

REVISE

.wales

2.16 – Angle facts & polygons

Mark schemes for the 2.16 question pack

Spec 3.4.1, 3.4.2, 3.4.3 – Unit 2

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 24 questions in the corresponding revise.wales question pack (113 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.

<p>3.(a)</p> $\frac{360}{45}$ <p>= 8 (sides)</p>		<p>M1 A1</p>	<p>For a clear intention of finding how many 45s in 360. Accept embedded answer e.g. $360/8 = 45$ or $45 \times 8 = 360$ for M1A1.</p>
<p>3.(b)</p> <p>Correct construction of 90°.</p> <p>Correct bisector of 90°.</p> <p>AB = 7cm AND BC = 7cm</p>		<p>B2 B1 B1</p>	<p>Do not penalise if they use their own point A. Use overlay but arcs required for the 3 'angle marks'.</p> <p>With sight of accurate 'method arcs'. For this B2 the construction need not be at point B. (Final B1 will not then be awarded) B1 for sight of 'method arcs' but perpendicular line not drawn (unless intersection of construction arcs for 90° are correctly used to construct the 45° angle. In this case the B2 and B1 are gained).</p> <p>With sight of accurate 'method arcs'. F.T. 'their 90°'.</p> <p>Allow ± 0.2cm. Do not penalise if the line AB is extended as long as the position of point B is unambiguous. (Allow labelling of points B and C to be missing if end points are unambiguously identifiable.) <i>If all marks gained but angle ABC = 45°, penalise -1.</i></p>

6.	(Perimeter of square =) $4 \times (2x + 3y) = 62$	✓	B1	Sight of $8x + 12y = 62$ or equivalent e.g. $2x + 3y = 15.5$
	(Perimeter of octagon =) $8 \times (x + 2y) = 72$	✓	B1	Sight of $8x + 16y = 72$ or equivalent e.g. $x + 2y = 9$
	Correct method to solve simultaneous equations, as far as attempt at subtraction	✓	M1	F.T. 'their equations'. Allow 1 'slip', if multiplication used, but not in 'equated variable' for M1 <u>only</u> .
	$y = 2.5$	✓	A1	
	$x = 4$	✓	A1	F.T. from their 1 st variable. (Substitution in any relevant equation.)
	Organisation and Communication.	✓	OC1	For OC1, candidates will be expected to: <ul style="list-style-type: none"> • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical
	Accuracy of writing.	✓	W1	For W1, candidates will be expected to: <ul style="list-style-type: none"> • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc.

<p>10(a) $35 - \frac{240}{360} \times \pi \times 2 \times 6$ or equivalent</p> <p style="text-align: right;">$35 - 8\pi$ (cm)</p>	<p>M2</p> <p>A1</p>	<p>M1 for sight of $\frac{240}{360} \times \pi \times 2 \times 6$ or equivalent</p> <p>Ignore attempts to substitute a value for π into this expression</p> <p>Do not ignore further incorrect simplification of the expression</p> <p><i>If no marks allow SC1 for an answer of $35 - 4\pi$ (cm) from sight of $\frac{240}{360} \times \pi \times 6$ or equivalent</i></p>
<p>10(b)(i) Sight of $\frac{240}{360} \times \pi \times 6^2$ OR $\frac{240}{360} \times \pi \times 3^2$</p> <p>Area of region $\frac{240}{360} \times \pi \times (6^2 - 3^2)$ or equivalent</p> <p style="text-align: center;">$= 18\pi$ (cm²)</p> <p>Cost of paint is 270π (p) or £ 2.7π</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>Or equivalent expressions</p> <p>Accept shown in stages</p> <p>FT $15 \times$ 'their 18π' provided their answer is a multiple of π, and in its simplest form</p> <p>If units are given they must be correct</p>
<p>10(b)(ii) (£)162</p>	<p>B1</p>	<p>FT 'their 2.7' or 'their 270' provided M1 previously awarded</p>

16. $AB = AC$ because ABC is an isosceles triangle. $AP = AQ$ AND angle \hat{A} common.	✓✓ ✓	B2 B1	B1 for $AB = AC$ alone.
(So triangles ABQ and ACP are congruent because of) 'two sides and the <u>included angle</u> ' or 'SAS'.	✓	B1	

1.(b)	-14·3		B2	B1 for 14·3 OR -14·2(.....)
2.	$3x - 2 + 2x + 1 + 5x - 9 = 180$ $10x = 190$ $x = 19$	✓	M1	F.T. from $ax = b$. Allow all 3 marks for $x = 19$. If $x \neq 19$ F.T. 'their <u>derived</u> value of x '. F.T. for this A1 if $x \geq 2$. Any two of these expressions correctly evaluated with no incorrect evaluation, provided the sum of the three found is ≥ 180 . (Statement not required)
	Substituting $x = 19$ into at least one expression.	✓	M1	
	$(3x - 2 =) 55(^{\circ})$ $(2x + 1 =) 39(^{\circ})$ $(5x - 9 =) 86(^{\circ})$ (So not a right-angled triangle)	✓	A1	

	= 286()		A1	SC1 for sight of 74(°).
11.	$\frac{BD \times 5}{2} = 35$ $BD = 14(\text{cm})$	✓	M1	May be seen on the diagram. <u>Note:</u> If they state that $AB = 14\text{cm}$, or indicate on the diagram that $AB = 14\text{cm}$ then it is MOA0 as an incorrect method used for area of a right-angled triangle (however an unattached 14cm has to be given the benefit of the doubt and be awarded M1A1).
		✓	A1	
	$\cos x = \frac{14}{32}$ $x = \cos^{-1} 0.4375$ $x = 64(^{\circ})$	✓	M1	FT 'their stated or shown length BD'. FT has to use 'their BD' (not CD).
		✓	m1	
		✓	A1	Accept answer rounded or truncated. [e.g. if their $BD = 7$, then accept $77(\cdot 36 \dots ^{\circ})$]
Organisation and Communication.		✓	OC1	For OC1, candidates will be expected to: <ul style="list-style-type: none"> • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical
Accuracy of writing.		✓	W1	For W1, candidates will be expected to: <ul style="list-style-type: none"> • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc.

