidence may appear on the graph 2. An incorrect answer in (a) must be followed through (working must be shown) with the possibility of awarding 2/2.					
Commonly Observed Responses: 1. For (a) $a=3$ and (b) $b=8$ with or without working award (a) 0/1 and (b) 0/2					

Question	Generic scheme	Illustrative scheme	Max mark
15.	**Ans:** 6·5		**3**
	Method 1		
	•[1] find scale factor	•[1] $\frac{5}{7}$ or $\frac{7}{5}$	
	•[2] form equation	•[2] $(x=)\ \frac{5}{7}(x+2\cdot6)$ or $\frac{7}{5}x=x+2\cdot6$	
	•[3] find x	•[3] 6·5	
	Method 2		
	•[1] form equation	•[1] $\frac{x}{5}=\frac{x+2\cdot6}{7}$ or equivalent	
	•[2] start to solve	•[2] $7x = 5(x + 2.6)$ or equivalent	
	•[3] find x	•[3] 6·5	
	Method 3		
	•[1] state ratio	•[1] $5{:}2 \equiv x{:}\ 2{\cdot}6$ stated or implied by	
	•[2] start to solve	•[2] $2\cdot6\times\frac{5}{2}$	
	•[3] find x	•[3] 6·5	
	Method 4		
	•[1] state ratio	•[1] $\frac{2}{7}\text{PR}=2\cdot6$	
	•[2] start to solve	•[2] $\text{PR}=\frac{7}{2}\times2\cdot6\quad(=9\cdot1)$	
	•[3] find x	•[3] $(9\cdot1-2\cdot6=)\ 6\cdot5$	

Notes:

1. Correct answer without working — award 0/3

Commonly Observed Responses:

1. $\frac{5}{7}=\frac{x}{2\cdot6}\rightarrow x=\frac{13}{7}$ — award 1/3 ✓××

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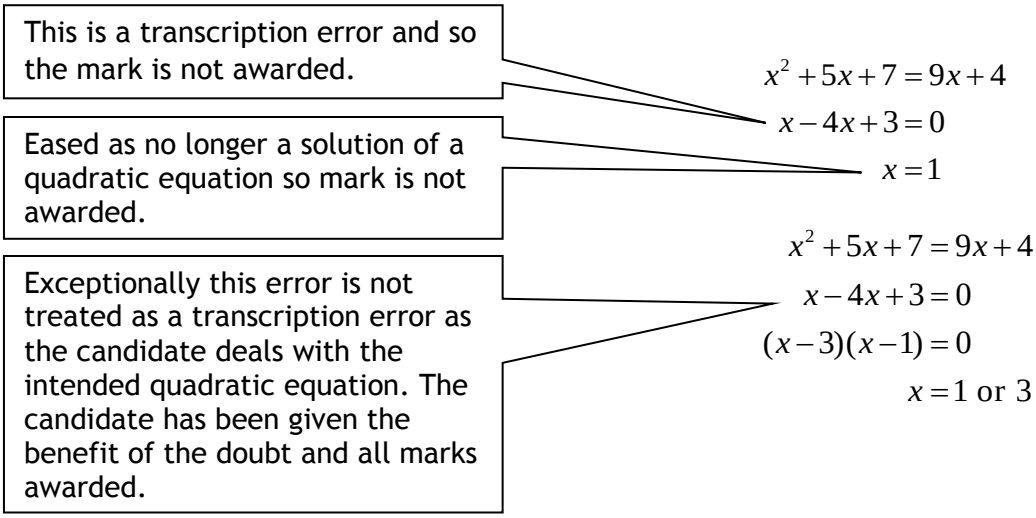

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$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

Horizontal: $\bullet^5$ $x=2$ and $x=-4$ Vertical: $\bullet^5$ $x=2$ and $y=5$
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Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Detailed marking instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			**Ans:** 23 • [1] start process • [2] solution	• [1] $18^2+(-14)^2+3^2$ • [2] 23	**2**

