

Marking instructions for each question

Question		Generic scheme	Illustrative scheme	Max mark										
1.		<ul style="list-style-type: none"> •¹ substitute into $5x^3$ •² evaluate $5x^3$ 	<ul style="list-style-type: none"> •¹ $5(-2)^3$ or equivalent •² -40 	2										
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 2/2 2. Accept 5×-2^3 for •¹ 3. For subsequent incorrect working, •² is not available 														
<p>Commonly observed responses:</p> <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 60%;">1. $-1000 [(5 \times -2)^3]$ (no working necessary)</td> <td style="width: 40%; text-align: right;">award 1/2 $\times \checkmark$</td> </tr> <tr> <td>2. (a) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40$</td> <td style="text-align: right;">award 2/2</td> </tr> <tr> <td> (b) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40 \rightarrow x = -38$</td> <td style="text-align: right;">award 1/2 $\checkmark \times$</td> </tr> <tr> <td>3. $5 \times 2^3 = 40$</td> <td style="text-align: right;">award 0/2</td> </tr> <tr> <td>4. $5 \times (-2)^2 = 20$</td> <td style="text-align: right;">award 0/2</td> </tr> </tbody> </table>					1. $-1000 [(5 \times -2)^3]$ (no working necessary)	award 1/2 $\times \checkmark$	2. (a) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40$	award 2/2	(b) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40 \rightarrow x = -38$	award 1/2 $\checkmark \times$	3. $5 \times 2^3 = 40$	award 0/2	4. $5 \times (-2)^2 = 20$	award 0/2
1. $-1000 [(5 \times -2)^3]$ (no working necessary)	award 1/2 $\times \checkmark$													
2. (a) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40$	award 2/2													
(b) $-2 = 5 \times (-2)^3 \rightarrow -2 = -40 \rightarrow x = -38$	award 1/2 $\checkmark \times$													
3. $5 \times 2^3 = 40$	award 0/2													
4. $5 \times (-2)^2 = 20$	award 0/2													

Question			Generic scheme	Illustrative scheme	Max mark
2.			<ul style="list-style-type: none"> •¹ start to multiply fractions •² consistent answer in simplest form 	<ul style="list-style-type: none"> •¹ $\frac{3}{8} \times \frac{12}{7}$ •² $\frac{9}{14}$ 	2
Notes: <p>1. Correct answer without working award 0/2</p> <p>2. •² is only available where simplifying is required</p> <p>3. For subsequent incorrect working, •² is not available</p> <p>eg $\frac{3}{8} \times \frac{12}{7} = \frac{9}{14} = 1\frac{5}{14}$ award 1/2 ✓x</p>					
Commonly observed responses: <p>1. $\frac{3}{8} \times \frac{12}{7} = \frac{36}{56}$ award 1/2 ✓x</p> <p>2. (a) $\frac{3}{8} \times \frac{7}{12} = \frac{7}{32}$ award 1/2 x✓</p> <p>(b) $\frac{3}{8} \times \frac{7}{12} = \frac{21}{96}$ award 0/2</p>					
3.			<ul style="list-style-type: none"> •¹ start to expand •² complete expansion •³ collect like terms (which must include a term in x^3) 	<ul style="list-style-type: none"> •¹ evidence of any 3 correct terms eg $2x^3 - 7x^2 - 3x$ •² $2x^3 - 7x^2 - 3x + 10x^2 - 35x - 15$ •³ $2x^3 + 3x^2 - 38x - 15$ 	3
Notes: <p>1. Correct answer without working award 3/3</p> <p>2. For subsequent incorrect working, •³ is not available</p>					
Commonly observed responses:					

Question		Generic scheme	Illustrative scheme	Max mark
4.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ appropriate fraction •² consistent substitution into appropriate formula •³ calculate length of arc <p>Method 2</p> <ul style="list-style-type: none"> •¹ appropriate fraction •² consistent substitution into appropriate formula •³ calculate length of arc 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $\frac{240}{360}$ or equivalent •² $\frac{240}{360} \times 3 \cdot 14 \times 60$ •³ 125.6 (cm) <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{240}{360}$ or equivalent •² $\frac{240}{360} = \frac{\text{arc}}{3 \cdot 14 \times 60}$ •³ 125.6 (cm) 	3

Notes:

1. Correct answer without working award 0/3
2. **BEWARE**

$$\frac{240}{360} \pi r^2 = \frac{240}{360} \times 3 \cdot 14 \times 30^2 \left(= \frac{240}{360} \times 3 \cdot 14 \times 30 \times 2 \right) = 125 \cdot 6(\text{cm})$$
award 1/3 ✓ x x
3. $\frac{120}{360} \times 3 \cdot 14 \times 60 = 62 \cdot 8(\text{cm})$ award 2/3 x ✓ ✓

Commonly observed responses:

1. $\frac{240}{360} \times 3 \cdot 14 \times 30 = 62 \cdot 8(\text{cm})$ award 2/3 ✓ x ✓
2. $\frac{360}{240} \times 3 \cdot 14 \times 60 = 282 \cdot 6(\text{cm})$ award 2/3 x ✓ ✓
3. $\frac{240}{360} \times \pi \times 60$ only award 1/3 ✓ x x
4. $3 \cdot 14 \times 60 = 188 \cdot 4(\text{cm})$ award 0/3
5. $\frac{240}{360} \pi r^2 = \frac{240}{360} \times 3 \cdot 14 \times 30^2 = 1884(\text{cm})$ award 2/3 ✓ x ✓

Question		Generic scheme	Illustrative scheme	Max mark
5.	(a)	<ul style="list-style-type: none"> •¹ state median •² find quartiles •³ calculate SIQR 	<ul style="list-style-type: none"> •¹ 5 •² 3·5 and 8 •³ 2·25 	3
<p>Notes:</p> <p>1. (a) Correct median without working award •¹ (b) Correct SIQR without working, do not award •² or •³</p> <p>2. Accept quartiles indicated in the list or on a diagram for •²</p> <p>3. If 'correct' SIQR is found from an (a) ordered list with one missing term or one extra number award 2/3 x✓✓ (b) unordered list $\left[Q_2 = 6, SIQR = \frac{1}{2}(7 - 5 \cdot 5) = 0 \cdot 75 \right]$ award 1/3 xx✓</p> <p>4. •² and •³ are not available for finding $\frac{1}{2}$ of the range ie $\frac{10 - 3}{2} = 3 \cdot 5$</p> <p>Commonly observed responses:</p> <p>1. (a) $Q_2 = 5, Q_1 = 4, Q_3 = 7; SIQR = \frac{1}{2}(7 - 4) = 1 \cdot 5$ or $\frac{3}{2}$ award 2/3 ✓x✓ (b) $Q_2 = 5; SIQR = \frac{1}{2}(7 - 4) = 1 \cdot 5$ award 1/3 ✓xx</p>				

Question		Generic scheme	Illustrative scheme	Max mark
5.	(b)	<ul style="list-style-type: none"> •⁴ valid comment comparing medians •⁵ valid comment comparing SIQRs 	<ul style="list-style-type: none"> •⁴ eg On average, temperatures in Grantford are lower. •⁵ eg Temperatures in Grantford are less consistent. 	2

Notes:

1. Answers must be consistent with answers to part (a).
eg If in part (a) the calculated median is 8 then award •⁴ for ‘on average the temperature is the same in both places’ or equivalent.
If in part (a) the calculated SIQR is 1.5 then award •⁵ for ‘the spread of temperatures is the same in both places’ or equivalent.
2. Comments must refer to Grantford and/or Endoch
(a) Accept eg On average the temperature in Endoch is higher and more consistent
(b) Do not accept eg On average the temperature is higher and more consistent
3. For the award of •⁴
(a) Accept eg
 - On average Grantford is colder
 - In general Endoch is warmer
(b) Do not accept eg
 - The median temperature in Grantford is less
 - The temperature in Endoch is more (this implies that all temperatures are more)
 - On average Endoch’s temperature is better
4. For the award of •⁵
(a) Accept eg
 - The spread of temperatures is more in Grantford
 - The temperatures in Endoch are less varied
(b) Do not accept eg
 - Grantford’s SIQR is more
 - The range of Endoch’s temperatures is less
 - On average the temperatures in Grantford are more varied
 - The SIQR of Grantford’s temperatures is less consistent