<p>3.</p> $4x - 3 = x + 48$ $3x = 51$ $x = 17$ $ABC \text{ (or/and } ACB) = 65(^{\circ})$ $y = 180 - 2 \times 65$ $= 50(^{\circ})$	<p>M1 A1 A1 B1 M1 A1</p>	<p>Look at diagram.</p> <p>F.T. from $ax = b$. $a \neq 1$. Unsupported $x = 17$ gains M1A1A1</p> <p>F.T. using 'their derived or stated value for x' substituted in either $(4x - 3)$ or $(x + 48)$.</p> <p>F.T. $180 - 2 \times$ 'their 65' <u>derived</u> using 'their x' in either angle'. OR F.T. $180 -$ 'their derived ABC' - 'their derived ACB' (Must be using a consistent value for x). A0 if error in either 'deriving ABC' or 'deriving ACB'. A0 if 'y' is negative on FT. <u>Alternative method</u> M1A1A1 as before. $y + (4x-3) + (x+48) = 180$ or equivalent B1 $y = 135 - 5 \times 17$ FT 'their derived or stated 17' M1 $y = 50(^{\circ})$ A1</p>
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2.(a)	48°	B1	Ignore 'recurring dot'.
2.(b)	East	B1	
2.(c)	300°	B1	

7. $\begin{aligned} &(\text{ADC} =) 109^\circ \\ x &= 180 - 26 - 109 \\ &= 45^\circ \end{aligned}$	B1 M1 A1	<i>Answers may be written on the diagram.</i> Allow for sight of 109° . FT 'their 109° ' (may be clearly indicated on the diagram) <u>provided</u> $\neq 71$ and $\neq 26$. An answer of 45° gains all 3 marks.
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<p>9.</p> <p style="text-align: center;">$\angle BXC = 80(^{\circ})$</p> <p>Reason: 'BX = BC' OR 'Isosceles triangle'</p> <p style="text-align: center;">$\angle AXB (= 180 - 80) = 100(^{\circ})$</p> <p>Reason: 'Angles on a straight line'.</p> <p style="text-align: center;">$\angle ABX (= 180 - 40 - 100) = 40(^{\circ})$</p> <p>Reason: 'Angles in a triangle'.</p> <p style="text-align: center;">Statement 'So AX = BX',</p> <p>Reason: 'Two equal angles (in a triangle)' OR $\angle ABX = \angle BAX$ OR 'Isosceles triangle'</p> <p>Sight of at least TWO of the above reasons.</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>E1</p>	<p><i>Angles shown on the diagram take precedence. If any angle is not named then it must be unambiguously identified either on the diagram, from a given reason or in further work. (e.g. must be convincing that X = 80 is referring to BXC and not AXB.)</i></p> <p>If initial incorrect assumptions are made then allow correct FT methods to calculate other relevant angles.</p> <p>FT 180 – 'their $\angle BXC$'</p> <p>FT 180 – 40 – 'their $\angle AXB$'.</p> <p>Only available if $\angle ABX$ stated or shown to be $40(^{\circ})$</p> <p>Reasons must be appropriate AND are dependent on associated B1 gained.</p>
<p><u>Alternative method 1.</u></p> <p style="text-align: center;">$\angle BXC = 80(^{\circ})$</p> <p>Reason: 'BX = BC' OR 'Isosceles triangle'.</p> <p style="text-align: center;">$\angle CBX (= 180 - 80 - 80) = 20(^{\circ})$</p> <p>Reason: 'Angles in a triangle'.</p> <p style="text-align: center;">$\angle ABX (= 180 - 80 - 40 - 20) = 40(^{\circ})$</p> <p>Reason: 'Angles in a triangle'.</p> <p style="text-align: center;">Statement 'So AX = BX'.</p> <p>Reason: 'Two equal angles (in a triangle)' OR $\angle ABX = \angle BAX$ OR 'Isosceles triangle'</p> <p>Sight of at least TWO of the above reasons.</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>E1</p>	<p>FT 180 – 80 – 'their $\angle BXC$'.</p> <p>FT 180 – 80 – 40 – 'their $\angle CBX$'.</p> <p>Only available if $\angle ABX$ stated or shown to be $40(^{\circ})$</p> <p>Reasons must be appropriate AND are dependent on associated B1 gained.</p>
<p><u>Alternative method 2. (Assumption that AX = BX).</u></p>		