Notes:

1. Correct answer without working — award 2/2

Commonly Observed Responses:

No working necessary:

1. $\sqrt{529}$ — award 1/2 ✓×
2. $11\cdot 7\ldots\left(\text{eg } \sqrt{324-196+9}=\sqrt{137}\right)$ — award 1/2 ×✓
3. $\sqrt{137}$ — award 0/2
4. $2\cdot 6\ldots\left(\text{eg } \sqrt{18-14+3}=\sqrt{7}\right)$ — award 0/2

Question	Generic scheme	Illustrative scheme	Max mark
2.	**Ans:** £1369		**3**
	$\bullet^1$ know how to increase by $4\cdot5\%$	$\bullet^1$ $\times1\cdot045$	
	$\bullet^2$ know how to calculate value after three years	$\bullet^2$ $1200\times1\cdot045^3$	
	$\bullet^3$ evaluate to nearest £	$\bullet^3$ 1369	

Notes:

1. Correct answer without working — award 3/3

2. Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3,
   eg for $1200\times1\cdot45^3=3658$, with working — award 2/3 ×✓✓

3. Where division is used,
   (a) along with $1\cdot045$, $\bullet^1$ is not available
   eg $1200\div1\cdot045^3=1052$ — award 2/3 ×✓✓

   (b) along with an incorrect percentage, $\bullet^1$ and $\bullet^2$ are not available
   eg $1200\div0\cdot955^3=1378$ — award 1/3 ××✓

Commonly Observed Responses:

1. No working necessary:
(a) $1369\cdot00$ — award 3/3
(b) 1370 or $1369\cdot40$ or $1369\cdot4$ — award 2/3 ✓✓×

2. Working must be shown:
(a) $1200\times0\cdot955^3=1045$ — award 2/3 ×✓✓
(b) $1200\times0\cdot045=54\rightarrow1200+3\times54=1362$ — award 1/3 ✓××
(c) $1200\times1\cdot045=1254$ — award 1/3 ✓××
(d) $1200\times1\cdot045\times3=3762$ — award 1/3 ✓××
(e) $1200\times0\cdot045\times3=162$ — award 0/3

Question	Generic scheme	Illustrative scheme	Max mark
3.	**Ans:** 413m		**3**
	• [1] correct substitution into cosine rule	• [1] $180^2+250^2-2\times180\times250\times\cos147$	
	• [2] evaluate QR^2	• [2] $170380\cdot3$	
	• [3] calculate QR	• [3] $412\cdot77\ldots(\text{m})$	

Notes:

1. Correct answer without working — award 0/3

2. Accept 412 metres with working — award 3/3

3. Where sine rule is used — award 0/3

4. Disregard errors due to premature rounding provided there is evidence

(a) $180^2+250^2-2\times180\times250\times(-0\cdot84)=170500\rightarrow412\cdot9\ldots$ — award 3/3

(b) $180^2+250^2-2\times180\times250\times(-0\cdot8)=166900\rightarrow408\cdot5\ldots$ — award 3/3

5. (a) 407 or 408 (RAD) — award 2/3 ✓×✓

(b) 394 (GRAD) — award 2/3 ✓×✓

Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15.

Commonly Observed Responses:

Working must be shown:

1. $\sqrt{180^2+250^2}=308(\cdot05\ldots)$ — award 1/3 ××✓

2. (a) $180^2+250^2-2\times180\times250\times\cos147=170380\cdot0\ldots\rightarrow410$ — award 3/3

(b) $180^2+250^2-2\times180\times250\times\cos147\rightarrow410$ — award 2/3 ✓×✓

3. $32400+62500-75480\cdot35\ldots=19419\cdot64\ldots\rightarrow139(\cdot35\ldots)$ — award 2/3 ✓×✓

