REVISE
.wales

2.17 — Circle theorems

Mark schemes for the 2.17 question pack

Spec 3.4.4, 3.4.5 — Unit 2

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 18 questions in the corresponding revise.wales question pack (68 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes.

8.			*Angles may be shown on the diagram.*
BDC = 28(°)	✓	B1	Allow D = 28.
BCD = 90(°)	✓	B1	May be implied in later work. (Allow this B1 for any use of a right-angle triangle trigonometric relationship for triangle BCD)
BD = $\frac{4{\cdot}7}{\text{Sin } 28}$	✓✓	M2	This implies previous B mark. FT 'their BDC'. M1 for $\frac{4{\cdot}7}{BD}$ = sin 28.
BD = 10(·…)(cm)	✓	A1	
			Alternative method
			COB = 56(°) *B1*
			OB = $\frac{2{\cdot}35}{\sin 28}$ *M2*
			(M1 for $\frac{2{\cdot}35}{OB}$ *= sin 28)*
			OB = 5(·…)(cm) *A1*
			BD = 10(·..)(cm) *A1*
Organisation and Communication	✓	OC1	For OC1, candidates will be expected to: • 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: • 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

13. RPQ = x	✓	B1	Check diagram.
(Reason =) Alternate segment (theorem)	✓	E1	Dependent on B1.
PQR = 90 – x	✓	B1	F.T. 90 – 'their RPQ'.
(Reason =) Angle in a semicircle is 90° (and angles in a triangle add up to 180°)	✓	E1	
			Accept correct alternative methods e.g.
			(i) PRA = 90 – x B1
			(Reason =) Angle in a semicircle is 90°
			(and angles on a straight line add up to 180°) E1
			PQR =90 –x FT PQR ='their PRA' B1
			(Reason =) Alternate segment (theorem) E1
			(ii) ORQ = 90 – x B1
			'radius and tangent meet at 90°' E1
			PQR = 90 – x B1
			Isosceles triangle E1

			= 28 C.A.O. B1
12.			*All 'E1' marks are dependent on associated 'B1' marks.*
ACB = 74(°)	✓	B1	By applying the alternate segment theorem. Check diagram.
Alternate segment (theorem)	✓	E1	
CAB (= 180 – 53 – 74) = 53(°)	✓	B1	FT from B1 E0, but not from B0 E0.
(Sum of) angles in a triangle (equals 180°)	✓	E1	
Concluding statement e.g. 'triangle ABC is isosceles as it has two equal angles.'	✓	E1	Must justify <u>why</u> the triangle is isosceles i.e. stating (only) 'triangle is isosceles' at this stage is insufficient.
			<u>Alternative method</u> CAX = 53(°) (by applying the alternate segment theorem) B1 Alternate segment (theorem) E1 CAB (= 180 – 53 – 74) = 53(°) B1 (Sum of) angles on a straight line (equals 180°) E1 Concluding statement. E1
			Be aware of equivalent methods (e.g. drawing a radius to the centre O etc.). These methods must lead to a proof before any marks are awarded

4.		*Note: Both E1 marks are awarded for a suitable/valid attempt at statement (not an implied reason from a calculation).* *Both E marks are dependent on attempt at related work.* *Look for angles seen on the diagram.* *For this question allow angles shown in diagram to take precedence over answer space.*
(RQP or QRP =) $\frac{180-30}{2}$	M1	
$= 75(°)$	A1	
Tangents (from external point) are equal (in length) OR a geometric consequence based on this fact e.g. 'QPR is isosceles' or 'PQOR is a kite'.	E1	Accept any suitable attempt at a valid statement. Allow PQ = PR. Also allow unambiguous indication on the diagram. 'Angles in a triangle' not sufficient.
(OQR = 90 – 75 =) 15(°)	B1	F.T. 'their derived 75' provided acute.
Tangent and radius (at any point) are perpendicular	E1	Accept any suitable attempt at a valid statement. Also allow unambiguous indication on the diagram.
		Alternative method 1 *(ROQ = 360−90−90−30 =) 150(°) B1* *Tangent and radius (at any point) are perpendicular. E1* *OQR = $\frac{180-150}{2}$ M1* *F.T. 'their derived 150'* *= 15(°) A1* *Radii form an isosceles triangle. E1*
		Alternative method 2 (with line OP drawn) *(POQ or RQP=) 180 −90 – 15 M1* *= 75(°) A1* *Tangents (from external point) are equal (in length) OR a geometric consequence based on this fact e.g. 'QPR is isosceles' or 'PQOR is a kite'. E1* *(OQR = 90 – 75 =) 15(°) B1* *F.T. 'their derived 75' provided acute* *Tangent and radius (at any point) are perpendicular. E1*
		[Note: Do not 'mix and match' marks from alternative methods.]
	OC1	Organisation and Communication. For OC1, candidates will be expected to: • 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
	W1	Accuracy of writing. For W1, candidates will be expected to: • 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