2.	$a = 55^\circ$ $b = 76^\circ$ $c = 104^\circ$ $d = 104^\circ$	B1 B1 B1 B1	FT 180° - 'their b' FT 180° - 'their b' or FT 'their c'
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4.	70	B3	B2 for 77 OR 80 B1 for any number between 65 and 79 inclusive, apart from 70(B3) and 77(B2) B1 for 56, 60 OR 63
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<p>3.</p> <p>(Angle AÔB or exterior angle =) $\frac{360}{8}$ = 45(°)</p> <p>(OÂB =) $\frac{180 - 45}{2}$ = 67.5(°)</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>Answers/working may be seen on diagram.</p> <p>Sight of 45 (even e.g. OÂB = 45) gains M1A1.</p> <p>FT 'their 45' (but not 60°).</p>
<p>3. <u>Alternative method 1</u></p> <p>(Sum of interior angles =) $(8 - 2) \times 180^\circ$ or equivalent = 1080(°)</p> <p>(OÂB =) $\frac{1}{2} \times (1080 \div 8)$ = 67.5(°)</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>(Interior angle =) 135(°) implies M1A1</p> <p>FT 'their interior angle sum' (≠ 1440)</p>
<p>3. <u>Alternative method 2</u></p> <p>(Using 16 right-angled triangles)</p> <p>(Angle at O =) $360 / 16$ = 22.5(°)</p> <p>(OÂB =) $180 - 90 - 22.5$ = 67.5(°)</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>FT 'their 22.5'.</p>
<p>Organisation and Communication.</p> <p>Accuracy of writing.</p>	<p>OC1</p> <p>W1</p>	<p>For OC1, candidates will be expected to:</p> <ul style="list-style-type: none"> • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means <p>For W1, candidates will be expected to:</p> <ul style="list-style-type: none"> • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc

<p>3.</p> <p>(Angle AÔB or exterior angle =) $\frac{360(^{\circ})}{8}$ $= 45(^{\circ})$</p> <p>(OÂB =) $\frac{180 - 45}{2}$ $= 67.5(^{\circ})$</p>	<p>M1 A1 M1 A1</p>	<p>Answers/working may be seen on diagram.</p> <p>Sight of 45 (even e.g. OÂB = 45) gains M1A1.</p> <p>FT 'their 45' (but not 60°).</p>
<p>3. <u>Alternative method 1</u> (Sum of interior angles =) $(8 - 2) \times 180^{\circ}$ or equivalent $= 1080(^{\circ})$</p> <p>(OÂB =) $\frac{1}{2} \times (1080 \div 8)$ $= 67.5(^{\circ})$</p>	<p>M1 A1 M1 A1</p>	<p>(Interior angle =) $135(^{\circ})$ implies M1A1</p> <p>FT 'their interior angle sum' ($\neq 1440$)</p>
<p>3. <u>Alternative method 2</u> (Using 16 right-angled triangles) (Angle at O =) $360 / 16$ $= 22.5(^{\circ})$</p> <p>(OÂB =) $180 - 90 - 22.5$ $= 67.5(^{\circ})$</p>	<p>M1 A1 M1 A1</p>	<p>FT 'their 22.5'.</p>
<p>Organisation and Communication.</p> <p>Accuracy of writing.</p>	<p>OC1 W1</p>	<p>For OC1, candidates will be expected to:</p> <ul style="list-style-type: none"> • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means <p>For W1, candidates will be expected to:</p> <ul style="list-style-type: none"> • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc

WJEC GCSE MATHEMATICS
AUTUMN 2019 MARK SCHEME

GCSE MATHEMATICS Unit 1: Higher Tier	Mark	Comments
1.(a) (Number of sides =) $\frac{360}{36}$ $= 10$	M1 A1	
1.(b) $(180 - 36) \times 10$ or equivalent $= 1440(^{\circ})$	M1 A1	F.T. 'their number of sides' if >2.
<u>Alternative method.</u> $(10 - 2) \times 180$ or equivalent $= 1440(^{\circ})$	M1 A1	F.T. 'their number of sides' if >2.
2.(a) Reflection in (the line) $x = -2$	B2	B1 for 'reflection' or 'reflected'. B1 for sight of ' $x = -2$ ' or equivalent e.g. $x + 2 = 0$ (written , not simply drawn).
2.(b) (i) Correct translation.	B2	B1 for translation '5 right'. B1 for translation '6 down'. SC1 for 2 correct vertices.
2.(b) (ii) $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$	B1	B0 for -5 (missing brackets) OR $\begin{pmatrix} -5,6 \\ 6 \end{pmatrix}$ B0 for $-\frac{5}{6}$ with or without brackets. No FT from part (b)(i).
3.(a) -5 -2 3	B2	B1 for two correct (in correct position) OR B1 for -6, -5, -2
3.(b) $6n - 1$ or equivalent	B2	B1 for sight of 6n. Mark final answer.
4.(a) 3^4	B1	
4.(b) 40·84101	B1	
4.(c) 3·6	B1	
5.(a) Correct construction of $\angle PQR = 60^{\circ}$. Correct triangle PQR drawn.	M1 A1	Correct construction arcs must be seen and angle drawn. PQ = 7 cm (± 2 mm) and triangle drawn. Allow non labelling of point P (unless position contradicted). Ignore extension of line QP if correct triangle drawn.
5.(b) Arc, <u>centre A</u> , intersecting LM at two points AND Intersecting arcs (equal radii) using the above two points as centres. Line drawn	M1 A1	[Note to markers: These arcs may be identified by the fact that they will 'cross the line LM at an acute angle'. Arcs 'crossing the line at 90° ' is evidence of an inappropriate method.]
<u>Alternative method.</u> Using the properties of a kite. Intersecting arcs whose centres are any two points on the line LM and respective radii equal in length to the distance from the points to the point A. Line drawn.	M1 A1	[Note to markers: The arcs will always intersect at a point that is a 'reflection of point A' in the line LM.]