Question	Generic scheme	Illustrative scheme	Max mark
4.	**Ans:** $x=-3\cdot1,\ x=0\cdot6$ $\bullet^1$ substitute correctly into quadratic formula $\bullet^2$ evaluate discriminant $\bullet^3$ calculate both values of x correct to one decimal place	$\bullet^1$ $\dfrac{-5\pm\sqrt{5^2-4\times2\times(-4)}}{2\times2}$ $\bullet^2$ 57 (stated or implied by $\bullet^3$) $\bullet^3$ $-3\cdot1,\ 0\cdot6$	**3**

Notes:

1. Correct answer without working — award 0/3
2. The final mark is only available if $b^2-4ac>0$; see CORs 2 - 5
3. The final mark is only available when answer requires rounding

Commonly Observed Responses:

1. 57 $\left(b^2-4ac\right)$ — award 1/3 ×✓×

2. $\dfrac{-5\pm\sqrt{5^2-4\times2\times(-4)}}{2\times2}\rightarrow\dfrac{-5\pm\sqrt{-7}}{2\times2}\rightarrow-1\cdot9,-0\cdot6$ — award 1/3 ✓××

   (Beware: candidate may get $\sqrt{-7}$ then change it to $\sqrt{7}$)

3. $\dfrac{-5\pm\sqrt{5^2-4\times2\times(-4)}}{2\times2}\rightarrow\dfrac{-5\pm\sqrt{7}}{2\times2}\rightarrow-1\cdot9,-0\cdot6$ — award 2/3 ✓×✓

4. $\dfrac{-5\pm\sqrt{5^2-4\times2\times4}}{2\times2}\rightarrow\dfrac{-5\pm\sqrt{-7}}{2\times2}\rightarrow-1\cdot9,-0\cdot6$ — award 1/3 ×✓×

   (Beware: candidate may get $\sqrt{-7}$ then change it to $\sqrt{7}$)

5. $\dfrac{-5\pm\sqrt{5^2-4\times2\times4}}{2\times2}\rightarrow\dfrac{-5\pm\sqrt{7}}{2\times2}\rightarrow-1\cdot9,-0\cdot6$ — award 1/3 ××✓

Question	Generic scheme	Illustrative scheme	Max mark
5.	**Ans:** 4200		**3**
	• [1] know that $115\% = 4830$	• [1] $115\% = 4830$	
	• [2] begin valid strategy	• [2] $1\% = \frac{4830}{115}$ or equivalent	
	• [3] complete calculation within valid strategy	• [3] 4200	

Notes:

1. For 4200 with or without working — award 3/3
2. For 4105 or 4106 $(85\%$ of $4830)$ or 5554 or 5555 $(115\%$ of $4830)$
   - (i) **and** evidence of • [1] — award 1/3 ✓××
   - (ii) otherwise — award 0/3

Commonly Observed Responses:

1. $\frac{4830}{1{\cdot}15} = 4200$ — award 3/3
2. $85\% = 4830 \rightarrow 5682$ — award 2/3 ×✓✓
3. $15\% = 4830 \rightarrow 32200$ — award 2/3 ×✓✓

Question			Generic scheme	Illustrative scheme	Max mark
6.			**Ans:** 4180mm^3		**5**
			$\bullet^1$ know to find difference of two volumes	$\bullet^1$ evidence of difference in two volumes	
			$\bullet^2$ substitute correctly into formula for volume of large sphere	$\bullet^2$ $\frac{4}{3}\times\pi\times12^3\ (=7238\cdot229\ldots)$	
			$\bullet^3$ substitute correctly into formula for volume of small sphere	$\bullet^3$ $\frac{4}{3}\times\pi\times9^3\ (=3053\cdot628\ldots)$	
			$\bullet^4$ carry out all calculations correctly (must involve difference or sum of two volume calculations and include a fraction)	$\bullet^4$ $4184\cdot601$	
			$\bullet^5$ round final answer to 3 significant figures and correct units	$\bullet^5$ 4180mm^3	

Notes:

1. Correct answer without working — award 0/5

2. Accept variations in π
   eg $\frac{4}{3}\times3\cdot14\times12^3-\frac{4}{3}\times3\cdot14\times9^3=4182\cdot48=4180\,\text{mm}^3$

3. In awarding $\bullet^5$
   (a) Intermediate calculations need not be shown
   eg $\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times9^3=4180\,\text{mm}^3$ — award 5/5
   (b) Where intermediate calculations are shown, they must involve at least four significant figures
   eg $7238\cdot229\ldots-3053\cdot628\ldots=7240-3050=4190\text{mm}^3$ — award 4/5 ✓✓✓✓×

4. Volume of second sphere may be calculated using volume scale factor
   eg accept $\left(\frac{3}{4}\right)^3\times\frac{4}{3}\times\pi\times12^3$ for the award of $\bullet^3$

Question	Generic scheme	Illustrative scheme	Max mark

Commonly Observed Responses:

Working must be shown:

1. (a) $\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times10\cdot5^3=(7238\cdot...-4849\cdot...)=2390\text{mm}^3$ award 4/5 ✓✓×✓✓

   (b) $\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times10\cdot5^3=7240-4850=2390\text{mm}^3$ award 3/5 ✓✓×✓×

2. $\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times3^3=7130\text{mm}^3$ award 4/5 ✓✓×✓✓

3. $\frac{4}{3}\times\pi\times12^3=7240\text{mm}^3$ award 2/5 ×✓××✓

4. $\frac{4}{3}\times\pi\times12^3+\frac{4}{3}\times\pi\times9^3=10300\text{mm}^3$ award 4/5 ×✓✓✓✓

5. $\frac{4}{3}\times\pi\times24^3-\frac{4}{3}\times\pi\times18^3=33500\text{mm}^3$ award 4/5 ✓×✓✓✓

6. $\frac{4}{3}\times\pi\times24^3-\frac{4}{3}\times\pi\times21^3=19100\text{mm}^3$ award 3/5 ✓××✓✓

7. $\frac{4}{3}\times\pi\times1\cdot5^3=14\cdot1\text{mm}^3$ award 1/5 ××××✓

8. $\frac{4}{3}\times\pi\times12^2-\frac{4}{3}\times\pi\times9^2=264\text{mm}^3$ award 4/5 ✓×✓✓✓

9. $\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times9^3=1332\pi\,\text{mm}^3$ award 4/5 ✓✓✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
7.			**Ans: No, with valid reason** **Method 1**		**3**
			•[1] valid strategy (Converse of Pythagoras' Theorem in correct triangle with correct combination of sides)	•[1] 8^2+19^2 and 22^2	
			•[2] evaluation	•[2] $8^2+19^2=425,\ 22^2=484$	
			•[3] comparison and state conclusion	•[3] $8^2+19^2\neq 22^2$; No	
			Method 2		
			•[1] valid strategy (Pythagoras' Theorem in correct triangle with correct combination of sides)	•[1] 8^2+19^2	
			•[2] evaluation	•[2] length of longest side $=20\cdot 6$	
			•[3] comparison and state conclusion	•[3] $20\cdot 6\neq 22$; No	
			Method 3		
			•[1] valid strategy (correct substitution into cosine rule to find largest angle in correct triangle)	•[1] $\cos x^{\circ}=\dfrac{8^2+19^2-22^2}{2\times 8\times 19}$	
			•[2] evaluation	•[2] $\cos x^{\circ}=-0\cdot 194$	
			•[3] find angle and state conclusion	•[3] $(x=)\ 101\cdot 2$; No	
			Method 4		
			•[1] valid strategy (correct substitutions into cosine rule to find angle opposite 6 in triangle A **and** angle opposite 16 in triangle B)	•[1] $\cos x^{\circ}=\dfrac{8^2+7^2-6^2}{2\times 8\times 7}$ and $\cos y^{\circ}=\dfrac{7^2+19^2-16^2}{2\times 7\times 19}$	
			•[2] evaluation of both cos values	•[2] $\cos x^{\circ}=0\cdot 6875$ and $\cos y^{\circ}=0\cdot 5789$	
			•[3] find sum of angles and state conclusion	•[3] (sum=) $101\cdot 2$; No	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. In Method 1 $\bullet^3$ is **not** available when evaluations at $\bullet^2$ have **not** been carried out
   eg $8^2+19^2=64+361$, $22^2=484$; $8^2+19^2\neq 22^2$; No — award 1/3 ✓××
   $8^2+19^2=64+361=425$, $22^2=484$; $8^2+19^2\neq 22^2$; No — award 3/3
2. Where the wrong triangle is chosen, $\bullet^2$ is only available for consistent application of Pythagoras or cosine rule; see CORs 2 and 3

