

Detailed marking instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			<ul style="list-style-type: none"> •¹ identify common denominator •² answer 	<ul style="list-style-type: none"> •¹ $2\frac{\dots}{15} + \frac{\dots}{15}$ or $\frac{\dots}{15} + \frac{\dots}{15}$ •² $3\frac{2}{15}$ or $\frac{47}{15}$ 	2
Notes: <ol style="list-style-type: none"> 1. Correct answer without working award 0/2 2. Do not penalise incorrect conversion of $\frac{47}{15}$ to a mixed number 					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
2.			<ul style="list-style-type: none"> •¹ start expansion •² complete expansion •³ collect like terms (see Note 2) 	<ul style="list-style-type: none"> •¹ $3x^2 - 3x + x - 1$ or $2x^2 - 10$ •² $3x^2 - 3x + x - 1 + 2x^2 - 10$ •³ $5x^2 - 2x - 11$ 	3
Notes: <ol style="list-style-type: none"> 1. Correct answer without working award 3/3 2. Terms in the expression to be simplified must include a constant and two different powers of x eg <ul style="list-style-type: none"> (a) $3x^3 - 3x + x - 1 + 2x^2 - 10 = 3x^3 + 2x^2 - 2x - 11$ award 2/3 ✓×✓ (b) $3(x-1) + 1(x-1) + 2(x^2 - 5) = 3x - 3 + x - 1 + 2x^2 - 10 = 2x^2 + 4x - 14$ award 2/3 ✓×✓ (c) $3x^2 + 1 - 1 + 2x^2 - 10 = 5x^2 - 10$ award 1/3 ✓×× 3. For subsequent incorrect working, the final mark is not available 					
Commonly Observed Responses:					

Question		Generic scheme	Illustrative scheme	Max mark				
3.		<ul style="list-style-type: none"> •¹ evidence of scaling (match x or y coefficients) •² follow a valid strategy through to produce values for x and y •³ calculate correct values for x and y 	<ul style="list-style-type: none"> •¹ eg $8x + 10y = -6$ $30x - 10y = 25$ •² values for x and y •³ $x = 0.5, y = -1$ 	3				
<p>Notes:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">1. Correct answer without working</td> <td style="width: 50%;">award 0/3</td> </tr> <tr> <td>2. Answer obtained by guess and check</td> <td>award 0/3</td> </tr> </table>					1. Correct answer without working	award 0/3	2. Answer obtained by guess and check	award 0/3
1. Correct answer without working	award 0/3							
2. Answer obtained by guess and check	award 0/3							
<p>Commonly Observed Responses:</p>								

Question		Generic scheme	Illustrative scheme	Max mark
4.		<ul style="list-style-type: none"> •¹ evidence of subtraction •² all components correct 	<ul style="list-style-type: none"> •¹ eg $\begin{pmatrix} 6 \\ -4 \\ 3 \end{pmatrix} - \begin{pmatrix} 1 \\ 5 \\ 1 \end{pmatrix}$ •² $\begin{pmatrix} 5 \\ -9 \\ 2 \end{pmatrix}$ 	2

Notes:

1. Correct answer without working award 2/2
2. The maximum mark available is 1/2 where
 - (a) brackets are omitted from the final answer
 - (b) final answer is given in coordinate form
2. Accept one correct component for evidence of subtraction

eg $\begin{pmatrix} 5 \\ \end{pmatrix}$ or $\begin{pmatrix} -9 \\ \end{pmatrix}$ or $\begin{pmatrix} \end{pmatrix} \begin{matrix} 2 \\ \end{matrix}$ award 1/2 ✓x

Commonly Observed Responses:

1. (a) $\begin{pmatrix} 1 \\ 5 \\ 1 \end{pmatrix} + \begin{pmatrix} 5 \\ -9 \\ 2 \end{pmatrix} = \begin{pmatrix} 6 \\ -4 \\ 3 \end{pmatrix}$ award 2/2
- (b) $\begin{pmatrix} 1 \\ 5 \\ 1 \end{pmatrix} + \begin{pmatrix} 5 \\ -9 \\ 2 \end{pmatrix} = \begin{pmatrix} 6 \\ -4 \\ 3 \end{pmatrix} \rightarrow \mathbf{v} = \begin{pmatrix} 6 \\ -4 \\ 3 \end{pmatrix}$ award 1/2
2. $\begin{pmatrix} -5 \\ 9 \\ -2 \end{pmatrix} [\mathbf{u} - (\mathbf{u} + \mathbf{v})]$ no working necessary award 1/2 x✓
3. $\begin{pmatrix} 7 \\ 1 \\ 4 \end{pmatrix} [\mathbf{u} + (\mathbf{u} + \mathbf{v})]$ no working necessary award 1/2 x✓
4. (5, -9, 2) or 5, -9, 2 award 1/2 ✓x

Question		Generic scheme	Illustrative scheme	Max mark
5.		<ul style="list-style-type: none"> •¹ correct factorisation •² solve for x 	<ul style="list-style-type: none"> •¹ $(x-3)(x-8)$ •² $(x=)3, (x=)8$ 	2
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 0/2 2. For an answer obtained by guess and check award 0/2 3. BEWARE <ul style="list-style-type: none"> •² is only available if 3,8 are clearly stated as solutions to $(x-3)(x-8)[=0]$ and not as factors of 24 4. Where quadratic formula is used award marks as follows <ul style="list-style-type: none"> •¹ $\frac{11 \pm \sqrt{25}}{2}$ •² 3,8 				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 1. $(x+3)(x+8) \rightarrow 3,8$ award 0/2 2. $(x+4)(x-6) \rightarrow -4,6$ award 1/2 $\times \checkmark$ 				

Question		Generic scheme	Illustrative scheme	Max mark
6.		<ul style="list-style-type: none"> •¹ state the value of a •² state the value of b 	<ul style="list-style-type: none"> •¹ $a = 5$ •² $b = 4$ 	2
Notes:				
Commonly Observed Responses:				
1. (a) $y = 5\cos 4x$			award 2/2	
(b) 5,4			award 1/2	
2. (a) $a = 4, b = 5$ or $y = 4\cos 5x$			award 1/2	
(b) 4,5			award 0/2	
3. (a) $y = 5\cos 2x$			award 1/2	
(b) 5,2			award 0/2	

Question		Generic scheme	Illustrative scheme	Max mark
7.	(a)	<p>Method 1: $y - b = m(x - a)$</p> <ul style="list-style-type: none"> •¹ calculate gradient •² substitute gradient and a point into $y - b = m(x - a)$ •³ state equation in simplest form in terms of P and d <p>Method 2: $y = mx + c$</p> <ul style="list-style-type: none"> •¹ calculate gradient •² substitute gradient and a point into $y = mx + c$ •³ state equation in simplest form in terms of P and d 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $\frac{6}{4}$ or equivalent •² eg $y - 20 = \frac{6}{4}(x - 12)$ •³ $P = \frac{3}{2}d + 2$ or equivalent <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{6}{4}$ or equivalent •² eg $20 = \frac{6}{4} \times 12 + c$ •³ $P = \frac{3}{2}d + 2$ or equivalent 	3