4.(a)	an expression	B1	
4.(b)	an equation	B1	
5.	(Mid-points) 2·5, (7·5), 12·5 and 17·5. $8 \times 2·5 + (0 \times 7·5) + 7 \times 12·5 + 5 \times 17·5$ $(20 + 0 + 87·5 + 87·5 = 195)$ $\div 20$ $= 9.75$	B1 M1 m1 A1	Allow for sight of mid-points. F.T. 'their mid-points' including bounds, provided they fall within the classes (including lower and upper bounds and used consistently). C.A.O.
6.	(x =) $\frac{360}{15}$ or $180 - \frac{(15-2) \times 180}{15}$ or equivalent $= 24(^{\circ})$ (BR =) $8 \times \cos 24$ or $8 \times \sin (90 - 24)$ $= 7·3(0...)(cm)$ or $7·31(cm)$	M1 A1 M2 A1	May be seen in parts. FT 'their stated value for x' (x < 90°) M1 for $\frac{BR}{8} = \cos 24$ or $\frac{BR}{8} = \sin (90 - 24)$ Accept equivalent of using sin rule (as sin 90 = 1). <u>Alternative method to find BR</u> A correct and complete method (using two trigonometric relationships and possibly Pythagoras's theorem) M2 $BR = 7·3(0...)(cm)$ or $7·31(cm)$ A1
7.	$2·656 \times 10^6$	B2	B1 for a correct value but not in standard form. Mark final answer. B1 for sight of 2 656 000. SC1 for $2·66 \times 10^6$ or $2·7 \times 10^6$ or $2·6 \times 10^6$ or $2·65 \times 10^6$
8.	Sight of 24·5 AND 15·5 OR Sight of 23·5 AND 14·5 $2(24·5 + 15·5) - 2(23·5 + 14·5)$ or equivalent $= 4(cm)$	B1 M1 A1	Sight of (Greatest =) 80 <u>OR</u> (Least =) 76 implies B1 FT only for upper bounds of 24·4 AND 15·4 or 24·49 AND 15·49 (lower bounds must be 23·5 AND 14·5 else M0) CAO If M0, award B1 and an SC1 for sight of (Greatest =) 80 <u>AND</u> (Least =) 76
	<u>Alternative method.</u> Difference between least and greatest length for each side = 1(cm) 4×1 $= 4(cm)$	B1 M1 A1	 FT only for differences of 0·9 or 0·99 CAO
9.	Method to eliminate variable e.g. equal coefficients with <u>appropriate</u> addition or subtraction. First variable found, x = 4 or y = -1. Substitute to find the 2 nd variable. Second variable found	M1 A1 m1 A1	No marks for trial and improvement. Allow 1 error in one term, not the term with equal coefficients. C.A.O. F.T. their '1 st variable'. Award no marks for unsupported correct answers.

<p>10.(a)(i) Correct reason given. e.g. 'An angle at the circumference subtended by a diameter is a right angle'. 'line AC is a diameter'</p>	<p>E1</p>	<p>Accept any correct unambiguous wording. The key word is 'diameter'. Allow eg 'angle in a semicircle is 90°', 'line AC goes through the centre', 'opposite a diameter' Do not accept 'because it's a right angle'.</p>
<p>10.(a)(ii) $\tan x = \frac{7.5}{4.7}$ $x = \tan^{-1}(7.5 / 4.7)$ or $\tan^{-1} 1.6$ or $\tan^{-1} 1.59(\dots)$ $= 57.9(\dots)^\circ$ or $57.8(\dots)^\circ$ or 58°</p>	<p>M1 m1 A1</p>	<p>Implies M1. C.A.O. <u>Alternative method to find x</u> A correct and complete method (using Pythagoras's theorem and a trigonometric relationship). M2 $x = 57.9(\dots)^\circ$ or $57.8(\dots)^\circ$ or 58° CAO A1</p>
<p>10.(b) $(y =) 58^\circ$ Correct circle theorem given. e.g. 'angles (at the circumference) subtended by the same chord (or arc) are equal', 'angles in the same segment (are equal)'.</p>	<p>B1 E1</p>	<p><u>Strict</u> FT of 'their x'. Accept any correct unambiguous wording. Allow eg 'angles on the same chord (are equal)' Do not accept e.g. 'they are equal' on its own.</p>
<p>11. 2^{400}</p>	<p>B2</p>	<p>B1 for $(2^{100})^4$ OR sight of 2^4</p>
<p>12. (Height =) $\frac{3 \times 5533}{825}$ OR $\frac{5533}{\frac{1}{3} \times 825}$ $= 20.1(2 \text{ cm})$ ----- <i>Alternative method (finding the radius first):</i> Use $A = \pi r^2$ to evaluate r or r^2. (Height =) $\frac{3 \times 5533}{\pi \times 16.2(05\dots)^2}$ OR $\frac{5533}{\frac{1}{3} \times \pi \times 16.2(05\dots)^2}$ OR $\frac{3 \times 5533}{\pi \times 262.6(\dots)}$ OR $\frac{5533}{\frac{1}{3} \times \pi \times 262.6(\dots)}$ $= 20.1(2\dots \text{ cm})$</p>	<p>M2 A1 M2 A1</p>	<p>M1 for $5533 = 1/3 \times \text{height} \times 825$ or equivalent. Allow an answer of 20(cm) from correct working. Allow use of $\pi = 3.14, 3.142$ or $3.14(59\dots)$. When using the π button on the calculator, $r = 16.2(05\dots)$ OR $r^2 = 262.6(\dots)$. There will be no FT for any radius other than $r = 16\text{cm}$, from working seen. M1 for $5533 = 1/3 \times \text{height} \times \pi \times 16.2(05\dots)^2$ or equivalent. Allow M1 for use of $r = 16$ (cm) A1 Allow an answer of 20(cm) from correct working. Accept an answer in the range 20.10 to 20.143(cm) <u>FT base radius = 16 cm</u>: Allow an answer in the range 20.6(cm) to 20.65(cm) OR 21(cm) from correct working.</p>
<p>13.(a) $(2x + 9)(2x - 9)$</p>	<p>B2</p>	<p>B1 for $(2x \dots 9)(2x \dots 9)$</p>
<p>13.(b) $(7x - 4)(x + 2)$</p>	<p>B2</p>	<p>B1 for $(7x \dots 4)(x \dots 2)$</p>
<p>13.(c) $(x + 2)^2(x + 7)$ OR $(x + 2)(x + 2)(x + 7)$</p>	<p>B2</p>	<p>B1 for $(x + 2)^2(x + 2 + 5)$ OR $(x + 2)[(x + 2)^2 + 5(x + 2)]$ OR $(x + 7)(x^2 + 4x + 4)$ OR $(x + 2)(x^2 + 9x + 14)$. Allow B1 for $(x + 2)^2(x + k)$ where $k \neq 0, 2$ or 7.</p>
<p>14. $-\frac{1}{2}$ or equivalent</p>	<p>B2</p>	<p>B1 for -2 or $\frac{1}{2}$.</p>
<p>15. $2n^2 + 1$ or equivalent $= 20001$</p>	<p>B2 B1</p>	<p>B1 for sight of $2n^2$ OR for sight of consistent 2nd difference 4. FT from their $2n^2 \pm k$, where $k \neq 0$ OR from their $2n^2 \pm an$, where $a \neq 0$ OR from their $2n^2 \pm an \pm k$, where $a \neq 0, k \neq 0$. An unsupported answer of 20001 gains all 3 marks. If no marks, award SC1 for an unsupported answer of 20000.</p>