Commonly Observed Responses:

1. $8^2+19^2=64+361=425, 22^2=484$; $8^2+19^2<22^2$; No — award 3/3
2. $7^2+16^2=305, 19^2=361$; $7^2+16^2\neq 19^2$; No — award 2/3 ×✓✓
3. $7^2+19^2=410, 16^2=256$; $7^2+19^2\neq 16^2$; No — award 1/3 ××✓
4. $8^2+22^2=548, 19^2=361$; $8^2+22^2\neq 19^2$; No — award 2/3 ×✓✓
5. (a) $8^2+19^2=425, 22^2=484$; The **square of the hypotenuse** is not equal to the sum of the squares of the other two sides; No — award 3/3
   (b) $8^2+19^2=425, 22^2=484$; The **hypotenuse** is not equal to the sum of the squares of the other two sides; No — award 2/3 ✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		**Ans:** $\mathbf{d}-\mathbf{c}$ $\bullet^1$ answer	 $\bullet^1$ $\mathbf{d}-\mathbf{c}$ or equivalent	**1**
Notes: 1. Accept $-\mathbf{c}+\mathbf{d}$ or $\mathbf{d}+-\mathbf{c}$ 2. Accept $\mathbf{D}-\mathbf{C}$ as bad form					
Commonly Observed Responses:					
	(b)		**Ans:** $\frac{3}{2}\mathbf{d}-\frac{1}{2}\mathbf{c}$ $\bullet^1$ valid pathway $\bullet^2$ correct simplified expression	 $\bullet^1$ $\overrightarrow{\mathbf{TP}}+\frac{1}{2}\overrightarrow{\mathbf{PR}}$ or $\overrightarrow{\mathbf{TQ}}+\overrightarrow{\mathbf{QR}}+\frac{1}{2}\overrightarrow{\mathbf{RP}}$ $\bullet^2$ $\frac{3}{2}\mathbf{d}-\frac{1}{2}\mathbf{c}$ or equivalent	**2**
Notes: **1.** Correct answer without working award 2/2 2. Accept $\frac{3}{2}\mathbf{D}-\frac{1}{2}\mathbf{C}$ 3. $\overrightarrow{\mathbf{TP}}+\overrightarrow{\mathbf{PV}}$ or $\overrightarrow{\mathbf{TQ}}+\overrightarrow{\mathbf{QR}}+\overrightarrow{\mathbf{RV}}$ alone is not enough for the award of $\bullet^1$ 4. For the award of $\bullet^1$ (a) accept $\mathbf{d}+\frac{1}{2}\overrightarrow{\mathbf{PR}}$ but **not** $\mathbf{d}+\overrightarrow{\mathbf{PV}}$ (b) accept $2\mathbf{d}-\mathbf{c}+\frac{1}{2}\overrightarrow{\mathbf{RP}}$ but **not** $2\mathbf{d}-\mathbf{c}+\overrightarrow{\mathbf{RV}}$ (c) accept $\overrightarrow{\mathbf{PV}}=\frac{1}{2}(\mathbf{d}-\mathbf{c})$ but **not** $\frac{1}{2}(\mathbf{d}-\mathbf{c})$ alone (d) accept $\overrightarrow{\mathbf{RV}}=\frac{1}{2}(\mathbf{c}-\mathbf{d})$ but **not** $\frac{1}{2}(\mathbf{c}-\mathbf{d})$ alone			
Commonly Observed Responses: 1. $\frac{1}{2}(3\mathbf{d}-\mathbf{c})$ award 2/2					