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/3 Gradient need not be simplified for the award of •² Where $\frac{6}{4}$ is simplified incorrectly •² is still available eg $m = \frac{6}{4} = \frac{2}{3} \rightarrow y - 20 = \frac{2}{3}(x - 12) \rightarrow P = \frac{2}{3}d + 12$ award 2/3 ✓✓x •³ is not available where the calculated gradient is an integer •³ is not available where a decimal approximation is used for the gradient eg $m = \frac{4}{6} = 0.67 \rightarrow y - 20 = 0.67(x - 12) \rightarrow P = 0.67d + 11.96$ award 1/3 x✓x •³ is not available for invalid subsequent working eg $P = \frac{3}{2}d + 2 \rightarrow 2P = 3d + 2$ award 2/3 ✓✓x 			
<p>Commonly Observed Responses: Working must be shown.</p> <ol style="list-style-type: none"> $y = \frac{3}{2}x + 2$ award 2/3 ✓✓x (a) $P = \frac{3}{2}d + 2 \rightarrow 2P = 3d + 4$ award 3/3 (b) $P = \frac{6}{4}d + 2 \rightarrow 4P = 6d + 8$ award 2/3 ✓✓x $m = \frac{6}{4} = 0.67 \rightarrow y - 20 = 0.67(x - 12) \rightarrow P = 0.67d + 11.96$ award 2/3 ✓✓x $m = \frac{6}{4} = \frac{3}{4} = 0.75 \rightarrow y - 20 = 0.75(x - 12) \rightarrow P = 0.75d + 11$ award 2/3 ✓✓x $m = \frac{4}{6} = \frac{2}{3} \rightarrow y - 20 = \frac{2}{3}(x - 12) \rightarrow P = \frac{2}{3}d + 12$ award 2/3 x✓✓ $m = \frac{3}{4} = 0.75 \rightarrow y - 20 = 0.75(x - 12) \rightarrow P = 0.75d + 11$ award 2/3 x✓✓ 			

Question		Generic scheme	Illustrative scheme	Max mark
	(b)	• ¹ calculate cost	• ¹ (£) 9.50	1
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 1/1 2. Do not penalise omission of £ 3. Do not accept 9.5 or $\frac{19}{2}$ 4. Follow through mark from part (a) is only available if 5 is multiplied or divided by a non-unitary fraction (or decimal equivalent) followed by an addition or subtraction 				
<p>Commonly Observed Responses:</p>				

Question			Generic scheme	Illustrative scheme	Max mark
8.			<ul style="list-style-type: none"> •¹ find discriminant •² state nature of roots 	<ul style="list-style-type: none"> •¹ -24 •² no real roots 	2

Notes:

1. Correct answer without working award 0/2
2. $16 - 40 < 0 \rightarrow$ no real roots, award 2/2
3. Do **not** accept 'no roots', 'no real (or) distinct roots', 'no real (and) distinct roots'
4. Expected answer(s) for the award of •², when
 - (a) $b^2 - 4ac > 0$: 'two real (and) distinct roots'
 - (b) $b^2 - 4ac = 0$: 'one repeated real root' or 'two equal real roots'

Commonly Observed Responses:

1. $\frac{-4 \pm \sqrt{16 - 40}}{4} = \frac{-4 \pm \sqrt{-24}}{4}$ award 1/2 ✓ x
2. $\sqrt{16 - 40} = \sqrt{-24}$ award 1/2 ✓ x

Question			Generic scheme	Illustrative scheme	Max mark
9.			<ul style="list-style-type: none"> •¹ calculate the size of an interior angle of the decagon or angle JKL •² calculate the size of angle KJL 	<ul style="list-style-type: none"> •¹ interior angle = $72 + 72$ or $\text{JKL} = 36$ •² 127 	2

Notes:

1. Correct answer without working award 2/2
2. Degree signs are not required
3. Full marks may be awarded for information marked on the diagram
4. For a **final** answer of 36 which is **not** named or shown at JKL award 0/2
5. Where JKL has been calculated incorrectly •² is only available where there is **clear evidence** that JKL has been calculated by using the interior angle or exterior angle of the decagon

Commonly Observed Responses:

Question		Generic scheme	Illustrative scheme	Max mark
10.		<ul style="list-style-type: none"> •¹ correct substitution into cosine rule •² calculate XY^2 •³ calculate XY 	<ul style="list-style-type: none"> •¹ $10^2 + 8^2 - 2 \times 10 \times 8 \times \frac{1}{8}$ •² 144 •³ 12 (cm) 	3

Notes:

1. Correct answer without working award 0/3

2. For $10^2 + 8^2 - 2 \times 10 \times 8 \times \cos \frac{1}{8} = 164 - 160 \times \cos \frac{1}{8} = 144 \rightarrow 12$
 where \cos is scored out in **each line** of working award 3/3

3. •³ is available for

(a) expressing \sqrt{x} as a surd in its simplest form

eg $\sqrt{10^2 + 8^2} = \sqrt{164} = 2\sqrt{41}$ award 1/3 $\times \times \checkmark$

[•³ is not available where \sqrt{x} cannot be simplified]

(b) calculating \sqrt{x} where x is a perfect square greater than 100

eg $\sqrt{10^2 - 8^2} = \sqrt{36} = 6$ award 0/3

Commonly Observed Responses:

1. $10^2 + 8^2 - 2 \times 10 \times 8 \times \cos \frac{1}{8} = 12$ award 2/3 $\times \checkmark \checkmark$

2. $10^2 + 8^2 - 2 \times 10 \times 8 \times \cos \frac{1}{8}$ award 0/3

Question		Generic scheme	Illustrative scheme	Max mark
11.		<ul style="list-style-type: none"> •¹ express as equivalent fraction with rational denominator •² express in simplest form 	<ul style="list-style-type: none"> •¹ $\frac{9\sqrt{6}}{6}$ •² $\frac{3\sqrt{6}}{2}$ 	2
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 0/2 2. Accept $1.5\sqrt{6}$ 3. For subsequent incorrect working, the final mark is not available <p>eg $\frac{9\sqrt{6}}{6} = \frac{3\sqrt{6}}{2} = 3\sqrt{3}$ award 1/2 ✓ x</p>				
<p>Commonly Observed Responses:</p>				

Question		Generic scheme	Illustrative scheme	Max mark
12.		• ¹ state value	• ¹ -0.5	1
Notes:				
Commonly Observed Responses:				

Question		Generic scheme	Illustrative scheme	Max mark
13.		• ¹ state coordinates of B • ² state coordinates of C	• ¹ (4, 8, 5) • ² (6, 8, 0)	2
Notes:				
<p>1. The maximum mark available is 1/2 where</p> <p>(a) brackets are omitted (unless already penalised in Q4)</p> <p>(b) answers are given in component form (unless already penalised in Q4)</p> <p>2. (a) For (4, 8, 5) and (6, 8, 0) award 2/2</p> <p>(b) For C(4, 8, 5) and B(6, 8, 0) award 1/2</p> <p>3. For eg (5, 4, 8) and (0, 6, 8) [repeated error] award 1/2</p> <p>4. •² is available for answers of the form B(x, y, z), C(x+2, y, z-5)</p> <p>eg (2, 8, 5) and (4, 8, 0)</p>				
Commonly Observed Responses:				
<p>1. 4,8,5 and 6,8,0 award 1/2 ×✓</p> <p>(award 2/2 if omission of brackets has already been penalised in Q4)</p> <p>2. $\begin{pmatrix} 4 \\ 8 \\ 5 \end{pmatrix}$ and $\begin{pmatrix} 6 \\ 8 \\ 0 \end{pmatrix}$ or 4 6 8 and 8 award 1/2 ×✓ 5 0</p> <p>(award 2/2 if use of coordinates instead of components has already been penalised in Q4)</p> <p>3. $\begin{pmatrix} 5 \\ 8 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} 6 \\ 8 \\ 0 \end{pmatrix}$ award 0/2</p>				

Question		Generic scheme	Illustrative scheme	Max mark
14.		<ul style="list-style-type: none"> •¹ subtract h •² divide by g •³ square 	<ul style="list-style-type: none"> •¹ $y - h = g\sqrt{x}$ •² $\sqrt{x} = \frac{y-h}{g}$ •³ $x = \left(\frac{y-h}{g}\right)^2$ 	3

Notes:

1. Correct answer without working award 1/3
2. For subsequent incorrect working, the final mark is not available

Commonly Observed Responses:

Working must be shown.