<p>4. $5x - 17 + 2x + 9 + x + 20 = 180$ $8x = 168$ $x = 21$</p> <p>Substituting $x = 21$ into at least one expression. $(5x - 17 =) 88(^{\circ})$ $(2x + 9 =) 51(^{\circ})$ $(x + 20 =) 41(^{\circ})$ (So not a right-angled triangle)</p>	<p>M1 A1 A1</p> <p>M1 A1</p>	<p>F.T. from $ax = b$. Allow all 3 marks for $x = 21$.</p> <p>If $x \neq 21$ FT 'their <u>derived</u> value of x'. F.T. for this A1 if $x \geq 4$. Any two of these expressions correctly evaluated with no incorrect evaluation, provided the sum of the two found is > 90. (statement not required). <i>Note</i> If further work indicates that the values found are not treated as angles (e.g. showing $51^2 + 41^2 \neq 88^2$) then award final MOA0.</p>
<p><u>Alternative method</u> $5x - 17 = 90$ OR $2x + 9 = 90$ OR $x + 20 = 90$ $x = 21.4$ AND $x = 40.5$ AND $x = 70$</p> <p>Then verifying: If $x = 21.4$: $5x - 17 + 2x + 9 + x + 20 = 183.2$ AND If $x = 40.5$: $5x - 17 + 2x + 9 + x + 20 = 336$ AND If $x = 70$: $5x - 17 + 2x + 9 + x + 20 = 572$ (So not a right-angled triangle)</p>	<p>M1 A2</p> <p>A2</p>	<p>Award A1 for any one of these: $x = 21.4$ OR $x = 40.5$ OR $x = 70$</p> <p>Award A1 for any one of these: If $x = 21.4$: $5x - 17 + 2x + 9 + x + 20 = 183.2$ OR If $x = 40.5$: $5x - 17 + 2x + 9 + x + 20 = 336$ OR If $x = 70$: $5x - 17 + 2x + 9 + x + 20 = 572$</p>
<p>5. $(AB =) 13.8 \times \cos 41$ OR $13.8 \times \sin 49$ $= 10.4(\dots)$ (cm)</p>	<p>M2 A1</p>	<p>M1 for $\cos 41 = \frac{AB}{13.8}$ OR $\sin 49 = \frac{AB}{13.8}$</p>
<p><u>Alternative method:</u> Correct use of 'two-step' method. $(AB) = 10.4(\dots)$(cm)</p>	<p>M2 A1</p>	<p>A partial trigonometric method is M0. Accept an answer that rounds to 10.4(cm)</p>
<p>6.a(i) $x^3 + 7x$</p>	<p>B2</p>	<p>B1 for sight of $x^3 + \dots + 7x$. Do not accept $x \times x \times x + x \times 7$ etc. Mark final answer.</p>
<p>6(a)(ii) $3x^2 - 4x - 15x + 20$ $3x^2 - 19x + 20$</p>	<p>B1 B1</p>	<p>Must be an expression. FT from an error in only one term (out of 4) only if of the form $ax^2 \pm bx \pm cx \pm d$.</p>
<p>6.(b)(i) $5n - 27 < n$ OR $n > 5n - 27$</p>	<p>B2</p>	<p>Allow B2 for an equivalent correct inequality. e.g. $4n - 27 < 0$. B1 if \leq or \geq used in a 'correct' inequality. OR B1 for $5n - 27 > n$ OR $n < 5n - 27$</p>
<p>6.(b)(ii) $4n < 27$ $n < \frac{27}{4}$ (Greatest number of clocks =) 6</p>	<p>B1 B1 B1</p>	<p>FT 'their inequality' if of equivalent difficulty. FT only from an $< b$ OR an $\leq b$ OR an $> b$ OR an $\geq b$. FT only from $n < c$ where c is positive OR $n \leq d$ where d is positive and not an integer An answer of 6 gains all 3 marks.</p>
<p>7.(a) $N \div 1.04$</p>	<p>B1</p>	
<p>7.(b) 248-832</p>	<p>B2</p>	<p>Allow B2 if 248-832 <u>seen</u> then corrected to a <u>final answer</u> of 249 or 248-8(..). If B2 not awarded, B1 for <u>final answer</u> of 249 or 248-832 i.e. 248-832 not seen.</p> <p>B1 for sight of 100×1.2^5 or for equivalent calculations, e.g. 144×1.2^3 or $100 \times 1.2 \times 1.2 \times 1.2 \times 1.2 \times 1.2$ (may be seen in stages) B1 for a final answer of 298-5984.</p>