Question			Generic scheme	Illustrative scheme	Max mark
9.	(a)		**Ans:** $(2x-5)(2x+5)$ •[1] factorise	 •[1] $(2x-5)(2x+5)$	**1**
Notes:					
Commonly Observed Responses:					
	(b)		**Ans:** $\dfrac{2x+5}{x+2}$ •[1] start to factorise •[2] complete factorising •[3] simplify	 •[1] $(2x\ \ 5)(x\ \ 2)$ •[2] $(2x-5)(x+2)$ •[3] $\dfrac{2x+5}{x+2}$	**3**

Notes:

1. Correct answer without working — award 3/3
2. For $(2x\ \ 10)(x\ \ 1)$ or $(2x\ \ 2)(x\ \ 5)$ etc — award 1/3 ✓××
3. For subsequent incorrect working, the final mark is not available
   eg $\dfrac{2\cancel{x}+5}{\cancel{x}+2}=\dfrac{7}{3}$ — award 2/3 ✓✓×
4. •[3] is only available when both the numerator and denominator have at least two factors

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
10.	**Ans: 9·9 kilometres**		**4**
	•[1] calculate size of angles DEF and DFE	•[1] 40 and 104	
	•[2] correct substitution into sine rule	•[2] $\frac{DF}{\sin 40} = \frac{15}{\sin 104}$	
	•[3] rearrange formula	•[3] $\frac{15 \times \sin 40}{\sin 104}$	
	•[4] calculate DF	•[4] $9 \cdot 9(36\ldots)$	

Notes:

1. Correct answer without working — award 0/4

2. Accept a final answer of 10, with working — award 4/4

3. •[1] may be awarded for sizes of angles DEF and DFE marked on the diagram

4. Where incorrect sizes are used for angles DEF and DFE
   (a) with prior evidence of angle sizes (marked on diagram or clearly attached to **named** angles), marks •[2], •[3] and •[4] are available
   (b) **without** prior evidence of angle sizes, only marks •[3] and •[4] are available

5. **BEWARE** $\frac{DF}{\sin 40} = \frac{15}{\sin 76} \rightarrow 9 \cdot 9$
   (a) with prior evidence of DEF = 40 and DFE = 76 — award 3/4 ×✓✓✓
   (b) **without** prior evidence of sizes of angles DEF and DFE — award 2/4 ××✓✓

6. Disregard errors due to premature rounding provided there is evidence

7. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15
   (a) $-34 \cdot 7\ldots$ (RAD)
   (b) $8 \cdot 8\ldots$ (GRAD)

Commonly Observed Responses:

1. $\frac{DF}{\sin 36} = \frac{15}{\sin 90} \rightarrow 8 \cdot 8$
   (a) with prior evidence of sizes of angles DEF and DFE marks — award 3/4 ×✓✓✓
   (b) **without** prior evidence of sizes of angles DEF and DFE — award 2/4 ××✓✓

2. $\frac{DF}{\sin 230} = \frac{15}{\sin 126} \rightarrow -14 \cdot 2$ — award 2/4 ××✓✓

3. $\frac{DF}{40} = \frac{15}{104} \rightarrow 5 \cdot 769\ldots\ldots$ — award 1/4 ✓×××

Question	Generic scheme	Illustrative scheme	Max mark
11.	**Ans:** $\frac{3}{5}$ or $0\cdot6$		**2**
	$\bullet^1$ isolate term in y or divide throughout by 5	$\bullet^1$ $-5y=-3x...$ or $3x...=5y$ or or $\frac{3x}{5}-\frac{5y}{5}-\frac{10}{5}=0$	
	$\bullet^2$ state gradient explicitly	$\bullet^2$ $\frac{3}{5}$ or $0\cdot6$	