Commonly observed responses:

Question		Generic scheme	Illustrative scheme	Max mark
6.	(a)	<p>Method 1</p> <ul style="list-style-type: none"> •¹ use points (1.5,14) and (3.5,8) to find gradient •² substitute gradient and a point into $y - b = m(x - a)$ •³ state equation in terms of F and E in simplest form (remove any brackets and collect constants) <p>Method 2</p> <ul style="list-style-type: none"> •¹ use points (1.5,14) and (3.5,8) to find gradient •² substitute gradient and a point into $y = mx + c$ •³ state equation in terms of F and E in simplest form 	<ul style="list-style-type: none"> •¹ $-\frac{6}{2}$ or equivalent •² eg $y - 8 = -\frac{6}{2}(x - 3.5)$ •³ eg $F = -3E + 18.5$ <ul style="list-style-type: none"> •¹ $-\frac{6}{2}$ or equivalent •² eg $8 = -\frac{6}{2} \times 3.5 + c$ •³ eg $F = -3E + 18.5$ 	3
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 0/3 2. •¹ is not available for using points other than (1.5,14) and (3.5,8) to find the gradient 3. Gradient need not be simplified for the award of •² 				
<p>Commonly observed responses:</p> <p>Working must be shown.</p> <ol style="list-style-type: none"> 1. $y = -3x + 18.5$ award 2/3 ✓✓x 2. $y = -3x$ award 1/3 ✓xx 3. $F = -\frac{3}{1}E + 18.5$ award 2/3 ✓✓x 4. $m = \frac{16-7}{1-4} = -3 \rightarrow y - 7 = -3(x - 4) \rightarrow F = -3E + 19$ award 2/3 x✓✓ 				
	(b)	• ⁴ calculate fuel consumption	• ⁴ 15.2 (km/l)	1
<p>Notes:</p> <ol style="list-style-type: none"> 1. Consistent answer without working award 1/1, but see Note 2. 2. •⁴ is not available where an incorrect answer in (a) is followed through to give a negative value in (b). 				
<p>Commonly observed responses:</p>				

Question	Generic scheme	Illustrative scheme	Max mark
7.	<p>Method 1</p> <ul style="list-style-type: none"> •¹ multiply by 2 •² divide by h •³ subtract y <p>Method 2</p> <ul style="list-style-type: none"> •¹ multiply by 2 •² expand bracket and subtract hy •³ divide by h 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $2A = h(x + y)$ •² $\frac{2A}{h} = x + y$ •³ $x = \frac{2A}{h} - y$ <p>Method 2</p> <ul style="list-style-type: none"> •¹ $2A = h(x + y)$ •² $2A - hy = hx$ •³ $x = \frac{2A - hy}{h}$ 	3

Notes:

1. Correct answer without working award 0/3
2. Apply Method 2 instructions in cases where bracket is expanded. Candidates may do •² followed by •¹
3. **BEWARE:** check all steps in answer
eg $A = \frac{1}{2}hx + hy \rightarrow \frac{1}{2}hx = A - hy \rightarrow hx = 2A - hy \rightarrow x = \frac{2A - hy}{h}$ award 1/3 $\times \times \checkmark$ (Method 2)
4. For subsequent incorrect working •³ is not available
5. Where **final answer** includes \times or \div sign(s), the maximum award is 2/3
6. Accept a final answer of $x = \frac{A2 - hy}{h}$ (working must be shown) as bad form award 3/3

Commonly observed responses:

1. $x = \frac{2a - hy}{h}$ award 3/3
2. $x = \frac{A}{\frac{1}{2}h} - y$ award 2/3 $\times \checkmark \checkmark$
3. $x = \frac{A - \frac{1}{2}hy}{\frac{1}{2}h}$ award 2/3 $\times \checkmark \checkmark$

Question		Generic scheme	Illustrative scheme	Max mark
8.	(a)	• ¹ construct equation	• ¹ eg $7c + 3g = 215$	1
Notes: 1. Accept $7c + 3g = 215$ kg as bad form				
	(b)	• ² construct equation	• ² eg $5c + 4g = 200$	1
Notes: 1. Accept $5c + 4g = 200$ kg as bad form				
	(c)	• ³ correct scaling • ⁴ value for c or g • ⁵ value for g or c • ⁶ communicate answer in kilograms	• ³ eg $28c + 12g = 860$ $15c + 12g = 600$ $35c + 15g = 1075$ or $35c + 28g = 1400$ • ⁴ $c = 20$ or $g = 25$ • ⁵ $g = 25$ or $c = 20$ • ⁶ cement = 20kg , gravel = 25kg	4
Notes: 1. Correct answer without working award 0/4 2. For a solution obtained by guess and check award 0/4 3. • ⁶ is not available if either c or g is negative 4. • ⁶ is only available where a candidate calculates values for c and g , and a conclusion containing the words 'cement' and 'gravel' along with the correct units in both cases				
Commonly observed responses:				

Question		Generic scheme	Illustrative scheme	Max mark	
9.	(a)	<ul style="list-style-type: none"> •¹ state equation of axis of symmetry 	<ul style="list-style-type: none"> •¹ $x = 4$ 	1	
Notes: 1. For an answer of 4 or axis of symmetry = 4 award 0/1					
	(b)	(i)	<ul style="list-style-type: none"> •² state the value of a 	<ul style="list-style-type: none"> •² -4 	1
Notes:					
		(ii)	<ul style="list-style-type: none"> •³ state the value of b 	<ul style="list-style-type: none"> •³ 20 	1
Notes: 1. For an answer of $y = 20 - (x - 4)^2$ award 1/1 for (i) and 1/1 for (ii) 2. For answers of (i) 20 and (ii) -4 award 0/1 for (i) and 1/1 for (ii) This note only applies where the “correct” answers have been switched 3. Mark (b) independently from (a)					

Question		Generic scheme	Illustrative scheme	Max mark
10.	(a)	• ¹ correct answer	• ¹ $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$	1
<p>Notes:</p> <p>1. Award 0/1 where: (a) brackets are omitted from the answer (b) the answer is given in coordinate form</p> <p>2. (a) Treat $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$ as bad form award 1/1 (b) However, for $\frac{5}{4}$ award 0/1</p>				
Commonly observed responses:				

Question		Generic scheme	Illustrative scheme	Max mark
(b)		<ul style="list-style-type: none"> •² valid pathway •³ consistent components 	<ul style="list-style-type: none"> •² $\frac{1}{2}\overline{PR} + \overline{RQ}$ or $\frac{1}{2}\begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix}$ OR $\frac{1}{2}\overline{RP} + \overline{PQ}$ or $\frac{1}{2}\begin{pmatrix} -6 \\ 4 \end{pmatrix} + \begin{pmatrix} 5 \\ 4 \end{pmatrix}$ •³ $\begin{pmatrix} 2 \\ 6 \end{pmatrix}$ 	2

Notes:

- Correct answer without working award 2/2
- Do not penalise the omission of brackets or giving the answer in coordinate form if this has already been penalised in part (a)
- $\overline{MR} + \overline{RQ}$ or $\overline{MP} + \overline{PQ}$ alone is not enough for the award of •²
- If candidate's response for (a) is $\overline{PR} - \overline{RQ} = \begin{pmatrix} 6 \\ -4 \end{pmatrix} - \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 7 \\ -12 \end{pmatrix}$ then accept
 - $\left[\frac{1}{2}\overline{PR} - \overline{RQ} \right] = \frac{1}{2}\begin{pmatrix} 6 \\ -4 \end{pmatrix} - \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 4 \\ -10 \end{pmatrix}$ award 2/2
 - $\left[\frac{1}{2}\overline{RP} + \overline{PQ} \right] = \frac{1}{2}\begin{pmatrix} -6 \\ 4 \end{pmatrix} + \begin{pmatrix} 7 \\ -12 \end{pmatrix} = \begin{pmatrix} 4 \\ -10 \end{pmatrix}$ award 2/2
 - $\left[\frac{1}{2}\overline{RP} - \overline{PQ} \right] = \frac{1}{2}\begin{pmatrix} -6 \\ 4 \end{pmatrix} - \begin{pmatrix} 7 \\ -12 \end{pmatrix} = \begin{pmatrix} -10 \\ 14 \end{pmatrix}$ award 2/2
- Where there is invalid subsequent working •³ is not available
eg $\begin{pmatrix} 2 \\ 6 \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ award 1/2 ✓x