Unit 1: Higher Tier	Mark	Comments
<p>1(a)(i) Correct statement of Pythagoras' theorem</p> <ul style="list-style-type: none"> • $(\text{Height}^2 =) 50^2 - (60 \div 2)^2$ • $(\text{Height}^2 =) 50^2 - 30^2$ • $50^2 = \text{height}^2 + (60 \div 2)^2$ • $50^2 = \text{height}^2 + 30^2$ <p>Correct stage of evaluation</p> <ul style="list-style-type: none"> • $(\text{Height}^2 =) 2500 - 900$ • $(\text{Height}^2 =) 1600$ • sight of $\sqrt{1600}$ • $(\text{Height} =) \sqrt{(50^2 - 30^2)}$ <p style="margin-left: 40px;"> $(\text{Height} =) \sqrt{1600}$ $(\text{Height} =) 40 \text{ mm}$ or $\text{Height}^2 = 1600$ $(\text{Height} =) 40 \text{ mm}$ or $1600 = 40^2$ $(\text{Height} =) 40 \text{ mm}$ </p>	<p>M1</p> <p>A1</p> <p>A1</p>	<p><u>Clear indication that all measurements have been converted to 3cm, 5cm, 4cm may be awarded all marks</u></p> <p>Working must be seen Allow M1 A1 for a slip in the initial notation then corrected at this evaluation stage</p> <p>Mark final answer A0 for an incorrect statement, e.g. $\sqrt{1600} = 40^2$</p>
<p>1(a)(i) <u>Alternative method 1</u> Identifies the relationship '3, 4, 5' and relates to the given (right-angled) triangle, e.g. sight of</p> <ul style="list-style-type: none"> • 3, 4, 5 and 30(mm), 40(mm), 50(mm) • 3cm, 4cm, 5cm • 3, 4, 5 and 'x 10' • 30, 40, 50 and '+ 10' <p>AND a statement or conclusion, e.g.</p> <ul style="list-style-type: none"> • Pythagorean triple • Right-angled triangle • 3, 4, 5 triangle means it would be 30, 40, 50 triangle 	<p>B3</p>	<p>For B3 there must be an accompanying statement or conclusion</p> <p>B2 for identifying the relationship '3, 4, 5' and relates to the given(right-angled) triangle</p> <ul style="list-style-type: none"> • without a conclusion or statement, or • with an incorrect conclusion or statement <p>B1 for sight of any one of the following:</p> <ul style="list-style-type: none"> • '3, 4, 5' • 30 (mm) and 40 (mm) appropriately indicated on the diagram • A right-angled triangle drawn (with or without 90° indicated) appropriately labelled 30 (mm), 40 (mm) and 50 (mm)
<p>1(a)(i) <u>Alternative method 2</u> Assuming height as 40mm with use of 50mm or 30mm within a correct statement of Pythagoras' Theorem, e.g.</p> <ul style="list-style-type: none"> • $((\frac{1}{2} \text{ base})^2 =) 50^2 - 40^2$ • $50^2 = 40^2 + x^2$ • $((\text{hypotenuse})^2 =) 40^2 + 30^2$ <p>Correct stage of evaluation, e.g.</p> <ul style="list-style-type: none"> • $((\frac{1}{2} \text{ base})^2 = 50^2 - 40^2 =) 900$ • $(\frac{1}{2} \text{ base} =) \sqrt{900}$ • $((\text{hypotenuse})^2 = 40^2 + 30^2 =) 2500$ • $(\text{hypotenuse} =) (\frac{1}{2} \text{ base} =) \sqrt{2500}$ <p>Appropriate full evaluation, e.g.</p> <ul style="list-style-type: none"> • $(\frac{1}{2} \text{ base} =) 30 \text{ (mm)}$ • $(\text{hypotenuse} =) 50 \text{ (mm)}$ 	<p>M1</p> <p>A1</p> <p>A1</p>	<p><u>Clear indication that all measurements have been converted to 3cm, 5cm, 4cm may be awarded all marks</u></p> <p>Working must be seen</p> <p>Mark final answer</p>
<p>1(a)(ii) (Volume) $\frac{1}{2} \times 60 \times 40 \times 20$ or equivalent</p> <p style="margin-left: 100px;">$24000 \text{ (mm}^3\text{)} \quad (> 20000 \text{ mm}^3)$</p>	<p>M2</p> <p>A1</p>	<p>M1 for sight of area of X-section possibly in stages, $\frac{1}{2} \times 60 \times 40$ or $\frac{1}{2} \times 30 \times 40 + \frac{1}{2} \times 30 \times 40$ (= 1200 mm²)</p> <p>CAO</p>