Notes:

1. Correct answer without working — award 2/2
2. Do not accept $x=\frac{3}{5}$ or $y=\frac{3}{5}$ for the award of $\bullet^2$
3. Where gradient formula is used with two points which
   (a) lie on the line $3x-5y+10=0$,
   award $\bullet^1$ for correct substitution into gradient formula
   award $\bullet^2$ for correct calculation of gradient
   (b) do not lie on the line $3x-5y+10=0$, award 0/2

Commonly Observed Responses:

1. $\frac{3}{5}x$ or $0\cdot6x$ (with working) — award 1/2 ✓×

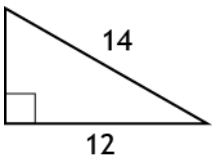
Question	Generic scheme	Illustrative scheme	Max mark
12.	**Ans:** $x^{-\frac{1}{3}}$ $\bullet^1$ apply $\sqrt[n]{x^m} = x^{\frac{m}{n}}$ $\bullet^2$ apply $\frac{1}{x^n} = x^{-n}$	$\bullet^1$ $\frac{1}{x^{\frac{1}{3}}}$ stated or implied by $\bullet^2$ $\bullet^2$ $x^{-\frac{1}{3}}$	**2**

Notes:

1. Correct answer without working — award 2/2
2. Accept $x^{\frac{1}{3}}$ for $\bullet^1$
3. Where a number or letter (excluding n) other than x is used
   eg $a^{-\frac{1}{3}}$ or $8^{-\frac{1}{3}}$ — award 1/2
   $n^{-\frac{1}{3}}$ — award 0/2

Commonly Observed Responses:

1. $n = -\frac{1}{3}$ — award 2/2
2. $-x^{\frac{1}{3}}$ — award 1/2 ✓×
3. x^{-3} — award 1/2 ×✓

Question			Generic scheme	Illustrative scheme		Max mark
13.			**Ans: $42\cdot4$ centimetres**			**4**
			$\bullet^1$ marshal facts and recognise right-angled triangle	$\bullet^1$		
			$\bullet^2$ consistent Pythagoras statement	$\bullet^2$	$x^2 = 14^2 - 12^2$	
			$\bullet^3$ calculation of x	$\bullet^3$	$7\cdot2$	
			$\bullet^4$ find height of the logo	$\bullet^4$	$42\cdot4$	

Notes:

1. Correct answer without working — award 0/4
2. The final mark is for doubling the result of a **Pythagoras (or trig.)** calculation and then adding 28
3. In the absence of a diagram accept $x^2 = 14^2 - 12^2$ as evidence for the award of $\bullet^1$ and $\bullet^2$
4. **BEWARE**
   Where a diagram is shown, working must be consistent with the diagram.
   $\bullet^2$ is not available for an **incorrect** diagram leading to $x^2 = 14^2 - 12^2$
5. Disregard errors due to premature rounding provided there is evidence

Commonly Observed Responses:

1. For $x^2 = 14^2 + 12^2 \rightarrow x = 18\cdot4$ height $= 64\cdot8\ldots$ or $64\cdot9$
   (a) working inconsistent with correct diagram — award 3/4 ✓×✓✓
   (b) working consistent with candidate's diagram (cosine rule may be used to calculate x) — award 3/4 ×✓✓✓
   (c) no diagram — award 2/4 ××✓✓

2. For $x^2 = 24^2 - 14^2 \rightarrow x = 19\cdot4\ldots$ height $= 66\cdot9\ldots$ or 67
   (a) working consistent with candidate's diagram — award 3/4 ×✓✓✓
   (b) no diagram or working not consistent with candidate's diagram — award 2/4 ××✓✓

3. For $x^2 = 24^2 + 14^2 \rightarrow x = 27\cdot8\ldots$ height $= 83\cdot5\ldots$ or $83\cdot6$
   (a) working consistent with candidate's diagram (cosine rule may be used to calculate x) — award 3/4 ×✓✓✓
   (b) no diagram or working not consistent with candidate's diagram — award 2/4 ××✓✓