Commonly observed responses:

- $\frac{1}{2}\begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 3 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ award 1/2 ✓x
 - $\begin{pmatrix} 3 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ award 0/2

Question		Generic scheme	Illustrative scheme	Max mark
11.		<ul style="list-style-type: none"> •¹ find angle AOB •² find angle FOB or ABO •³ find angle OFB 	<ul style="list-style-type: none"> •¹ 72 •² 108 or 54 •³ 36 	3
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without relevant working award 0/3. 2. Degrees signs are not required. 3. •² is only available where angle AOB is acute. 4. Full marks may be awarded for information marked on the diagram. 5. Do not penalise a candidate who marks the correct answer on the diagram but then writes an incorrect answer outwith the diagram. 6. Accept clear working outwith the diagram, but the final answer must be clearly indicated. 7. An answer of $360 \div 5 = 72$ alone is not enough for the award of •¹. 8. Alternative method <ul style="list-style-type: none"> eg •¹ $EAB = 108$ (interior angle of pentagon) •² $ABO = 54$ ($OAB = ABO$) •³ $OFB = 36$ ($OBF = 90 - ABO$; $OFB = OBF$) 				
<p>Commonly observed responses:</p> <ol style="list-style-type: none"> 1. (a) $AOB = 60 \rightarrow FOB = 120 \rightarrow OFB = 30$ award 2/3 x✓✓ (b) $FOB = 120 \rightarrow OFB = 30$ award 1/3 xx✓ (c) $AOB = 90 \rightarrow FOB = 90 \rightarrow OFB = 45$ award 1/3 xx✓ 				

Question	Generic scheme	Illustrative scheme	Max mark
12.	<p>Method 1</p> <ul style="list-style-type: none"> •¹ express as equivalent fraction with rational denominator •² express numerator in simplest form •³ express in simplest form <p>Method 2</p> <ul style="list-style-type: none"> •¹ express denominator in simplest form •² express as equivalent fraction with rational denominator •³ express in simplest form <p>Method 3</p> <ul style="list-style-type: none"> •¹ correct division •² express denominator in simplest form •³ express as equivalent fraction with rational denominator 	<ul style="list-style-type: none"> •¹ $\frac{\sqrt{2}\sqrt{40}}{40}$ or $\frac{\sqrt{80}}{40}$ •² $\frac{4\sqrt{5}}{40}$ •³ $\frac{\sqrt{5}}{10}$ •¹ $\frac{\sqrt{2}}{2\sqrt{10}}$ or $\frac{\dots}{2\sqrt{10}}$ •² $\frac{\sqrt{2}\sqrt{10}}{20}$ or $\frac{\sqrt{20}}{20}$ •³ $\frac{\sqrt{5}}{10}$ •¹ $\frac{1}{\sqrt{20}}$ •² $\frac{1}{2\sqrt{5}}$ •³ $\frac{\sqrt{5}}{10}$ 	3

Notes:

1. Correct answer with no working

award 0/3

2. For subsequent incorrect working •³ is not available eg $\frac{\sqrt{5}}{10} = \frac{1}{2}$

3. Method 2: Accept $\frac{1\sqrt{2}}{2\sqrt{10}}$ for the award of •¹

4. Candidates may use a mixture of methods

eg (a) Method 2 then Method 3: $\frac{\sqrt{2}}{2\sqrt{10}} = \frac{1}{2\sqrt{5}} = \frac{\sqrt{5}}{10}$

(b) Method 3 then Method 2: $\frac{1}{\sqrt{20}} = \frac{\sqrt{20}}{20} = \frac{\sqrt{5}}{10}$

Commonly observed responses:

Question		Generic scheme	Illustrative scheme	Max mark
13.		<ul style="list-style-type: none"> •¹ state x-coordinate •² state y-coordinate 	<ul style="list-style-type: none"> •¹ $(135, \dots)$ •² $(\dots, -3)$ 	2
<p>Notes:</p> <p>1. For $x = 135, y = -3$ award 2/2</p> <p>2. Award 1/2 where brackets are omitted unless</p> <ul style="list-style-type: none"> (a) answer in form shown in Note 1 above (b) omission of brackets has already been penalised in Q10 (c) For $(-3, 135)$ award 1/2 				
<p>Commonly observed responses:</p>				

Question		Generic scheme	Illustrative scheme	Max mark
14.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ eliminate denominators •² rearrange into form $ax = b$ •³ solve for x <p>Method 2</p> <ul style="list-style-type: none"> •¹ collect algebraic terms and express as a fraction in simplest form •² rearrange into form $ax = b$ •³ solve for x 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $5x - 10 = 6 - 2x$ or equivalent •² $7x = 16$ •³ $x = \frac{16}{7}$ <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{7x-6}{10} = 1$ or equivalent •² $7x = 16$ •³ $x = \frac{16}{7}$ 	3
<p>Notes:</p> <p>1. Correct answer without working award 0/3</p> <p>2. Accept $5x - 10 = 2(3 - x)$ for the award of •¹</p> <p>3. For the award of •³ the answer must be a non-integer value</p> <p>4. Do not award •³ for a decimal approximation to $\frac{16}{7}$, but do not penalise incorrect conversion to a mixed number or decimal approximation following an answer of $\frac{16}{7}$</p>				
<p>Commonly observed responses:</p> <p>1. $5x - 1 = 6 - 2x \rightarrow 7x = 7 \rightarrow x = 1$ award 1/3 $\times\checkmark\times$</p>				

Question		Generic scheme	Illustrative scheme	Max mark
15.	(a)	• ¹ calculate height	• ¹ $(12 \times 2 - 5 \times 2^2 =) 4(\text{m})$	1
	(b)	• ² construct equation • ³ rearrange and equate to zero • ⁴ consistent factorisation • ⁵ solve equation and select correct value	• ² $12t - 5t^2 = -17$ • ³ eg $5t^2 - 12t - 17 = 0$ • ⁴ $(5t - 17)(t + 1) (= 0)$ • ⁵ $(t =) \frac{17}{5}$ (seconds) or equivalent	4

Notes:

- Correct answer without working award 0/4
- For a solution obtained by guess and check award 0/4
- ³ is available for eg $12t - 5t^2 + 17 = 0$
- Do not penalise incorrect conversion of answer to a decimal or mixed number
- ⁴ is available for eg $\frac{12 \pm \sqrt{(-12)^2 - 4 \times 5 \times (-17)}}{2 \times 5}$
- Where candidate finds two positive roots or two negative roots, then •⁵ is not available

Commonly observed responses:

- $12t - 5t^2 = 17$ \times •²
- $5t^2 - 12t + 17 = 0$ \checkmark •³
- $(5t - 17)(t + 1) = 0$ \times •⁴
- $t = \frac{17}{5}, -1$
- $t = \frac{17}{5}$ \checkmark •⁵

[END OF MARKING INSTRUCTIONS]



National
Qualifications
2019

2019 Mathematics

National 5 - Paper 2

Finalised Marking Instructions

© Scottish Qualifications Authority 2019

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

The information in this document may be reproduced in support of SQA qualifications only on a non-commercial basis. If it is reproduced, SQA must be clearly acknowledged as the source. If it is to be reproduced for any other purpose, written permission must be obtained from permissions@sqa.org.uk.