<p>1(b) Sight of or implication that: $5 \times \text{number of people} + 105 =$ $207 + 3 \times \text{number of people}$ or $5x + 105 = 207 + 3x$</p> <p>$(5 - 3) \times \text{number of people} = 207 - 105$</p> <p>or number of people = $\frac{207-105}{5-3}$</p> <p>or $5x - 3x = 207 - 105$ or $2x = 102$</p> <p style="text-align: right;">51 (people)</p>	<p>M1 Implication includes attempt to balance costing for the same number of people ≥ 3 at each venue, e.g.</p> <ul style="list-style-type: none"> • (10 people) $5 \times 10 + 105$ with $207 + 3 \times 10$ • (110, 115,) 120 with (210, 213,) 216 <p>m1 Includes correctly evaluated trial to attempt to balance costing for the same number of people at each venue provided</p> <p>‘their trial for $30 \leq \text{the number of people} \leq 70$’, e.g. correct costing for both venues for 40 people as (FH) (£)305 and (ML) (£)327</p> <p>From M1, allow 1 slip in the rearrangement of ‘their equation’ provided ‘their equation’ is then simplified to $ax = b$, where $a \neq 0$ and $b \neq 0$</p> <p>Sight of cost (£)360 for each venue implies M1 m1</p> <p>A1 CAO</p> <p>If no marks, award SC1 for finding the number of (whole) people for the same cost at each venue, provided the cost is $> (\pounds) 220$, e.g.</p>
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Unit 2: Higher Tier	Mark	Comments									
<p>20. Complete strategy to calculate x, e.g. first an attempt to use the cosine rule to calculate BD and then an attempt to use the cosine rule by rearrangement to calculate x using BD.</p> <p>(BD² =) $13^2 + 17^2 - 2 \times 13 \times 17 \times \cos 43$ (BD² =) 134.7(...) OR (BD =) 11.6(...cm)</p> <p>$\cos x = \frac{11^2 + 19^2 - 11.6(\dots)^2}{2 \times 11 \times 19}$</p> <p>($x =$) 33.8(...°)</p>	<p>S1</p> <p>M1</p> <p>A1</p> <p>M2</p> <p>A1</p>	<p>Stating the formulae is insufficient. Both stages must be seen. If many attempts are offered for both stages and they are not clearly identified as being used to evaluate BD and then x, then mark final attempt.</p> <p>Allow an alternative complete correct method for M1.</p> <table border="1"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>BD²</td> <td>212.639...</td> <td>113.049....</td> </tr> <tr> <td>BD</td> <td>14.582...</td> <td>10.632....</td> </tr> </tbody> </table> <p>FT 'their stated or derived BD', provided $8 < \text{'their BD'} < 30$ M1 for $11.6(\dots)^2 = 11^2 + 19^2 - 2 \times 11 \times 19 \times \cos x$ Allow an alternative complete correct method for M2.</p> <p>Accept an answer which rounds to 33.8(°) Allow an answer of 34(°) from correct working. An answer of 36(.039...) from BD=12 is: S1M1A0M2A1.</p> <p><u>Note:</u> The first A1 is only withheld if 12 (rounded from 11.6) is used in the subsequent cosine rule to find the angle x AND only if the work is worthy of any further marks.</p>		Radians	Gradians	BD ²	212.639...	113.049....	BD	14.582...	10.632....
	Radians	Gradians									
BD ²	212.639...	113.049....									
BD	14.582...	10.632....									

<p>4. (Number of sides =) $\frac{360}{180 - 171}$</p> <p style="text-align: right;">= 40 (sides)</p>	<p>M2</p> <p>A1</p>	<p>Award M1 for sight of one of the following:</p> <ul style="list-style-type: none"> • 180 – 171 • an appropriate 9. <p>CAO.</p> <p>Allow an embedded answer but penalise -1 if contradicted by number of sides \neq 40.</p>
<p>4. <u>Alternative method</u></p> <p>$\frac{(n-2) \times 180}{n} = 171$ or $180n - 360 = 171n$ or equivalent</p> <p>$9n = 360$ or equivalent</p> <p>$n = 40$ (sides)</p>	<p>M1</p> <p>m1</p> <p>A1</p>	<p>Brackets may be implied by later correct work.</p> <p>CAO.</p> <p>Allow an embedded answer but penalise -1 if contradicted by number of sides \neq 40.</p>