Question	Generic scheme	Illustrative scheme	Max mark
14.	**Ans:** 282°		**3**
	Method 1		
	$\bullet^1$ expression for arc length	$\bullet^1 \ \frac{\text{angle}}{360}\times\pi\times 12\cdot 8$	
	$\bullet^2$ know how to find angle	$\bullet^2 \ \frac{31\cdot 5\times 360}{\pi\times 12\cdot 8}$	
	$\bullet^3$ calculate angle	$\bullet^3 \ \ 282(\cdot\ )$	
	Method 2		
	$\bullet^1$ arc length: circumference ratio	$\bullet^1 \ \frac{31\cdot 5}{\pi\times 12\cdot 8} \quad (=0\cdot 78\ldots)$	
	$\bullet^2$ know how to find angle	$\bullet^2 \ \frac{31\cdot 5\times 360}{\pi\times 12\cdot 8}$	
	$\bullet^3$ calculate angle	$\bullet^3 \ \ 282(\cdot\ )$	

Notes:

1. Correct answer without working — award 0/3
2. Accept variations in π
3. Premature rounding of $\frac{31\cdot 5}{\pi\times 12\cdot 8}$ must be to at least 2 decimal places
4. For the award of $\bullet^3$, the calculation must involve a division by a product.
   The calculation must include $31\cdot 5$, π, 360 and the candidate's chosen diameter or radius
5. For subsequent incorrect working, the final mark is not available
   eg $360-282=78$ — award 2/3 ✓✓×

Commonly Observed Responses:

1. For $\frac{31\cdot 5\times 360}{\pi\times 6\cdot 4}=564$ — award 2/3 ×✓✓
2. For $\frac{31\cdot 5\times 360}{\pi\times 6\cdot 4^2}=88\cdot 1\ldots$ — award 2/3 ×✓✓
3. For $\frac{31\cdot 5}{360}\times\pi\times 12\cdot 8=3\cdot 518\ldots$ — award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
15.	(a)		**Ans: 51·5 metres** •[1] calculate height	•[1] 51·5	**1**
Notes: 1. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15 (a) 18·1… (RAD) (b) 53·5… (GRAD)					
Commonly Observed Responses: 1. 51·5, 308·5 award 0/1					
	(b)		**Ans: 17 metres** •[1] calculate minimum height	•[1] 17	**1**
Notes: 1. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15 (a) 26·2… (RAD) (b) 18·1… (GRAD)					
Commonly Observed Responses:					
	(c)		**Ans: 24·1° and 335·9°** •[1] substitute 61 correctly into equation •[2] calculate cos x •[3] calculate value of x •[4] calculate 2nd value of x	•[1] $61 = 40 + 23\cos x$ •[2] $\cos x = \frac{21}{23}$ •[3] $24(\cdot 07\ldots)$ •[4] $335(\cdot 92\ldots)$	**4**

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

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

2. Accept 24 and 336 with valid working

3. Disregard errors due to premature rounding provided there is evidence

4. Do not penalise omission of degree sign throughout the question

5. Inappropriate use of RAD or GRAD should only be penalised once in either Q3, 10 or 15
   (a) $0\cdot418\ldots, 359\cdot5\ldots$ (RAD)
   (b) $26\cdot7\ldots$, $333\cdot3\ldots$ (GRAD)

Commonly Observed Responses:

1. $61 = 40 + 23\cos x \rightarrow 61 = 63\cos x \rightarrow \cos x = \frac{61}{63} \rightarrow x = 14\cdot5,\ 345\cdot5$ — award 3/4 ✓××✓✓

2. $\cos x = \frac{-2}{60} \rightarrow x = 91\cdot9,\ 268\cdot1$ — award 2/4 ××✓✓

[END OF MARKING INSTRUCTIONS]