1. $x = \left(\frac{y-h}{g} - \frac{h}{g}\right)^2$ award 3/3

2. $x = \frac{y-h}{g}^2$ award 2/3 ✓✓x

Question		Generic scheme	Illustrative scheme	Max mark
15.		<ul style="list-style-type: none"> •¹ start process •² complete process 	<ul style="list-style-type: none"> •¹ $\frac{4}{9}$ or p^8 •² $\frac{4}{9}p^8$ 	2

Notes:

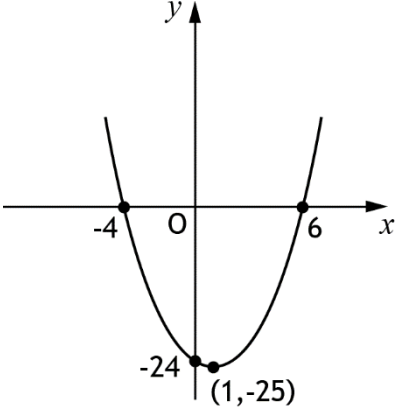
1. For a correct answer without working award 2/2
2. For subsequent incorrect working, the final mark is not available

3. **BEWARE** : For $\frac{2}{3}p^4 + \frac{2}{3}p^4 = \frac{4}{3}p^8$ award 0/2

4. Award •¹ for an incorrect expansion leading to $\frac{4}{9} + \dots$ or $\dots + p^8$

$$\text{eg } \left(\frac{2}{3}p^4\right)\left(\frac{2}{3}p^4\right) = \frac{4}{9} + \frac{2}{3}p^4 + \frac{2}{3}p^4 + p^8 = \frac{4}{9} + \frac{4}{3}p^4 + p^8 \quad \text{award 1/2 } \checkmark \times$$

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
16.	<ul style="list-style-type: none"> •¹ identify roots •² identify turning point OR y-intercept •³ identify the turning point AND the y-intercept and sketch a consistently annotated parabola 	<ul style="list-style-type: none"> •¹ -4 AND 6 •² (1, -25) OR -24 •³ (1, -25) AND -24 and consistently annotated parabola (see Note 1). 	3

Notes:

1. •³ is only available where the roots, turning point AND y-intercept are clearly marked and consistently annotated on the sketch
2. Accept correctly calculated roots and/or y-intercept annotated as (0, -4), (0, 6) and (-24, 0) as evidence for the award of •³ (treat as bad form)
3. •³ is not available if graph is not a parabola
eg roots = -6 and 4 → (-1, -21) or -24 award 1/3 x✓x

Commonly Observed Responses:

Question		Generic scheme	Illustrative scheme	Max mark
17.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ start substitution into formula •² complete substitution into formula •³ calculate height <p>Method 2</p> <ul style="list-style-type: none"> •¹ change subject to h •² correct substitution into formula •³ calculate height 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $\frac{1}{3} \times 6^2 \times h$ or $\frac{1}{3} Ah = 138$ •² $\frac{1}{3} \times 6^2 \times h = 138$ •³ 11.5 (cm) <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{3V}{A}$ or $\frac{V}{\frac{1}{3}A}$ •² $\frac{3 \times 138}{6 \times 6}$ or $\frac{138}{\frac{1}{3} \times 6 \times 6}$ •³ 11.5 (cm) 	3

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> 1. For a correct answer without working award 0/3 2. For an answer obtained by guess and check award 0/3 3. Accept $\frac{23}{2}$ or $11\frac{1}{2}$ 4. For subsequent incorrect working, the final mark is not available eg $\frac{23}{2} = 11.1$ 5. Calculation must involve division by a number greater than 10 for the award of ●³ 			
<p>Commonly Observed Responses: Working must be shown.</p> <ol style="list-style-type: none"> 1. (a) $\frac{1}{3} \times 6^2 \times h = 138 \rightarrow \frac{1}{3} \times 12 \times h = 138 \rightarrow 4h = 138 \rightarrow h = 34.5$ award 2/3 ✓✓x (b) $\frac{1}{3} \times 12 \times h = 138 \rightarrow 4h = 138 \rightarrow h = 34.5$ award 1/3 ✓xx 2. $\frac{1}{3} \times 18 \times h = 138 \rightarrow 6h = 138 \rightarrow h = 23$ [$A = \frac{1}{2} \times 6^2$] award 1/3 ✓xx 3. $\frac{1}{3} \times 24 \times h = 138 \rightarrow 8h = 138 \rightarrow h = 17.25$ [$A = 4 \times 6$] award 1/3 ✓xx 4. (a) $V = \frac{1}{3} Ah \rightarrow \frac{1}{3} \times 6 \times h = 138 \rightarrow 2h = 138 \rightarrow h = 69$ award 1/3 ✓xx (b) $h = \frac{3V}{A} \rightarrow h = \frac{3 \times 138}{6} \rightarrow h = 69$ award 1/3 ✓xx (c) $\frac{1}{3} \times 6 \times h = 138 \rightarrow 2h = 138 \rightarrow h = 69$ award 0/3 			

Question			Generic scheme	Illustrative scheme	Max mark
19.	(a)	(i)	<ul style="list-style-type: none"> •¹ correct bracket with square •² complete process 	<ul style="list-style-type: none"> •¹ $(x-3)^2 \dots$ •² $(x-3)^2 - 90$ 	2
Notes: <ol style="list-style-type: none"> 1. Correct answer without working award 2/2 2. If the solution to (a)(i) only appears in (a)(ii) then both marks are available 					
Commonly Observed Responses: No working necessary: <ol style="list-style-type: none"> 1. Award 2/2 for (a) $(x-3)^2 + (-90)$ or $(x-3)^2 + -90$ (b) $(x-3)(x-3) - 90$ 2. Award 1/2 $\times\checkmark$ for (a) $(x-3) - 90$ (b) $(x^2 - 3) - 90$ (c) $(x^2 - 3)^2 - 90$ (d) $(x - 3x)^2 - 90$ (e) $(x-6)^2 - 117$ 3. (a) $(x-6)^2 - 117$ award 1/2 $\times\checkmark$ (b) $(x-6)^2 - 90$ award 0/2 					
		(ii)	<ul style="list-style-type: none"> •¹ state equation of axis of symmetry 	<ul style="list-style-type: none"> •¹ $x = 3$ 	1
Notes: <ol style="list-style-type: none"> 1. For 3 or axis of symmetry = 3 award 0/1 2. Answer must be consistent with answer to 19(a)(i) [unless no answer given to 19(a)(i)] 					
Commonly Observed Responses:					

Question		Generic scheme	Illustrative scheme	Max mark
19.	(b)	<p>Ans: $d = 3, e = 10$</p> <p>Method 1</p> <ul style="list-style-type: none"> •¹ equate complete square form to zero •² start to solve •³ solve equation •⁴ complete process <p>Method 2</p> <ul style="list-style-type: none"> •¹ correct substitution into quadratic formula •² evaluate discriminant •³ express discriminant in simplest form •⁴ complete process 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $(x-3)^2 - 90 = 0$ •² $x-3 = \pm\sqrt{90}$ •³ $x = 3 \pm \sqrt{90}$ •⁴ $d = 3, e = 10$ or $3 \pm 3\sqrt{10}$ <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)}}{2 \times 1}$ •² 360 (stated or implied by •³) •³ $6\sqrt{10}$ •⁴ $d = 3, e = 10$ or $3 \pm 3\sqrt{10}$ 	4

Notes:

1. Correct answer without working award 0/4
2. Where a, b and c are all positive •² is not available
3. Where $b^2 - 4ac$ is calculated incorrectly, •³ and •⁴ are only available if $b^2 - 4ac > 0$ (See CORs 2 - 5)
4. •⁴ is only available where a correct simplification of $\sqrt{\text{discriminant}}$ leads to a final answer of the form $d \pm d\sqrt{e}$ (See COR 6)

Commonly Observed Responses:

Working must be shown.

1. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{360}}{2} \rightarrow \frac{6 \pm 3\sqrt{40}}{2} \rightarrow 3 \pm 1.5\sqrt{40}$ award 2/4 ✓✓xx

2. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{-288}}{2} \rightarrow \frac{6 \pm 12\sqrt{2}}{2} \rightarrow 3 \pm 6\sqrt{2}$ award 1/4 ✓xxx
(**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

3. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{288}}{2} \rightarrow \frac{6 \pm 12\sqrt{2}}{2} \rightarrow 3 \pm 6\sqrt{2}$ award 2/4 ✓x✓x

4. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 81}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{-288}}{2} \rightarrow \frac{6 \pm 12\sqrt{2}}{2} \rightarrow 3 \pm 6\sqrt{2}$ award 1/4 x✓xx
(**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

5. $\frac{-6 \pm \sqrt{6^2 - 4 \times 1 \times 81}}{2 \times 1} \rightarrow \frac{-6 \pm \sqrt{-288}}{2} \rightarrow \frac{-6 \pm 12\sqrt{2}}{2} \rightarrow -3 \pm 6\sqrt{2}$ award 0/4
(**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

6. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 81}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{288}}{2} \rightarrow \frac{6 \pm 12\sqrt{2}}{2} \rightarrow 3 \pm 6\sqrt{2}$ award 1/4 xx✓x

7. $\frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)}}{2 \times 1} \rightarrow \frac{6 \pm \sqrt{288}}{2} \rightarrow \frac{6 \pm 6\sqrt{8}}{2} \rightarrow 3 \pm 3\sqrt{8}$ award 2/4 ✓xxx✓

8. $6 \pm \sqrt{(-6)^2 - 4 \times 1 \times (-81)} \rightarrow 6 \pm \sqrt{360} \rightarrow 6 \pm 6\sqrt{10}$ award 2/4 x✓✓x

[END OF MARKING INSTRUCTIONS]



National
Qualifications
2018

2018 Mathematics

National 5 - Paper 2

Finalised Marking Instructions

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Detailed marking instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			<ul style="list-style-type: none"> •¹ know how to decrease by 2% •² know how to calculate new total •³ carry out calculations correctly within a valid strategy 	<ul style="list-style-type: none"> •¹ $\times 0.98$ •² $125\,000 \times 0.98^3$ •³ 117 649 (tonnes) 	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, with working
eg $125\,000 \times 0.02^3 = 1$, with working award 2/3 $\times\check{\check{\check{}}}$
3. Where division is used
 - (a) along with 0.98 , •¹ is not available
eg $125\,000 \div 0.98^3 = 132810(.3\dots)$ award 2/3 $\times\check{\check{\check{}}}$
 - (b) along with an incorrect percentage, •¹ and •² are not available
eg $125\,000 \div 1.02^3 = 117790(.2\dots)$ award 1/3 $\times\times\check{\check{}}$

Commonly Observed Responses:

Working must be shown:

- | | |
|--|--|
| 1. $125\,000 \times 1.02^3 = 132651$ | award 2/3 $\times\check{\check{\check{}}}$ |
| 2. $125\,000 \times 0.98 = 122500$ | award 1/3 $\check{\times\times}$ |
| 3. $125\,000 \times 0.98 \times 3 = 367500$ | award 1/3 $\check{\times\times}$ |
| 4. $125\,000 \times 0.02 = 2500 \rightarrow 125000 - 3 \times 2500 = 117500$ | award 1/3 $\check{\times\times}$ |
| 5. $125\,000 \times 0.02 \times 3 = 7500$ | award 0/3 |

Question		Generic scheme	Illustrative scheme	Max mark
2.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ appropriate fraction •² correct substitution into arc length formula •³ calculate arc length <p>Method 2</p> <ul style="list-style-type: none"> •¹ appropriate fraction •² correct substitution into arc length formula •³ calculate arc length 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $\frac{320}{360}$ •² $\frac{320}{360} \times 2 \times \pi \times 7 \cdot 4$ •³ 41(.32...) (cm) <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{360}{320}$ •² $2 \times \pi \times 7 \cdot 4 \div \frac{360}{320}$ •³ 41(.32...) (cm) 	3

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/3 Do not penalise variations in π eg $\frac{320}{360} \times 2 \times 3.14 \times 7.4 = 41(.30\dots)$ award 3/3 Premature rounding: rounded working must be to at least 2 significant figures eg (a) $\frac{320}{360} \times 2 \times \pi \times 7.4 = 0.89 \times 2 \times \pi \times 7.4 = 41(.38\dots)$ award 3/3 (b) $\frac{320}{360} \times 2 \times \pi \times 7.4 = 0.9 \times 2 \times \pi \times 7.4 = 42$ or $41.8(46\dots)$ award 2/3 ✓✓x Accept $2 \times \pi \times 7.4 - \frac{40}{360} \times 2 \times \pi \times 7.4 = 41$ or $41(.32\dots)$ award 3/3 For subsequent incorrect working, the final mark is not available eg $2 \times \pi \times 7.4 - \frac{320}{360} \times 2 \times \pi \times 7.4 = 5$ or $5(.16\dots)$ award 2/3 ✓✓x 			
<p>Commonly Observed Responses: Working must be shown:</p> <ol style="list-style-type: none"> $\frac{320}{360} \times \pi \times 7.4 = 21$ or $20.6(64\dots)$ award 2/3 ✓x✓ $\frac{320}{360} \times \pi \times 7.4^2 = 153$ or $152.9(18\dots)$ award 2/3 ✓x✓ $\frac{40}{360} \times 2 \times \pi \times 7.4 = 5(.16\dots)$ award 2/3 x✓✓ $\frac{40}{360} \times \pi \times 7.4 = 3$ or 2.6 or $2.5(83\dots)$ award 1/3 xx✓ $\frac{40}{360} \times \pi \times 7.4^2 = 19(.11\dots)$ award 1/3 xx✓ $2 \times \pi \times 7.4 = 46(.49\dots)$ award 0/3 			

Question		Generic scheme	Illustrative scheme	Max mark
3.		<ul style="list-style-type: none"> •¹ start process •² solution 	<ul style="list-style-type: none"> •¹ $24^2 + (-12)^2 + 8^2$ •² 28 	2

Notes:

1. Correct answer without working award 2/2
2. Accept $24^2 + 12^2 + 8^2$ for the award of •¹
3. For eg $\sqrt{24^2 + (-12)^2} = \sqrt{720} = 26 \cdot 8(3\dots)$ or $12\sqrt{5}$ award 0/2

Commonly Observed Responses:

No working necessary:

1. $\sqrt{784}$ or 784 award 1/2 ✓ x
2. $22 \cdot 2(7\dots)$ or $4\sqrt{31}$ ($\sqrt{24^2 - 12^2 + 8^2} = \sqrt{496}$) award 1/2 x✓
3. $\sqrt{496}$ award 0/2
4. $\sqrt{20} = 4 \cdot 4\dots$ ($\sqrt{24 - 12 + 8}$) award 0/2