Marking instructions for each question

Question		Generic scheme	Illustrative scheme	Max mark
1.		<ul style="list-style-type: none"> •¹ know how to increase by 15% •² know how to calculate number of packages after 3 years •³ evaluate 	<ul style="list-style-type: none"> •¹ $\times 1.15$ •² $80\,000 \times 1.15^3$ •³ 121 670 	3
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 $80\,000 \times 0.15^3 = 270$			award 2/3 $\times \checkmark \checkmark$	
3. Where an incorrect power (≥ 2) is used, the working must be followed through to give the possibility of awarding 2/3 eg $80\,000 \times 1.15^2 = 105\,800$, $80\,000 \times 1.15^4 = 139\,920(.5)$ or 139 921			award 2/3 $\checkmark \times \checkmark$	
4. Where division is used				
(a) along with 1.15, • ¹ is not available eg $80\,000 \div 1.15^3 = 52601(.2\dots)$			award 2/3 $\times \checkmark \checkmark$	
(b) along with an incorrect percentage, • ¹ and • ² are not available eg $80\,000 \div 0.85^3 = 130266(.6\dots)$ or 130266			award 1/3 $\times \times \checkmark$	
Commonly observed responses:				
1. $80\,000 \times 1.015^3 = 83654(.27)$			award 2/3 $\times \checkmark \checkmark$	
2. $80\,000 \times 0.85^3 = 49\,130$			award 2/3 $\times \checkmark \checkmark$	
3. $80\,000 \times 1.15 = 92\,000$			award 1/3 $\checkmark \times \times$	
4. $80\,000 \times 1.15 \times 3 = 276\,000$			award 1/3 $\checkmark \times \times$	
5. $80\,000 \times 0.15 = 12\,000 \rightarrow 80\,000 + 3 \times 12\,000 = 116\,000$			award 1/3 $\checkmark \times \times$	
6. $80\,000 \times 0.15 \times 3 = 36\,000$			award 0/3	

Question		Generic scheme	Illustrative scheme	Max mark
2.		<ul style="list-style-type: none"> •¹ start process •² consistent solution 	<ul style="list-style-type: none"> •¹ $6^2 + 27^2 + (-18)^2$ •² 33 	2
Notes:				
1. Correct answer without working,			award 2/2	
2. Accept $6^2 + 27^2 + 18^2$ for the award of • ¹				
3. For a solution of $21\left(\sqrt{6^2 + 27^2 - 18^2}\right)$, with or without working,			award 1/2	
4. For eg $\sqrt{6^2 + (-18)^2} = \sqrt{360} = 18.97\dots$ or $6\sqrt{10}$			award 0/2	
5. For eg $\frac{\sqrt{6^2 + 27^2 + (-18)^2}}{2 \times 6 \times 27} = \frac{33}{324} = \frac{11}{108} = 0.1\dots$			award 0/2	
Commonly Observed Responses: No working necessary				
1. $\sqrt{1089}$ or 1089			award 1/2 ✓✗	
3.		<ul style="list-style-type: none"> •¹ correct substitution into area of triangle formula •² calculate area 	<ul style="list-style-type: none"> •¹ $\frac{1}{2} \times 45 \times 70 \times \sin 129$ •² $1224(\cdot 004\dots)(\text{cm}^2)$ 	2
Notes:				
1. Correct answer without working			award 2/2	
2. For $45 \times 70 \times \sin 129 = 2448(\cdot 0\dots)$			award 1/2 ✗✓	
3. Inappropriate use of RAD or GRAD should only be penalised once in Qu 3, 7, 11, 14 or 19				
(a) $\pm 304.7\dots$ (RAD) [no working necessary]			award 1/2 ✓✗	
(b) $1414.3\dots$ (GRAD) [no working necessary]			award 1/2 ✓✗	
4. Where cosine rule is used			award 0/2	
Commonly observed responses:				
1. $\frac{1}{2} \times 45 \times 70 \times \sin 129 = \sqrt{1224 \cdot \dots} = 34.9\dots$			award 1/2	

Question		Generic scheme	Illustrative scheme	Max mark
4.		<ul style="list-style-type: none"> •¹ correct method •² answer 	<ul style="list-style-type: none"> •¹ $0.08 \times 3.6 \times 10^{-6}$ or equivalent •² 2.88×10^{-7} (kg) 	2
Notes:				
1. Correct answer without working			award 2/2	
2. Accept 2.9×10^{-7} (no working necessary)			award 2/2	
3. Accept $100\% = 3.6 \times 10^{-6} \rightarrow 1\% = \dots \rightarrow 8\% = \dots$ for the award of • ¹				
4. For 0.000000288 or $\frac{9}{31\,250\,000}$ (no working necessary)			award 1/2 ✓×	
5. For $(0.08 \times 3.6 = 0.288 \rightarrow) 0.288 \times 10^{-6}$ (no working necessary)			award 1/2 ✓×	
6. • ² is available for correctly carrying out calculation(s) involving a number expressed in scientific notation and a change in the power of 10; the answer must be given in scientific notation.				
Commonly observed responses:				
1. $0.08 \times 3.6 \times 10^{-6} = 2.8 \times 10^{-7}$			award 1/2 ✓×	
2. $0.08 \times 3600000 = 2.88 \times 10^5$			award 1/2 ×✓	
3. $3.6 \times 10^{-6} \div 8 = 4.5 \times 10^{-7}$			award 1/2 ×✓	
4. (a) $3.6 \times 10^{-6} \div 8\% = 4.5 \times 10^{-5}$			award 1/2 ×✓	
(b) $3.6 \times 10^{-6} \div 8\% = 4.5 \times 10^{-7}$			award 0/2	

Question		Generic Scheme	Illustrative Scheme	Max Mark
5.		<ul style="list-style-type: none"> •¹ state coordinates of A •² state coordinates of B 	<ul style="list-style-type: none"> •¹ (3,0,0) •² (3,3,8) 	2
<p>Notes:</p> <p>1. The maximum mark available is 1/2 where brackets are omitted and/or answers are given in component form See COR 1.</p> <p>2. (a) For (3,0,0) and (3,3,8) award 2/2 (b) For B(3,0,0) and A(3,3,8) award 1/2</p> <p>3. For eg (0,0,3) and (8,3,3) [repeated error] award 1/2</p> <p>4. •² is available for answers of the form $A(x,0,0) \rightarrow B(x,x,8)$ See COR 2.</p> <p>5. Answer(s) given in two dimensions (a) Where both answers are given in 2D award 0/2 (b) Where one answer is given in 2D and one in 3D (i) award 1/2 for the correct answer eg (3,0) and (3,3,8) award 1/2 (ii) follow through mark is not available eg (6,0) and (6,6,8) award 0/2</p>				
<p>Commonly observed responses:</p> <p>1. (a) $\begin{pmatrix} 3 \\ 0 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 3 \\ 8 \end{pmatrix}$ award 1/2 $\times \checkmark$</p> <p style="margin-left: 40px;">3 3</p> <p>(b) $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 8 \end{pmatrix}$ award 1/2 $\times \checkmark$</p> <p>2. (a) (6,0,0) and (6,6,8) award 1/2 $\times \checkmark$ (b) (6,0,0) and (6,3,8) award 0/2</p>				

Question		Generic scheme	Illustrative scheme	Max mark
6.		<ul style="list-style-type: none"> •¹ correct substitution into quadratic formula •² evaluate discriminant •³ calculate both roots correct to one decimal place 	<ul style="list-style-type: none"> •¹ $\frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times (-2)}}{2 \times 3}$ •² 105 (stated or implied by •³) •³ -3.2, 0.2 	3

Notes:

1. Correct answer without working award 0/3
2. •³ is only available when $b^2 - 4ac > 0$, and the roots require rounding.