<p>20.(a) $(\cos x =) (5^2 + 11^2 - 7^2) / (2 \times 5 \times 11)$ $(= 97/110 \text{ OR } 0.8818\dots)$</p> <p>$(x =) 28.1(\dots^\circ)$</p>	<p>M2</p> <p>A1</p>	<p>An incorrect trigonometric ratio explicitly stated in the solution is M0, e.g., $\sin x = (5^2 + 11^2 - 7^2) / (2 \times 5 \times 11)$ M1 for $7^2 = 5^2 + 11^2 - 2 \times 5 \times 11 \times \cos x$</p> <p>Allow an answer of 28° from correct working.</p> <table border="1" data-bbox="852 344 1157 405"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>x</td> <td>0.49...</td> <td>31.26...</td> </tr> </tbody> </table> <p>If no marks, award either:</p> <ul style="list-style-type: none"> SC2 for an answer of $78.4(6\dots^\circ)$ OR 78.5° from working using $CG = 6\text{cm}$ SC1 for sight of $(\cos x =) (5^2 + 6^2 - 7^2) / (2 \times 5 \times 6)$ 		Radians	Gradians	x	0.49...	31.26...						
	Radians	Gradians												
x	0.49...	31.26...												
<p><u>Alternative method by first calculating $\hat{G}\hat{C}\hat{H}$</u> A correct and complete method first using the cosine rule to calculate $\hat{G}\hat{C}\hat{H}$ and then using the sine rule to calculate x.</p> <p>$(\cos \hat{G}\hat{C}\hat{H} =) (7^2 + 11^2 - 5^2) / (2 \times 7 \times 11)$ $(= 145/154 \text{ OR } 0.9415\dots)$ $(\hat{G}\hat{C}\hat{H} =) 19.6(\dots^\circ)$</p> <p>$(\sin x =) 7 \times \sin(\hat{G}\hat{C}\hat{H}) / 5$ $(= 0.4715\dots)$ $(x =) 28.1(\dots^\circ)$</p>	<p>M2</p> <p>A1</p>	<p>A partial method is M0.</p> <table border="1" data-bbox="852 736 1278 797"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>$\hat{G}\hat{C}\hat{H}$</td> <td>0.343...</td> <td>21.872...</td> </tr> </tbody> </table> <table border="1" data-bbox="852 851 1262 911"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>x</td> <td>0.49...</td> <td>31.26...</td> </tr> </tbody> </table> <p>If no marks, award</p> <ul style="list-style-type: none"> SC2 for an answer of $78.4(6\dots^\circ)$ OR 78.5° from working using $CG = 6\text{cm}$ SC1 for a complete alternative method using length $CG = 6\text{cm}$ 		Radians	Gradians	$\hat{G}\hat{C}\hat{H}$	0.343...	21.872...		Radians	Gradians	x	0.49...	31.26...
	Radians	Gradians												
$\hat{G}\hat{C}\hat{H}$	0.343...	21.872...												
	Radians	Gradians												
x	0.49...	31.26...												
<p><u>Alternative method by first calculating $\hat{C}\hat{H}\hat{G}$</u> A correct and complete method first using the cosine rule to calculate $\hat{C}\hat{H}\hat{G}$ and then using the sine rule to calculate x.</p> <p>$(\cos \hat{C}\hat{H}\hat{G} =) (5^2 + 7^2 - 11^2) / (2 \times 5 \times 7)$ $(= -47/70 \text{ OR } -0.67(14\dots))$ $(\hat{C}\hat{H}\hat{G} =) 132.1(\dots^\circ)$</p> <p>$(\sin x =) 7 \times \sin(\hat{C}\hat{H}\hat{G}) / 11$ $(= 0.4715\dots)$ $(x =) 28.1(\dots^\circ)$</p>	<p>M2</p> <p>A1</p>	<p>A partial method is M0.</p> <table border="1" data-bbox="852 1267 1278 1328"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>$\hat{C}\hat{H}\hat{G}$</td> <td>2.306...</td> <td>146.863...</td> </tr> </tbody> </table> <table border="1" data-bbox="852 1404 1262 1464"> <thead> <tr> <th></th> <th>Radians</th> <th>Gradians</th> </tr> </thead> <tbody> <tr> <td>x</td> <td>0.49...</td> <td>31.26...</td> </tr> </tbody> </table> <p>If no marks, award</p> <ul style="list-style-type: none"> SC2 for an answer of $78.4(6\dots^\circ)$ OR 78.5° from working using $CG = 6\text{cm}$ SC1 for a complete alternative method using length $CG = 6\text{cm}$ 		Radians	Gradians	$\hat{C}\hat{H}\hat{G}$	2.306...	146.863...		Radians	Gradians	x	0.49...	31.26...
	Radians	Gradians												
$\hat{C}\hat{H}\hat{G}$	2.306...	146.863...												
	Radians	Gradians												
x	0.49...	31.26...												

<p>20.(b)</p> <p>(Area of triangle =) $\frac{1}{2} \times 5 \times 11 \times \sin[28 \cdot 1(\dots)]$</p> <p style="text-align: center;">$= 12 \cdot 9(\dots \text{cm}^2)$ or $13(\text{cm}^2)$</p> <p>(Major sector area =) $(360 - 28 \cdot 1(\dots)) / 360 \times \pi \times 5^2$ OR (Area of circle AND Minor sector area =) $\pi \times 5^2$ AND $28 \cdot 1 / 360 \times \pi \times 5^2$</p> <p>$72 \cdot 36(\text{cm}^2)$ to $72 \cdot 42(\text{cm}^2)$ OR $78 \cdot 5(\text{cm}^2)$ to $78 \cdot 6(\text{cm}^2)$ AND $6 \cdot 1(\dots \text{cm}^2)$</p> <p>[Total area = $12 \cdot 9(\dots) + 72 \cdot 4(\dots) =$] OR [Total area = $12 \cdot 9(\dots) + 78 \cdot 5(\dots) - 6 \cdot 1(\dots) =$] Answer in the range $85 \cdot 26$ to $85 \cdot 5(\text{cm}^2)$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>B1</p>	<p>FT 'their derived x'. If $CG=6\text{cm}$ is consistently used in part (a), allow a FT with length $CG=6\text{cm}$.</p> <p>FT 'their stated or derived x'.</p> <p>FT 'their derived $12 \cdot 9(\dots \text{cm}^2)$' and 'their derived $72 \cdot 4(\dots \text{cm}^2)$' OR 'their derived $12 \cdot 9(\dots \text{cm}^2)$' and 'their derived $78 \cdot 5(\dots \text{cm}^2)$' AND 'their derived $6 \cdot 1(\dots \text{cm}^2)$', provided previous M1M1 awarded.</p>
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3. Premature Approximation
A candidate who approximates prematurely and then proceeds correctly to a final answer loses 1 mark as directed by the Principal Examiner.

UNIT 1: NON-CALCULATOR, HIGHER TIER

GCSE Mathematics Unit 1 · Higher Tier	Mark	Comments
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End of solutions