Question		Generic scheme	Illustrative scheme	Max mark
4.		<ul style="list-style-type: none"> •¹ start to process right hand side •² collect like terms •³ solve for x 	<ul style="list-style-type: none"> •¹ $6x - 6 - 12$ •² $-3x < -18$ or $18 < 3x$ •³ $x > 6$ or $6 < x$ 	3
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without valid working award 0/3 Treat guess and check as invalid working 2. For subsequent incorrect working final mark is not available eg $6 < x \rightarrow x < 6$ award 2/3 				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 1. $3x < 6x - 6 - 12 \rightarrow 3x < -18 \rightarrow x < -6$ award 1/3 ✓×× 2. $3x < 6x - 1 - 12 \rightarrow -3x < -13 \rightarrow x > \frac{13}{3}$ award 2/3 ×✓✓ 3. (a) $3x = 6x - 6 - 12 \rightarrow -3x = -18 \rightarrow x = 6 \rightarrow x > 6$ award 3/3 (b) $3x = 6x - 6 - 12 \rightarrow -3x = -18 \rightarrow x = 6$ award 2/3 ✓✓× 				

Question		Generic scheme	Illustrative scheme	Max mark
5.	(a)	<p>Method 1</p> <ul style="list-style-type: none"> •¹ calculate mean •² calculate $(x - \bar{x})^2$ •³ substitute into formula •⁴ calculate standard deviation <p>Method 2</p> <ul style="list-style-type: none"> •¹ calculate mean •² calculate $\sum x$ and $\sum x^2$ •³ substitute into formula •⁴ calculate standard deviation 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ 126 •² 36, 0, 1, 25, 16, 4 •³ $\sqrt{\frac{82}{5}}$ •⁴ 4(·049...) <p>Method 2</p> <ul style="list-style-type: none"> •¹ 126 •² 756, 95338 •³ $\sqrt{\frac{95338 - \frac{756^2}{6}}{5}}$ •⁴ 4(·049...) 	4

Notes:

1. For 126 and 4(·04...) without working award 1/4 ✓ x x x
2. Accept (standard deviation =) 4·04 with working
3. (a) For 126 and $\frac{\sqrt{82}}{5} = 4(·049...)$ award 4/4
 (b) For 126 and $\frac{\sqrt{82}}{5} = 1(·811...)$ award 3/4 ✓ ✓ x ✓

Commonly Observed Responses:

Question		Generic scheme	Illustrative scheme	Max mark
5.	(b)	<ul style="list-style-type: none"> •¹ compare means •² compare standard deviations 	<ul style="list-style-type: none"> •¹ eg on average the number of customers was higher on Saturday •² eg the number of customers was less varied on Saturday 	2

Notes:

1. Answers must be consistent with answers to part (a)
2. Statements must involve
 - (a) reference to number of customers **and** a chronological comparison or reference to Saturday and/or Sunday
 - Accept eg ‘there were more customers on Saturday’
‘on average the number of customers decreased’
 - Do **not** accept eg ‘there were more visits on Saturday’,
‘the customers were more consistent on Saturday’
‘on average the number of customers was more’
3. For the award of •¹
 - (a) eg Accept
 - Saturday’s average number of customers was more
 - The amount of people was higher on Saturday
 - (b) eg Do **not** accept
 - The mean number of customers on Saturday was more
 - There were more customers at each stall on Saturday
 - The average number of people visiting the stalls was better
4. For the award of •²
 - (a) eg Accept
 - The spread of customer numbers on Saturday was less
 - The number of customers on Saturday was more consistent
 - Saturday’s customer numbers were less varied
 - (b) eg Do **not** accept
 - The standard deviation on Saturday was less
 - The range of customer numbers on Saturday was less
 - The customers on Saturday were less varied
 - On average the number of customers on Saturday was less varied
 - The standard deviation is more consistent

Commonly Observed Responses:

Question		Generic scheme	Illustrative scheme	Max mark
6.		<ul style="list-style-type: none"> •¹ valid strategy •² state value of a 	<ul style="list-style-type: none"> •¹ $5+4a=73$ or $5+4\times 17$ •² ($a=$)17 	2
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 2/2 2. Accept $f(17)=73$ without working award 2/2 3. Accept use of x in place of a 				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 1. $5+4\times 73=297$ award 0/2 2. $5+4a=73$ or $5+4\times 17\rightarrow a=17\rightarrow f(a)=17$ award 2/2 3. $5+4a=73$ or $5+4\times 17\rightarrow f(a)=17$ award 1/2 ✓x 4. $f(73)=5+4x\rightarrow x=17$ award 2/2 				

Question		Generic scheme	Illustrative scheme	Max mark
7.		<ul style="list-style-type: none"> •¹ substitute into formula •² calculate volume •³ round to 2 significant figures 	<ul style="list-style-type: none"> •¹ $\frac{4}{3} \times \pi \times 3 \cdot 2^3$ •² $137 \cdot 2 \dots$ •³ $140(\text{cm}^3)$ 	3

Notes:

1. Correct answer without working award 0/3

2. Accept variations in π

eg $\frac{4}{3} \times 3 \cdot 14 \times 3 \cdot 2^3 = 137 \cdot 188 \dots = 140$

Commonly Observed Responses:

1. $\frac{4}{3} \times \pi \times 6 \cdot 4^3 = 1098 \cdot 0 \dots = 1100$ award 2/3 x✓✓

2. $\frac{4}{3} \times \pi \times 3 \cdot 2^2 = 42 \cdot 8 \dots = 43$ award 2/3 x✓✓

3. $\frac{4}{3} \times \pi \times 3 \cdot 2^3 = 42 \cdot 8 \dots = 43$ award 2/3 ✓x✓

4. $\frac{4}{3} \times \pi \times 3 \cdot 2 = 13 \cdot 4 \dots = 13$ award 1/3 xx✓

Question		Generic scheme	Illustrative scheme	Max mark
8.		<ul style="list-style-type: none"> •¹ rearrange equation •² calculate value of x •³ calculate 2nd value of x 	<ul style="list-style-type: none"> •¹ $\sin x = \frac{1}{7}$ •² $8 \cdot 2(1 \dots)$ •³ $171 \cdot 8$ or $171 \cdot 7(8 \dots)$ 	3

Notes:

1. Correct answers without working award 1/3 $\times \times \checkmark$
2. Accept 8 and 172 with valid working
3. Degree signs are not required
4. Premature rounding: rounded working must be to at least 2 decimal places
eg (a) $\sin x = \frac{1}{7} = 0 \cdot 14 \rightarrow x = 8(\cdot 04 \dots), 172$ or $171 \cdot (95 \dots)$ award 3/3
(b) $\sin x = \frac{1}{7} = 0 \cdot 1 \rightarrow x = 6$ or $5(\cdot 73 \dots), 174 \cdot (26 \dots)$ award 2/3 $\checkmark \times \checkmark$
5. Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17
(a) $0 \cdot 143 \dots, 179 \cdot 856 \dots$ (RAD)
(b) $9 \cdot 125 \dots, 170 \cdot 874 \dots$ (GRAD)

Commonly Observed Responses:

1. $\sin x = \frac{5}{7} \rightarrow x = 45 \cdot 6, 134 \cdot 4$ award 2/3 $\times \checkmark \checkmark$
2. (a) $\sin x = -\frac{1}{7} \rightarrow x = 188 \cdot 2, 351 \cdot 8$ award 2/3 $\times \checkmark \checkmark$
(b) $\sin x = -\frac{1}{7} \rightarrow x = 8 \cdot 2, 171 \cdot 8$ award 0/3

Question		Generic scheme	Illustrative scheme	Max mark
9.		<ul style="list-style-type: none"> •¹ correct substitution into sine rule •² re-arrange formula •³ calculate length 	<ul style="list-style-type: none"> •¹ $\frac{20}{\sin 37} = \frac{DC}{\sin 105}$ •² $\frac{20 \sin 105}{\sin 37}$ •³ 32(.1... cm) 	3

Notes:

1. Correct answer without working award 0/3
2. Degree signs are not required
3. **BEWARE** $\frac{20}{\sin 37} = \frac{DC}{\sin 75} \rightarrow 32(.1\dots)$ award 2/3 x✓✓
4. Disregard errors due to premature rounding provided there is evidence
5. Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17
 - (a) 30(.16...) (RAD)
 - (b) 36(.31...) (GRAD)