Commonly observed responses:

1. $105(b^2 - 4ac)$ award 1/3 x✓x
2. $\frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times (-2)}}{2 \times 3} = \frac{-9 \pm \sqrt{57}}{6} = -2.8, -0.2$ award 2/3 ✓x✓
3. $\frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times 2}}{2 \times 3} = \frac{-9 \pm \sqrt{57}}{6} = -2.8, -0.2$ award 1/3 xx✓
4. $\frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times (-2)}}{2 \times 3} = \frac{-9 \pm \sqrt{105}}{6} = -10.7, -7.3$ award 2/3 ✓✓x
5. $-9 \frac{\pm \sqrt{9^2 - 4 \times 3 \times (-2)}}{2 \times 3} = -9 \frac{\pm \sqrt{105}}{6} = -10.7, -7.3$ award 2/3 x✓✓

Question		Generic Scheme	Illustrative Scheme	Max Mark
7.		<ul style="list-style-type: none"> •¹ correct substitution into cosine rule to find angle Z •² evaluate •³ calculate angle 	<ul style="list-style-type: none"> •¹ $(\cos Z =) \frac{7 \cdot 2^2 + 8 \cdot 5^2 - 6 \cdot 3^2}{2 \times 7 \cdot 2 \times 8 \cdot 5}$ •² $(\cos Z =) \frac{84 \cdot 4}{122 \cdot 4} \left(= \frac{211}{306} = 0 \cdot 689 \dots \right)$ •³ $(Z =) 46 \cdot 406 \dots$ 	3

Notes:

1. Correct answer without working award 0/3
2. Where two or three more angles are calculated correctly
 - (a) all three angles are calculated correctly; 46·4 need not be identified award 3/3
 - (b) two angles are calculated correctly and 46·4 has been clearly identified award 3/3
 - (c) two angles are calculated correctly and 46·4 has **NOT** been clearly identified award 2/3 ✓✓x
3. Do not penalise omission of degrees sign
4. Disregard errors due to premature rounding provided there is evidence
5. Inappropriate use of RAD or GRAD should only be penalised once in Qu 3, 7, 11, 14 or 19
 - (a) 0·81... (RAD)
 - (b) 51·56... (GRAD)

Commonly observed responses:

1. $\frac{8 \cdot 5^2 + 6 \cdot 3^2 - 7 \cdot 2^2}{2 \times 8 \cdot 5 \times 6 \cdot 3} \left(= \frac{60 \cdot 1}{107 \cdot 1} = \frac{601}{1071} = 0 \cdot 561 \dots \right) \rightarrow 55 \cdot 86 \dots$ award 2/3 x✓✓
2. $\frac{7 \cdot 2^2 + 6 \cdot 3^2 - 8 \cdot 5^2}{2 \times 7 \cdot 2 \times 6 \cdot 3} \left(= \frac{19 \cdot 28}{90 \cdot 72} = \frac{241}{1134} = 0 \cdot 212 \dots \right) \rightarrow 77 \cdot 72 \dots$ award 2/3 x✓✓
3. $(\cos Z =) \frac{7 \cdot 2^2 + 8 \cdot 5^2 - 6 \cdot 3^2}{2 \times 7 \cdot 2 \times 8 \cdot 5} = \sqrt{0 \cdot 689 \dots} \rightarrow Z = 33 \cdot 8 \dots$ award 2/3 ✓x✓

Question		Generic Scheme	Illustrative Scheme	Max Mark
8.		<ul style="list-style-type: none"> •¹ correct substitution into formula for volume of sphere •² correct substitution into formula for volume of cylinder •³ know to add volume of hemisphere to volume of cylinder •⁴ all calculations correct (must involve the sum or difference of two different calculations both involving π) •⁵ round final answer to 3 significant figures and state correct units 	<ul style="list-style-type: none"> •¹ $\frac{4}{3} \times \pi \times 12^3$ •² $\pi \times 12^2 \times 58$ •³ $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 + \pi \times 12^2 \times 58$ •⁴ $(3619 \cdot 1... + 26238 \cdot 5...) = 29\,857 \cdot ...$ •⁵ $29\,900 \text{ cm}^3$ 	5

Question	Generic scheme	Illustrative scheme	Max mark
Notes:			
1. Correct answer without working		award 0/5	
2. Accept 29 900 ml or 29.9 litres			
3. Accept variations in π			
eg $\frac{1}{2} \times \frac{4}{3} \times 3 \cdot 14 \times 12^3 + 3 \cdot 14 \times 12^2 \times 58 = 29842 \cdot 56 = 29800 \text{ cm}^3$			
4. \bullet^5 is not available if final answer is given in terms of π			
eg $\frac{2}{3} \times \pi \times 12^3 + \pi \times 12^2 \times 58 = 1152\pi + 8352\pi = 9504\pi \text{ cm}^3$		award 4/5	✓✓✓✓x
5. In awarding \bullet^5			
(a) Intermediate calculations need not be shown			
eg $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 + \pi \times 12^2 \times 58 = 29900 \text{ cm}^3$		award 5/5	
(b) Where intermediate calculations are shown, they must involve at least four significant figures			
eg $3619 \cdot 1\dots + 26238 \cdot 5\dots = 3620 + 26200 = 29820 = 29800 \text{ cm}^3$		award 4/5	✓✓✓✓x
Commonly observed responses:			
1. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 24^3 + \pi \times 24^2 \times 58 = 134000 \text{ cm}^3$		award 4/5	x✓✓✓✓
2. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 24^2 + \pi \times 24^2 \times 58 = 106000 \text{ cm}^3$		award 4/5	x✓✓✓✓
3. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 + \pi \times 12^2 \times 70 = 35300 \text{ cm}^3$		award 4/5	✓x✓✓✓
4. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 24^3 + \pi \times 24^2 \times 70 = 156000 \text{ cm}^3$		award 3/5	xx✓✓✓
5. $\frac{4}{3} \times \pi \times 12^3 + \pi \times 12^2 \times 58 = 33500 \text{ cm}^3$		award 4/5	✓✓x✓✓
6. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 + \pi \times 24 \times 58 = 7990 \text{ cm}^3$		award 4/5	✓x✓✓✓
7. $\frac{4}{3} \times \pi \times 12^3 = 7240 \text{ cm}^3$		award 2/5	✓xxx✓
8. $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 = 3620 \text{ cm}^3$		award 2/5	✓xxx✓
9. $\pi \times 12^2 \times 58 = 26200 \text{ cm}^3$		award 2/5	x✓xxx✓

Question		Generic scheme	Illustrative scheme	Max mark
9.		<ul style="list-style-type: none"> •¹ know that $102.5\% = £977.85$ •² begin valid strategy •³ complete calculation within valid strategy 	<ul style="list-style-type: none"> •¹ $102.5(\%) = 977.85$ •² $977.85 \div 102.5$ or equivalent •³ $(£)23.85$ 	3
<p>Notes:</p> <p>1. Correct answer without working award 3/3</p> <p>2. 2.5% of $977.85 = 24.45$ (a) and evidence of •¹ award 1/3 ✓xx (b) otherwise award 0/3</p> <p>3. 97.5% of $977.85 = 953.40$ (a) and evidence of •¹ award 1/3 ✓xx (b) otherwise award 0/3</p>				
<p>Commonly observed responses:</p> <p>1. $\frac{977.85}{1.025} = 954$ award 2/3 ✓✓x</p> <p>2. (a) $97.5\% = 977.85 \rightarrow \frac{977.85}{0.975} = 1002.92$ award 1/3 x✓x (b) $\frac{977.85}{0.975} = 1002.92$ award 0/3</p> <p>3. (a) $2.5\% = 977.85 \rightarrow \frac{977.85}{0.025} = 39114$ award 1/3 x✓x (b) $\frac{977.85}{0.025} = 39114$ award 0/3</p>				

Question		Generic scheme	Illustrative scheme	Max mark
10.		<ul style="list-style-type: none"> •¹ correct bracket with square •² complete process 	<ul style="list-style-type: none"> •¹ $(x+5)^2 \dots$ •² $(x\dots5)^2 - 40$ 	2
<p>Notes:</p> <p>1. Correct answer without working award 2/2</p> <p>2. Answer for •² must be consistent with •¹</p> <p style="padding-left: 40px;">eg (a) $(x \pm 10)^2 - 115$ award 1/2 x✓</p> <p style="padding-left: 40px;">(b) $(x \pm 10)^2 - 40$ award 0/2</p>				
<p>Commonly observed responses:</p> <p>No working necessary.</p> <p>1. Award 2/2 for (a) $(x+5)^2 + (-40)$ or $(x+5)^2 + -40$</p> <p style="padding-left: 40px;">(b) $(x+5)(x+5) - 40$</p> <p>2. Award 1/2 x✓ for (a) $(x \pm 5) - 40$</p> <p style="padding-left: 40px;">(b) $(x^2 \pm 5) - 40$</p> <p style="padding-left: 40px;">(c) $(x^2 \pm 5)^2 - 40$</p> <p style="padding-left: 40px;">(d) $(x \pm 5x)^2 - 40$</p>				