Commonly Observed Responses:

1. $\frac{20}{\sin 37} = \frac{?}{\sin 38} \rightarrow \frac{20 \sin 38}{\sin 37} = 20(.46\dots)$ award 2/3 x✓✓
2. $\frac{20}{37} = \frac{DC}{105} \rightarrow 57$ or $56(.7\dots)$ award 0/3

Question		Generic scheme	Illustrative scheme	Max mark
10.		<ul style="list-style-type: none"> •¹ express \overrightarrow{ED} in terms of \mathbf{u} and \overrightarrow{DC} in terms of \mathbf{w} •² express \overrightarrow{BC} in terms of \mathbf{u} and \mathbf{w} in simplest form 	<ul style="list-style-type: none"> •¹ $\overrightarrow{ED} = 2\mathbf{u}$ and $\overrightarrow{DC} = \frac{1}{2}\mathbf{w}$ •² $\mathbf{u} - \frac{1}{2}\mathbf{w}$ 	2

Notes:

1. Correct answer without working award 2/2
2. Accept $\mathbf{u} + -\frac{1}{2}\mathbf{w}$ award 2/2
3. Evidence for the award of •¹ may appear on the diagram
4. For the award of •¹ accept
 - (a) $-\mathbf{u} - \mathbf{w} + 2\mathbf{u} + \frac{1}{2}\mathbf{w}$
 - (b) $-\mathbf{u} - \mathbf{w} + 2\overrightarrow{AB} + \frac{1}{2}\overrightarrow{EA}$
5. $\overrightarrow{BA} + \overrightarrow{AE} + \overrightarrow{ED} + \overrightarrow{DC}$ alone is not enough for the award of •¹
6. For $-\mathbf{u} + \frac{1}{2}\mathbf{w}$
 - (a) without working award 0/2
 - (b) but may be worth 1/2 if there is valid working

Commonly Observed Responses:

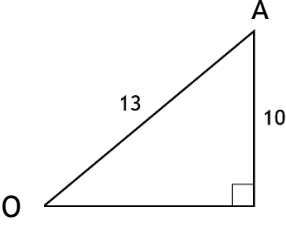
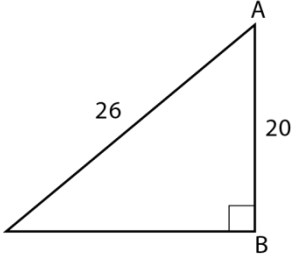
Question		Generic scheme	Illustrative scheme	Max mark
11.		<ul style="list-style-type: none"> •¹ know that $85\% = 9.3 \times 10^{11}$ •² begin valid strategy •³ complete calculation within valid strategy 	<ul style="list-style-type: none"> •¹ $85\% = 9.3 \times 10^{11}$ •² $1\% = \frac{9.3 \times 10^{11}}{85}$ •³ $1.094... \times 10^{12}$ (km³) or 1094117647000 (km³) 	3

Notes:

1. 1.1×10^{12}
(a) with valid working award 3/3
(b) without working award 0/3
2. **BEWARE**
 115% of $9.3 \times 10^{11} = 1.1 \times 10^{12}$ or $1.06... \times 10^{12}$
(a) and evidence of •¹ award 1/3 ✓ x x
(b) otherwise award 0/3
3. 85% of $9.3 \times 10^{11} = 7.9(05) \times 10^{11}$
(a) and evidence of •¹ award 1/3 ✓ x x
(b) otherwise award 0/3
4. Do not accept eg $10.94... \times 10^{11}$ for the award of •³

Commonly Observed Responses:

1. $\frac{9.3 \times 10^{11}}{0.85} = 1.094... \times 10^{12}$ award 3/3
2. $115\% = 9.3 \times 10^{11} \rightarrow \frac{9.3 \times 10^{11}}{1.15} = 8.086... \times 10^{11}$ award 2/3 x ✓ ✓
3. $15\% = 9.3 \times 10^{11} \rightarrow \frac{9.3 \times 10^{11}}{0.15} = 6.2 \times 10^{12}$ award 2/3 x ✓ ✓

Question	Generic scheme	Illustrative scheme	Max mark
12.	<p>Method 1</p> <ul style="list-style-type: none"> •¹ marshal facts and recognise right angled triangle •² consistent Pythagoras statement •³ calculate x •⁴ calculate width <p>Method 2</p> <ul style="list-style-type: none"> •¹ marshal facts and recognise right angled triangle •² consistent Pythagoras statement •³ calculate x •⁴ calculate width 	<ul style="list-style-type: none"> •¹  •² $x^2 = 13^2 - 10^2$ •³ 8.3(...) •⁴ 21.3(... cm) <ul style="list-style-type: none"> •¹  •² $x^2 = 26^2 - 20^2$ •³ 16.6(...) •⁴ 21.3(... cm) 	4

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/4 In the absence of a diagram accept $x^2 = 13^2 - 10^2$ or $x^2 = 26^2 - 20^2$ as evidence for the award of •¹ and •² BEWARE Where a diagram is shown, working must be consistent with the diagram •² is not available for an <u>incorrect</u> diagram leading to $x^2 = 13^2 - 10^2$ or $x^2 = 26^2 - 20^2$ •² is available for a valid trig. method Where a candidate assumes the sizes of one or both of the smaller angles in the right-angled triangle, only •¹ and •⁴ are available •⁴ is only available following a Pythagoras (or trig.) calculation within a right-angled triangle involving 13 and 10 or 26 and 20 Disregard errors due to premature rounding provided there is evidence 			
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> $x^2 = 13^2 + 10^2 \rightarrow x = 16.4$; width = 29.4 <ul style="list-style-type: none"> (a) working inconsistent with correct diagram award 3/4 ✓x✓✓ (b) working consistent with candidate's diagram award 3/4 x✓✓✓ (cosine rule may be used to calculate x) (c) no diagram award 2/4 xx✓✓ $x^2 = 26^2 + 20^2 \rightarrow x = 32.8$; width = 29.4 <ul style="list-style-type: none"> (a) working inconsistent with correct diagram award 3/4 ✓x✓✓ (b) working consistent with candidate's diagram award 3/4 x✓✓✓ (cosine rule may be used to calculate x) (c) no diagram award 2/4 xx✓✓ $x^2 = 20^2 - 13^2 \rightarrow x = 15.2$; width = 28.2 <ul style="list-style-type: none"> (a) working consistent with candidate's diagram award 2/4 x✓✓x (cosine rule may be used to calculate x) (b) no diagram award 1/4 xx✓x 			

Question		Generic scheme	Illustrative scheme	Max mark
13.		<ul style="list-style-type: none"> •¹ correct substitution into cosine rule •² correct calculation of $\cos YTF$ •³ calculate angle YTF •⁴ calculate bearing 	<ul style="list-style-type: none"> •¹ $\frac{10 \cdot 3^2 + 5 \cdot 6^2 - 7 \cdot 2^2}{2 \times 10 \cdot 3 \times 5 \cdot 6}$ •² $\frac{85 \cdot 61}{115 \cdot 36} (= 0.742\dots)$ •³ 42(.088...) •⁴ 282(.088...) 	4

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/4 For subsequent invalid working \bullet^4 is not available eg $282 \rightarrow 360 - 282 = 078$ Degree signs are not required Where an incorrect angle has been calculated \bullet^4 can only be awarded where there is clear evidence of an intention to calculate angle T eg $\cos T = \frac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2}$ OR $T = 31$ OR angle marked at T on the diagram \bullet^4 can only be awarded for adding 240 to a value previously calculated using trig. Disregard errors due to premature rounding provided there is evidence Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17 (a) 240.73... (RAD) (b) 286.76... (GRAD) 			
<p>Commonly Observed Responses: Working must be shown.</p> <ol style="list-style-type: none"> <p>(a) $\cos T = \frac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2} = \frac{126.57}{148.32} \rightarrow 31 \rightarrow 271$ award 3/4 $\times \checkmark \checkmark \checkmark$ (see Note 4)</p> <p>(b) $\frac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2} = \frac{126.57}{148.32} \rightarrow 31 \rightarrow 271$ award 2/4 $\times \checkmark \checkmark \times$</p> <p>(a) $\cos T = \frac{7 \cdot 2^2 + 5 \cdot 6^2 - 10 \cdot 3^2}{2 \times 7 \cdot 2 \times 5 \cdot 6} = \frac{-22.89}{80.64} \rightarrow 106 \rightarrow 346$ award 3/4 $\times \checkmark \checkmark \checkmark$ (see Note 4)</p> <p>(b) $\frac{7 \cdot 2^2 + 5 \cdot 6^2 - 10 \cdot 3^2}{2 \times 7 \cdot 2 \times 5 \cdot 6} = \frac{-22.89}{80.64} \rightarrow 106 \rightarrow 346$ award 2/4 $\times \checkmark \checkmark \times$</p> 			

Question		Generic scheme	Illustrative scheme	Max mark
14.		<p>Method 1</p> <ul style="list-style-type: none"> •¹ isolate term in y or divide throughout by 5 •² state coordinates (must use brackets) <p>Method 2</p> <ul style="list-style-type: none"> •¹ substitute $x = 0$ into equation •² state coordinates (must use brackets) 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $-5y = \dots + 20$ or $\dots - 20 = 5y$ or $\frac{2x}{5} - \frac{5y}{5} = \frac{20}{5}$ •² $(0, -4)$ <p>Method 2</p> <ul style="list-style-type: none"> •¹ $2 \times 0 - 5y = 20$ •² $(0, -4)$ 	2
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 2/2 2. Disregard errors in the x term for the award of •¹ 3. For finding where the line crosses the x-axis, $(10, 0)$, with working award 1/2 				
<p>Commonly Observed Responses</p> <ol style="list-style-type: none"> 1. $0, -4$ (no working necessary) award 1/2 ✓\times 2. $y = -4$ (no working necessary) award 1/2 ✓\times 				

Question		Generic scheme	Illustrative scheme	Max mark
15.		<ul style="list-style-type: none"> •¹ start to divide fractions •² factorise •³ multiply and simplify 	<ul style="list-style-type: none"> •¹ $\frac{n}{n^2-4} \times \frac{n-2}{3}$ •² $(n+2)(n-2)$ •³ $\frac{n}{3(n+2)}$ or $\frac{n}{3n+6}$ S 	3
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working 0/3 2. For subsequent incorrect working, the final mark is not available <p>eg (a) $\frac{n}{3(n+2)} = \frac{n}{3n+2}$ award 2/3 ✓✓x</p> <p>(b) $\frac{\cancel{n}}{3(\cancel{n}+2)} = \frac{1}{3(1+2)} = \frac{1}{9}$ award 2/3 ✓✓x</p>				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 1. $\frac{n}{n^2-4} \div \frac{3(n+2)}{n^2-4} \rightarrow \frac{n}{n^2-4} \times \frac{n^2-4}{3(n+2)} \rightarrow \frac{n}{3(n+2)}$ award 3/3 				

Question		Generic scheme	Illustrative scheme	Max mark
16.		<ul style="list-style-type: none"> •¹ start valid strategy •² continue strategy •³ calculate length of space diagonal •⁴ valid conclusion with comparison 	<ul style="list-style-type: none"> •¹ $40^2 + 40^2$ or $40^2 + 70^2$ (stated or implied by •²) •² $\sqrt{40^2 + 40^2 + 70^2}$ •³ 90 •⁴ Yes, since $85 < 90$ 	4

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working 0/4 Accept correct use of cosine rule Accept eg $\begin{pmatrix} -40 \\ 40 \\ 70 \end{pmatrix} \rightarrow \sqrt{(-40)^2 + 40^2 + 70^2}$ for the award of •¹ and •² •⁴ can only be awarded for a valid conclusion and comparison made with a value obtained from a Pythagoras (or trigonometric) calculation Award of •⁴: eg (a) $\sqrt{40^2 + 40^2 + 70^2} = 90$; Yes, since the umbrella is only 85 award 4/4 (b) $\sqrt{40^2 + 40^2 + 70^2} = 90$; Yes award 3/4 ✓✓✓x (c) $\sqrt{40^2 + 70^2} = 80 \cdot 62\dots$; No, since the locker is only 80·62... award 2/4 ✓xx✓ 			
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> (a) $\sqrt{40^2 + 70^2} = 80 \cdot 62\dots$; No, since $85 > 80 \cdot 62\dots$ award 2/4 ✓xx✓ (b) $\sqrt{40^2 + 40^2} = 56 \cdot 56\dots$; No, since $85 > 56 \cdot 56\dots$ award 2/4 ✓xx✓ (a) $\sqrt{40^2 + 40^2} = 56 \cdot 56\dots = 57 \rightarrow \sqrt{57^2 + 70^2} = 90 \cdot 27 = 90$; Yes, since $85 < 90$ award 4/4 (b) $\sqrt{40^2 + 70^2} = 80 \cdot 62\dots = 81 \rightarrow \sqrt{81^2 + 40^2} = 90 \cdot 33 = 90$; Yes, since $85 < 90$ award 4/4 (a) $40^2 + 40^2 + 70^2 = 8100$; $85^2 = 7225$ Yes, since $8100 > 7225$ award 4/4 (b) $40^2 + 40^2 + 70^2 = 8100$; $85^2 = 7225$ Yes, since $8100 \neq 7225$ award 3/4 ✓✓✓x (a) $40^2 + 40^2 = 3200$; $85^2 = 7225$ No, since $3200 < 7225$ award 2/4 ✓xx✓ (b) $40^2 + 40^2 = 3200$; $85^2 = 7225$ No, since $3200 \neq 7225$ award 1/4 ✓xxx (c) $40^2 + 70^2 = 6500$; $85^2 = 7225$ No, since $6500 < 7225$ award 2/4 ✓xx✓ (d) $40^2 + 70^2 = 6500$; $85^2 = 7225$ No, since $6500 \neq 7225$ award 1/4 ✓xxx $40^2 + 40^2 = 3200$; $70^2 = 4900$ No, since $3200 < 4900$ award 1/4 ✓xxx 			

Question		Generic scheme	Illustrative scheme	Max mark
17.		<ul style="list-style-type: none"> •¹ substitute correctly into area of triangle formula •² appropriate fraction for sector •³ substitute correctly into area of sector formula •⁴ know to subtract area of sector from area of triangle •⁵ calculate area of shaded region and state correct units 	<ul style="list-style-type: none"> •¹ $\frac{1}{2} \times 38 \times 55 \times \sin 75 (= 1009.39\dots)$ •² $\frac{75}{360}$ •³ $\frac{75}{360} \times \pi \times 30^2 (= 589.04\dots)$ •⁴ evidence of area of triangle – area of sector •⁵ $420(.3\dots) \text{ cm}^2$ 	5