Question		Generic scheme	Illustrative scheme	Max mark
11.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ use perimeter to find length of BC and use a valid strategy (Converse of Pythagoras' Theorem) •² evaluate •³ explicit comparison •⁴ conclusion with valid reason <p>Method 2</p> <ul style="list-style-type: none"> •¹ use perimeter to find length of BC and use a valid strategy (correct substitution into cosine rule) •² evaluate •³ calculate angle •⁴ conclusion with reason 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ eg $600^2 + 250^2$ and 650^2 •² $600^2 + 250^2 = 422\,500$ and $650^2 = 422\,500$ •³ $600^2 + 250^2 = 650^2$ •⁴ Yes, as angle is a right angle. <p>Method 2</p> <ul style="list-style-type: none"> •¹ $(\cos B =) \frac{600^2 + 250^2 - 650^2}{2 \times 600 \times 250}$ •² $(\cos B =) 0$ •³ $(B =) 90$ [stated explicitly] •⁴ Yes, as angle is a right angle 	4

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> For method 1 there must be an explicit comparison stated for the award of ●³ The conclusion must include a reference to 90° or a right angle. <ol style="list-style-type: none"> Where candidate starts by stating that eg $650^2 = 600^2 + 250^2$, ●¹ and ●³ are not available $650^2 = 600^2 + 250^2$ ×●¹ ×●³ (marks not available) $422\ 500 = 422\ 500$ ✓●² (evaluation) Yes, as it's right-angled ✓●⁴ (conclusion and reason) award 2/4 ×✓×✓ Where candidate starts by stating that eg If triangle is right-angled then $650^2 = 600^2 + 250^2$ ●³ is not available If triangle is right-angled then $650^2 = 600^2 + 250^2$ ✓●¹ ×●³ (●³ not available) $422\ 500 = 422\ 500$ ✓●² (evaluation) Yes ✓●⁴ (conclusion; reason implicit in ✓●¹) award 3/4 ✓✓×✓ <ol style="list-style-type: none"> Where there is no working to indicate how 250 has been obtained, then assume it has been obtained using the perimeter. Where working shows that 250 has been obtained by the use of Pythagoras' theorem, ●¹ is not available; apply the MIs for the award of ●², ●³ and ●⁴ Inappropriate use of RAD or GRAD should only be penalised once in Qu 3, 7, 11, 14 or 19 <ol style="list-style-type: none"> 1.57... (RAD), no, angle is not a right angle 100 (GRAD), no, angle is not a right angle 			
<p>Commonly observed responses:</p> <ol style="list-style-type: none"> Variation on Method 1: award 4/4 eg $600^2 + 250^2 = 422500$ $\sqrt{422500} = 650$ $600^2 + 250^2 = 650^2$ Yes, as angle is a right angle $(\cos A =) \frac{600^2 + 650^2 - 250^2}{2 \times 600 \times 650} = \frac{12}{13} \rightarrow A = 22.6\dots$ award 2/4 ×✓✓× If triangle is right-angled then $BC^2 = 650^2 - 600^2$ ✓●¹ $BC = 250$ ✓●² (evaluation) $1500 - 650 - 600 = 250 = BC$ ✓●³ (explicit comparison of BC obtained from Pythagoras' with BC obtained from perimeter) Yes ✓●⁴ (conclusion; reason implicit in ✓●¹) award 4/4 $BC^2 = 650^2 - 600^2$ ×●¹ (mark not available) $BC = 250$ ✓●² (evaluation) $1500 - 650 - 600 = 250 = BC$ ✓●³ (explicit comparison of BC obtained from Pythagoras' with BC obtained from perimeter) Yes, as angle is a right angle ✓●⁴ (conclusion and reason) award 3/4 ×✓✓✓ 			

Question		Generic scheme	Illustrative scheme	Max mark
12.	(a)	<p>Method 1</p> <ul style="list-style-type: none"> •¹ linear scale factor •² know to multiply area by square of linear scale factor •³ find area of smaller sector (calculation must include a power of the linear scale factor) <p>Method 2</p> <ul style="list-style-type: none"> •¹ linear scale factor •² know to divide area by square of linear scale factor •³ find area of smaller sector (calculation must include a power of the linear scale factor) <p>Method 3 [Combination of (b) and (a)]</p> <ul style="list-style-type: none"> •⁴•⁵•⁶ calculate size of angle ACB (see part (b) below) •¹ appropriate fraction •² consistent substitution into area of sector formula •³ calculate area of smaller sector 	<ul style="list-style-type: none"> •¹ $\frac{30}{50}$ •² $2750 \times \left(\frac{30}{50}\right)^2$ •³ 990 (cm²) <ul style="list-style-type: none"> •¹ $\frac{50}{30}$ •² $2750 \div \left(\frac{50}{30}\right)^2$ •³ 990 (cm²) <ul style="list-style-type: none"> •⁴•⁵•⁶ 126(.05...) •¹ $\frac{126(.05...)}{360}$ •² $\frac{126(.05...)}{360} \times \pi \times 30^2$ •³ 990 (cm²) 	3

Question	Generic scheme	Illustrative scheme	Max mark
Notes: 1. Correct answer without working award 0/3. 2. \bullet^3 is not available where there is invalid subsequent working eg $2750 - 990 = 1760$ award 2/3 ✓✓x 3. Method 3: Accept $\frac{126}{360} \times \pi \times 30^2 = 989.6(0\dots)$			
Commonly observed responses: 1. $2750 \times \frac{30}{50} = 1650$ award 1/3 ✓xx 2. $2750 \times \left(\frac{30}{50}\right)^3 = 594$ award 2/3 ✓x✓ 3. $2750^2 \times \frac{30}{50} = 4537500$ award 1/3 ✓xx 4. $2750 \times \left(\frac{50}{30}\right)^2 = 7638(.8\dots)$ or 7639 award 2/3 ✓x✓ 5. $2750 \times \left(\frac{50}{30}\right)^2 = 2750 \times 1.67^2 = 7669(.4\dots)$ (Premature rounding leads to inaccurate answer) award 1/3 ✓xx 6. $2750 \div \left(\frac{50}{30}\right)^2 = 2750 \div 1.67^2 = 986(.0\dots)$ (Premature rounding leads to inaccurate answer) award 2/3 ✓✓x			

Question		Generic scheme	Illustrative scheme	Max mark
12.	(b)	<p>Method 1</p> <ul style="list-style-type: none"> •⁴ expression for sector area •⁵ know how to find angle •⁶ calculate angle <p>Method 2</p> <ul style="list-style-type: none"> •⁴ sector area: circle area ratio •⁵ know how to find angle •⁶ calculate angle 	<ul style="list-style-type: none"> •⁴ $\frac{\text{angle}}{360} \times \pi \times 50^2$ •⁵ $\frac{2750 \times 360}{\pi \times 50^2}$ •⁶ $126(\cdot 05\dots)$ •⁴ $\frac{2750}{\pi \times 50^2} (= 0\cdot 35\dots)$ •⁵ $\frac{2750 \times 360}{\pi \times 50^2}$ •⁶ $126(\cdot 05\dots)$ 	3

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/3 Alternative Method 1: $\frac{\text{angle}}{360} \times \pi \times 30^2 \rightarrow \frac{990 \times 360}{\pi \times 30^2} = 126(\cdot 05\dots)$ Alternative Method 2: $\frac{990}{\pi \times 30^2} \rightarrow \frac{990 \times 360}{\pi \times 30^2} = 126(\cdot 05\dots)$ Where any of the above alternative methods are used, an incorrect answer to part (a) must be followed through with possibility of awarding 3/3 for part (b) Accept variations in π Premature rounding of $\frac{2750}{\pi \times 50^2}$ must be to at least 2 decimal places For the award of \bullet^6, the calculation must involve a division by a product. The calculation must include a sector area, π, 360 and the candidate's chosen radius or diameter. 			
<p>Commonly observed responses:</p>			
1. (a) 1650 \rightarrow (b)	$\frac{1650 \times 360}{\pi \times 30^2} = 210(\cdot 08\dots)$	award 3/3	
2. (a) 1650 \rightarrow (b)	$\frac{1650 \times 360}{\pi \times 50^2} = 75(\cdot 63\dots)$	award 2/3 $\times \checkmark \checkmark$	
3.	$\frac{2750 \times 360}{\pi \times 100^2} = 31\cdot 5(1\dots)$	award 2/3 $\times \checkmark \checkmark$	
4.	$\frac{2750 \times 360}{\pi \times 100} = 3151(\cdot 2\dots)$	award 2/3 $\times \checkmark \checkmark$	
5.	$\frac{2750 \times 360}{\pi \times 100} = \sqrt{3151(\cdot 2\dots)} = 56(\cdot 1\dots)$	award 1/3 $\times \times \checkmark$	
6.	$\frac{2750}{360} \times \pi \times 50^2 = 59995(\cdot 6\dots)$	award 0/3	

Question	Generic scheme	Illustrative scheme	Max mark
13.	<ul style="list-style-type: none"> •¹ correct substitution into gradient formula •² factorise using difference of two squares •³ factorise using common factor and simplify 	<ul style="list-style-type: none"> •¹ $\frac{4p^2 - 9}{4p - 6}$ or $\frac{9 - 4p^2}{6 - 4p}$ $(2p + 3)(2p - 3)$ •² or $(3 + 2p)(3 - 2p)$ $\frac{(2p + 3)(2p - 3)}{2(2p - 3)} = \frac{2p + 3}{2}$ •³ or $\frac{(3 + 2p)(3 - 2p)}{2(3 - 2p)} = \frac{3 + 2p}{2}$ 	3

Notes:

1. Correct answer without working

award 0/3.

2. Accept $p + \frac{3}{2}$ for •³

3. For subsequent incorrect working •³ is not available

eg $\frac{\cancel{2}p + 3}{\cancel{2}} = p + 3$

award 2/3 ✓✓x

Commonly observed responses:

Question	Generic scheme	Illustrative scheme	Max mark
14.	<ul style="list-style-type: none"> •¹ rearrange equation •² find one value of x •³ find second value of x 	<ul style="list-style-type: none"> •¹ $\cos x = -\frac{1}{5}$ or equivalent •² $101.5(3\dots)$ •³ $258.4(6\dots)$ 	3

Notes:

1. Correct answer without working award 0/3.
2. Accept (a) 102 and 258 (b) 101.6 (180–78.4) and 258.4 (180+78.4) with valid working.
3. Do not penalise omission of degrees sign.
4. If $\cos x < 0$ then •² and •³ are only available for consistent 2nd and 3rd quadrant angles
eg $\cos x = -\frac{1}{5} \rightarrow$ (a) 78.5, 101.5 award 2/3 ✓×✓
(b) 78.5, 258.5 award 2/3 ✓×✓
(c) 78.5, 281.5 award 1/3 ✓××
5. If $\cos x > 0$ then •² is not available (working eased) but •³ is available for consistent 4th quadrant angle
eg $\cos x = \frac{1}{5} \rightarrow$ (a) 78.5, 101.5 award 0/3
(b) 78.5, 258.5 award 0/3
(c) 78.5, 281.5 award 1/3 ××✓
(d) 101.5, 258.5 award 0/3
6. If 78.5 is clearly included as one of the final answers then award marks as follows:
eg $\cos x = -\frac{1}{5} \rightarrow$ (a) 78.5, 101.5, 258.5 award 2/3 ✓×✓
(b) 78.5, 101.5, 281.5 award 1/3 ✓××
(c) 78.5, 101.5, 258.5, 281.5 award 1/3 ✓××
7. (a Inappropriate use of RAD should only be penalised once in Qu 3, 7, 11, 14 or 19
 $\cos^{-1}\left(\frac{1}{5}\right) = 1.3\dots \rightarrow 178.6\dots, 181.3\dots$
(b) However, for $\cos^{-1}\left(-\frac{1}{5}\right) = 1.7\dots \rightarrow 1.7\dots, 358.3\dots$ award 1/3 ✓×× since the answers are not 2nd and 3rd quadrant angles
8. Inappropriate use of GRAD should only be penalised once in Qu 3, 7, 11, 14 or 19
(a) $\cos^{-1}\left(\frac{1}{5}\right) = 87.1\dots \rightarrow 92.8\dots, 267.1\dots$
(b) $\cos^{-1}\left(-\frac{1}{5}\right) = 112.8\dots \rightarrow 112.8\dots, 247.2\dots$

Commonly observed responses:

1. $\cos x = \frac{3}{5} \rightarrow 53.1, 306.9$ award 1/3 ××✓

Question		Generic scheme	Illustrative scheme	Max mark
15.		<ul style="list-style-type: none"> •¹ correct denominator •² correct numerator •³ express in simplest form (remove brackets in numerator and collect like terms) 	<ul style="list-style-type: none"> •¹ $(x-2)(x+5)$ •² $4(x+5)-3(x-2)$ •³ $\frac{x+26}{(x-2)(x+5)}$ 	3

Notes:

1. Correct answer without working award 3/3

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

3. Do not accept $x-2(x+5)$ or $(x-2)x+5$ for the award of •¹ unless the correct expansion appears in the final answer

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

(a) $\frac{4(x+5)}{(x-2)(x+5)} - \frac{3(x-2)}{(x-2)(x+5)} = \frac{x+26}{x^2+3x-10}$ award 3/3

(b) $\frac{4(x+5)}{(x-2)(x+5)} - \frac{3(x-2)}{(x-2)(x+5)} = \frac{x+26}{x^2-10}$ award 2/3 ✓✓x

(c) $\frac{4(x+5)}{x^2-10} - \frac{3(x-2)}{x^2-10} = \frac{x+26}{x^2-10}$ award 2/3 x✓✓

5. For subsequent incorrect working, •³ is not available eg

$\frac{x+26}{x^2+3x-10} = \frac{26}{x^2-7}$ award 2/3 ✓✓x

Commonly observed responses:

1. $\frac{4x+20}{(x-2)(x+5)} - \frac{3x-6}{(x-2)(x+5)} = \frac{x+14}{(x-2)(x+5)}$ award 2/3 ✓✓x

2. $\frac{4x+5}{(x-2)(x+5)} - \frac{3x-2}{(x-2)(x+5)} = \frac{x+7}{(x-2)(x+5)}$ award 1/3 ✓xx

Question	Generic scheme	Illustrative scheme	Max mark
16.	<ul style="list-style-type: none"> •¹ apply $a^m \times ka^n = ka^{m+n}$ •² evidence of $\sqrt{a} = a^{\frac{1}{2}}$ •³ complete simplification 	<ul style="list-style-type: none"> •¹ eg $a^4 \times 3a = 3a^5$ •² $a^{\frac{1}{2}}$ •³ $3a^{\frac{9}{2}}$ 	3

Notes:

1. Correct answer without working award 3/3.

2. Accept $3a^{4\frac{1}{2}}$ or $3a^{4.5}$ (as bad form).

3. (a) Accept $3\sqrt{a^9}$.

(b) Do not penalise $3a^{\frac{9}{2}} = 3\sqrt[2]{a^9}$.