Question	Generic scheme	Illustrative scheme	Max mark
<p>Notes:</p> <ol style="list-style-type: none"> Correct answer without working award 0/5 Accept variations in π Disregard errors due to premature rounding provided there is evidence Inappropriate use of GRAD leading to $376(.40\dots)$ cm² should only be penalised once in Q8, Q9, Q13 or Q17 The following answers should be awarded <ul style="list-style-type: none"> 4/5 if the use of RAD has already been penalised in Q8, Q9 or Q13 3/5 if the use of RAD has not already been penalised in Q8, Q9 or Q13 <ol style="list-style-type: none"> $-405(.23\dots) - 589(.04) = -994(.28\dots)$ cm² $405(.23\dots) - 589(.04) = -183(.81\dots)$ cm² $589(.04) - 405(.23\dots) = 183(.81\dots)$ cm² $589(.04) - (-405(.23\dots)) = 994(.28\dots)$ cm² ⁵ is only available for calculating the sum or difference of the area of a triangle and the area of a sector, where the area of the triangle is calculated using trigonometry 			
<p>Commonly Observed Responses: Working must be shown:</p> <ol style="list-style-type: none"> $\frac{1}{2} \times 38 \times 55 \times \sin 75 - \frac{75}{360} \times \pi \times 60 = 970(.1\dots)$ cm² award 4/5 ✓✓x✓✓ $\frac{1}{2} \times 38 \times 55 \times \sin 75 + \frac{75}{360} \times \pi \times 30^2 = 1598(.4\dots)$ cm² award 4/5 ✓✓✓x✓ $\frac{1}{2} \times 38 \times 55 \times \sin 75 + \frac{75}{360} \times \pi \times 60 = 1048(.6\dots)$ cm² award 3/5 ✓✓xx✓ $\frac{75}{360} \times \pi \times 30^2 = 589(.0\dots)$ cm² award 2/5 x✓✓xx $\frac{1}{2} \times 38 \times 55 \times \sin 75 = 1009(.3\dots)$ cm² award 1/5 ✓xxxx $\pi \times 30^2 = 2827(.4\dots)$ cm² award 0/5 			

Question		Generic scheme	Illustrative scheme	Max mark
18.	(a)	<p><u>Method 1</u></p> <ul style="list-style-type: none"> •¹ state linear scale factor •² know to multiply volume by cube of linear scale factor •³ correct calculation (must involve a power of the scale factor), valid comparison and conclusion <p><u>Method 2</u></p> <ul style="list-style-type: none"> •¹ state linear scale factor •² know to divide volume by cube of linear scale factor •³ correct calculation (must involve a power of the scale factor), valid comparison and conclusion <p><u>Method 3</u></p> <ul style="list-style-type: none"> •¹ state volume scale factor •² know to multiply depth by cube root of volume scale factor •³ correct calculation (must involve a root of the volume scale factor), valid comparison and conclusion <p><u>Method 4</u></p> <ul style="list-style-type: none"> •¹ state linear scale factor •² know to compare cube of linear scale factor with volume scale factor •³ correct calculation (must involve a power of the scale factor), valid comparison and conclusion 	<p><u>Method 1</u></p> <ul style="list-style-type: none"> •¹ eg $\frac{24}{16}$ or equivalent •² $576 \times \left(\frac{24}{16}\right)^3$ •³ $1944 \neq 1125$, so the cartons are not similar <p><u>Method 2</u></p> <ul style="list-style-type: none"> •¹ eg $\frac{16}{24}$ or equivalent •² $576 \div \left(\frac{16}{24}\right)^3$ •³ $1944 \neq 1125$, so the cartons are not similar <p><u>Method 3</u></p> <ul style="list-style-type: none"> •¹ eg $\frac{1125}{576}$ or equivalent •² $\sqrt[3]{\frac{1125}{576}} \times 16$ •³ $20 \neq 24$, so the cartons are not similar <p><u>Method 4</u></p> <ul style="list-style-type: none"> •¹ eg $\frac{24}{16}$ or equivalent •² $\left(\frac{24}{16}\right)^3$ and $\frac{1125}{576}$ •³ $3.375 \neq 1.95\dots$, so the cartons are not similar 	3

Question		Generic scheme	Illustrative scheme	Max mark
18.	(a)	<p>Method 5</p> <ul style="list-style-type: none"> •¹ state volume scale factor •² know to compare cube root of volume scale factor with linear scale factor •³ correct calculation (must involve a root of the volume scale factor), valid comparison and conclusion 	<p>Method 5</p> <ul style="list-style-type: none"> •¹ eg $\frac{1125}{576}$ or equivalent •² $\sqrt[3]{\frac{1125}{576}}$ and $\frac{24}{16}$ •³ $1.25 \neq 1.5$, so the cartons are not similar 	

Notes:

1. Correct answer without working award 0/3
2. For the award of •¹ accept a rounded or truncated decimal equivalent (to at least 2 decimal places) for evidence of the scale factor eg $\frac{1125}{576} = 1.95$, $\frac{16}{24} = 0.66$; but see Note 3
3. Where premature rounding leads to an inaccurate answer, •³ is not available
eg $1125 \times \left(\frac{16}{24}\right)^3 \rightarrow 1125 \times 0.7^3 = 385.875$; $385.875 \neq 576$, so the cartons are not similar
award 2/3 ✓✓x
4. For the award of •³ there must be a numerical comparison or a statement such as ‘the two scale factors are different’; a simple statement of ‘not similar’ is not sufficient

Commonly Observed Responses:

1. $1125 \times \left(\frac{16}{24}\right)^3 = 333.3\dots$; $333.3 \neq 576$, so the cartons are not similar award 3/3
2. (a) $576 \times \frac{24}{16} = 864$; $864 \neq 1125$, so the cartons are not similar award 1/3 ✓xx
(b) $576 \times \frac{16}{24} = 384$; $384 \neq 1125$, so the cartons are not similar award 1/3 ✓xx
3. (a) $576 \times \left(\frac{24}{16}\right)^2 = 1296$; $1296 \neq 1125$, so the cartons are not similar award 2/3 ✓x✓
(b) $576 \times \left(\frac{16}{24}\right)^2 = 256$; $256 \neq 1125$, so the cartons are not similar award 2/3 ✓x✓
4. (a) $\frac{576}{16^3} = 0.14\dots$, $\frac{1125}{24^3} = 0.08\dots$; $0.14\dots \neq 0.08\dots$, so the cartons are not similar award 3/3
(b) $\frac{576}{16^2} = 2.25$, $\frac{1125}{24^2} = 1.95\dots$; $2.25 \neq 1.95\dots$, so the cartons are not similar award 2/3 ✓x✓
(c) $\frac{576}{16} = 36$, $\frac{1125}{24} = 46.875$; $36 \neq 46.875$, so the cartons are not similar award 1/3 ✓xx

Question		Generic scheme	Illustrative scheme	Max mark
18.	(b)	<p>Method 1</p> <ul style="list-style-type: none"> •¹ find volume scale factor •² correct calculation to find height (must involve a root of the volume scale factor) <p>Method 2</p> <ul style="list-style-type: none"> •¹ find volume scale factor •² correct calculation to find height (must involve a root of the volume scale factor) 	<p>Method 1</p> <ul style="list-style-type: none"> •¹ $\frac{1500}{576}$ •² $\sqrt[3]{\frac{1500}{576}} \times 16 = 22(\cdot 0\dots \text{ cm})$ <p>Method 2</p> <ul style="list-style-type: none"> •¹ $\frac{576}{1500}$ •² $16 \div \sqrt[3]{\frac{576}{1500}} = 22(\cdot 0\dots \text{ cm})$ 	2
<p>Notes:</p> <ol style="list-style-type: none"> 1. Correct answer without working award 0/2 2. Disregard errors due to premature rounding provided there is evidence 				
<p>Commonly Observed Responses:</p> <ol style="list-style-type: none"> 1. $\frac{1500}{576} \times 16 = 41.66\dots$ award 1/2 ✓ x 2. $\sqrt{\frac{1500}{576}} \times 16 = 25.81\dots$ award 1/2 ✓ x 3. $\sqrt[3]{\frac{1500}{1125}} \times 24 = 26.41\dots$ award 1/2 x ✓ 				

[END OF MARKING INSTRUCTIONS]