4. Where candidate starts by rationalising the denominator, •¹ is available for

eg (i) obtaining $3a^5$ as follows: $\frac{a^4 \times 3a}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = \frac{3a^5 \times \sqrt{a}}{a}$

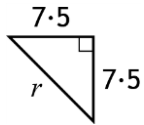
(ii) obtaining $3a^4$ as follows: $\frac{a^4 \times 3a}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = 3a^4 \times \sqrt{a}$ or $a^4 \times 3\sqrt{a}$

5. **BEWARE** •¹ is not available where $3a^5$ has been obtained incorrectly

eg $\frac{a^4 \times 3a}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = \frac{a^4 \times 3a \times \sqrt{a}}{a} = \frac{\sqrt{3a^5}}{a}$

Commonly observed responses:

Question		Generic scheme	Illustrative scheme	Max mark
17.		<ul style="list-style-type: none"> •¹ expand brackets •² simplify expression 	<ul style="list-style-type: none"> •¹ $\sin^2 x + \sin x \cos x + \cos x \sin x + \cos^2 x$ •² $1 + 2 \sin x \cos x$ 	2
Notes:				
1. Correct answer without working			award 0/2	
2. Do not penalise omission of degrees sign				
3. Accept $1 + \sin 2x$				
4. Accept $(\sin x)^2$ and $(\cos x)^2$ or $\sin x \sin x$ and $\cos x \cos x$				
eg (a) $(\sin x)^2 + 2 \sin x \cos x + (\cos x)^2 = 1 + 2 \sin x \cos x$			award 2/2	
(b) $\sin x \sin x + 2 \sin x \cos x + \cos x \cos x = 1 + 2 \sin x \cos x$			award 2/2	
5. Do not accept $\sin x^2$ and $\cos x^2$.				
eg $\sin x^2 + 2 \sin x \cos x + \cos x^2 = 1 + 2 \sin x \cos x$			award 1/2 ×✓	
6. • ¹ is not available if there are no variables				
eg $\sin^2 + 2 \sin \cos + \cos^2 = 1 + 2 \sin \cos$			award 1/2 ×✓	
7. • ² is not available if there is invalid subsequent working				
8. Alternative acceptable strategy:				
• ¹ $\left(\frac{o}{h}\right)^2 + \left(\frac{o}{h}\right)\left(\frac{a}{h}\right) + \left(\frac{a}{h}\right)\left(\frac{o}{h}\right) + \left(\frac{a}{h}\right)^2$				
• ² $\left(\frac{o}{h}\right)^2 + 2\left(\frac{o}{h}\right)\left(\frac{a}{h}\right) + \left(\frac{a}{h}\right)^2 = 1 + 2 \sin x \cos x$			award 2/2	
Commonly observed responses:				
1. $(\sin x + \cos x)^2 = \sin^2 x + \cos^2 x = 1$			award 0/2	
2. $(\sin x + \cos x)^2 = \sin^2 x + \sin x \cos x + \cos^2 x = 1 + \sin x \cos x$			award 1/2 ×✓	

Question	Generic scheme	Illustrative scheme	Max mark
18.	<ul style="list-style-type: none"> •¹ marshal facts and recognise right-angled triangle •² consistent Pythagoras statement •³ calculate radius of larger circle •⁴ calculate CD 	<ul style="list-style-type: none"> •¹  •² $7 \cdot 5^2 + 7 \cdot 5^2$ •³ $10 \cdot 6 \dots$ •⁴ $25 \cdot 6 \dots (\text{cm})$ 	4

Notes:

1. Correct answer without working award 0/4.
2. In the absence of a diagram, or a diagram without right angle indicated, accept $7 \cdot 5^2 + 7 \cdot 5^2$ as evidence for the award of •¹ and •².
3. **BEWARE**
Where a diagram is shown, working must be consistent with the diagram.
4. •² and •³ are available for a valid trigonometric method.
5. •³ is available for a consistent calculation of a length using Pythagoras or trigonometry
6. •⁴ is only available following a Pythagoras (or trigonometric) calculation within a right-angled triangle involving 7.5 or 15.
7. Disregard errors due to premature rounding provided there is evidence.

Commonly observed responses:

1. [Triangle SBT with $SB = ST = 15$] $r^2 = 15^2 + 15^2 \rightarrow r = 21 \cdot 2 \rightarrow CD = 51 \cdot 2$
 - (a) working inconsistent with correct diagram award 3/4 ✓x✓✓
 - (b) working consistent with candidate's diagram award 3/4 x✓✓✓
 - (c) no diagram award 2/4 xx✓✓
2. [Square with side AB] $d^2 = 15^2 + 15^2 \rightarrow r = 10 \cdot 6 \rightarrow CD = 25 \cdot 6$
If consistent with a correct diagram award 4/4; otherwise apply COR 1 MIs
3. [Triangle ATB] $r^2 + r^2 = 15^2 \rightarrow r = 10 \cdot 6 \rightarrow CD = 25 \cdot 6$
Apply MIs and Note 2 becomes accept $r^2 + r^2 = 15^2$ as evidence for the award of •¹ and •²

Question	Generic scheme	Illustrative scheme	Max mark
19.	<p>Method 1</p> <ul style="list-style-type: none"> •¹ correct substitution into sine rule •² re-arrange formula •³ calculate BK •⁴ consistent substitution into appropriate trig formula •⁵ calculate height using trigonometry <p>Method 2</p> <ul style="list-style-type: none"> •¹ correct substitution into sine rule •² re-arrange formula •³ calculate BM •⁴ consistent substitution into appropriate trig formula •⁵ calculate height using trigonometry 	<ul style="list-style-type: none"> •¹ $\frac{BK}{\sin 34} = \frac{350}{\sin 94}$ •² $BK = \frac{350 \sin 34}{\sin 94}$ •³ $196(.195\dots)$ •⁴ $\sin 52 = \frac{h}{196}$ or $\frac{h}{\sin 52} = \frac{196}{\sin 90}$ •⁵ 154.6 (m) <ul style="list-style-type: none"> •¹ $\frac{BM}{\sin 52} = \frac{350}{\sin 94}$ •² $BM = \frac{350 \sin 52}{\sin 94}$ •³ $276(.477\dots)$ •⁴ $\sin 34 = \frac{h}{276}$ or $\frac{h}{\sin 34} = \frac{276}{\sin 90}$ •⁵ 154.6 (m) 	5

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <p>1. Correct answer without working award 0/5.</p> <p>2. Do not penalise omission of degrees signs.</p> <p>3. Disregard errors due to premature rounding provided there is evidence. However, do not accept sin34, sin52 or sin94 rounded to less than 3 decimal places. eg $BM = \frac{350 \sin 52}{\sin 94} = \frac{275 \cdot 8}{0 \cdot 99} = 275 \cdot 59 \rightarrow h = 275 \cdot 59 \sin 34 = 155 \cdot 8$ award 4/5 ✓✓x✓✓</p> <p>4. Where both BK and BM are calculated but one is calculated incorrectly, if there is (a) further working then apply the MIs based on the length used to calculate the height (b) no further working disregard incorrect length ie award 3/5</p> <p>5. Alternative strategy for \bullet^4 and \bullet^5 eg \bullet^4 $A = \frac{1}{2} \times 350 \times 196(\cdot 195 \dots) \times \sin 52 (= 27055 \dots)$ \bullet^5 $\frac{1}{2} \times 350 \times h = 27055 \dots \rightarrow h = 154 \cdot 6$</p> <p>6. Inappropriate use of GRAD or RAD should only be penalised once in Qu 3, 7, 11, 14 or 19 (a) 130·4... (GRAD) (b) ±744·9... (RAD); \bullet^5 is not available due to the negative length. However, \bullet^3 is available if use of RAD has already been penalised in Qu 3, 7, 11, 14 or 19</p>			
<p>Commonly observed responses:</p> <p>1. $\frac{x}{\sin 52} = \frac{350}{\sin 34} \rightarrow x = 493(\dots)$ award 2/5 x✓✓xx</p> <p>2. eg $\frac{BK}{34} = \frac{350}{94} \rightarrow BK = 126(\cdot 59 \dots) \rightarrow h = 126(\cdot 59 \dots) \times \sin 52 = 99(\cdot 75 \dots)$ award 2/5 xxx✓✓</p>			

[END OF MARKING INSTRUCTIONS]