10. For a correct proof: i.e. each angle within the triangle is correctly evaluated as 60° AND with correct reasons. No assumptions can be made at any stage of the proof for the evaluation of any angles.	E1 E1 E1	If any other angle is used within the proof e.g. angle FYH, then a correct reason must again be stated (there is no E1 for this angle as it is working towards one of the angles within the triangle). Award E2 for two angles within the triangle correctly evaluated as 60° AND with correct reasons. Award E1 for one angle within the triangle correctly evaluated as 60° AND with correct reason(s). *Do not accept 'Z' angles for alternate angles. *Examples* *<EFY = 60° AND Alternate Segment Theorem; E1* *<FEY = 60° AND Alternate angles; E1* *(<EYF = 60° AND) angles in a triangle (therefore equilateral) OR* *(<EYF = 60° AND) therefore equilateral E1* *<FEY = 60° AND Alternate angles E1* *<FYH = 60° AND Alternate Segment Theorem* *<FYE = (180°–60°–60°)=60° AND straight line E1* *(<EFY = 60° AND) angles in a triangle (therefore equilateral) OR* *(<EFY = 60° AND) therefore equilateral E1* *<EFY = 60° AND Alternate Segment Theorem E1* *<FYH = 60° AND Alternate angles* *<FYE = (180°–60°–60°)=60° AND straight line E1* *(<FEY = 60° AND) angles in a triangle (therefore equilateral) OR* *(<FEY = 60° AND) therefore equilateral E1* *<EFY = 60° AND Alternate Segment Theorem E1* *<FYE = 60° AND Interior angles E1* *(<FEY = (180°–60°–60°)=60° AND) angles in a triangle (therefore equilateral) OR* *(<FEY = 60° AND) therefore equilateral E1*

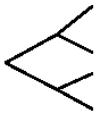
19.(a) $(AE^2 =)\ 8^2 + 11^2 - 2\times8\times11\times\cos31°$ $(AE =)\ 5.8(...\text{cm})$	M1 A2	Award A2 for an answer of 6(cm) from correct working. A1 for $(AE^2 =)\ 34.1(\ldots)$
19.(b) $\sin CAE = \frac{8 \times \sin 31°}{5.8(...)}$ $(CAE =)\ 44.8(\ldots°)$ $(CED =)\ 44.8(\ldots°)$	M2 A1 B1	FT 'their AE' from 19(a). Check the diagram. M1 for $\frac{\sin CAE}{8} = \frac{\sin 31°}{5.8(\ldots)}$ or equivalent Accept answers in the range 44.7° to 45.3°. Strict FT of 'their CAE', provided not 31°. Must be convincing (check the diagram). Accept answers in the range 44.7° to 45.3°.
Alternative method 1 $\cos(CAE) = \frac{11^2+5.8(...)^2-8^2}{2\times11\times5.8(...)}$ *(CAE=) 44.8(…°)* *(CED=) 44.8(…°)*	*M2* *A1* *B1*	FT 'their AE' from 19(a). Check the diagram. *M1 for* $8^2 = 11^2 + 5.8(...)^2 - 2\times11\times5.8(...)\times\cos(CAE)$ *Accept answers in the range 44.7° to 45.3°.* *Strict FT of 'their CAE', provided not 31°. Must be convincing (check the diagram).* *Accept answers in the range 44.7° to 45.3°.*
Alternative method 2 (Initially evaluating CEA) *sin CEA* $= \frac{11 \times \sin 31°}{5.8(...)}$ *OR* *cos CEA* $= \frac{5.8(...)^2 + 8^2 - 11^2}{2\times5.8(...)\times8}$ *(CEA=) 104.1(…) [or 75.8(…) from sine rule]* *(CAE=) 180−31−75.8(…)= 73.2(…) or 180−31−104.1(…)= 44.8(…)* *(CED=) 44.8(…) or 73.2(…)*	*M2* *A1* *B1*	FT 'their AE' from 19(a). Check the diagram. *M1 for* $\frac{\sin CEA}{11} = \frac{\sin 31°}{5.8(...)}$ *or equivalent OR* *M1 for* $11^2 = 5.8(...)^2 + 8^2 - 2\times5.8(...)2\times8\times\cos CEA$ *Accept answers in the range 103.7 to 104.3 or 75.7 to 77.7 OR 78.* *Strict FT of 'their CAE', provided not 31°. Must be convincing (check the diagram).* *Accept answers in the range 44.7° to 45.3°.*

14. (Total area =) (2 ×) $\pi \times 30^2 \times 20 / 360$ or equivalent (= 100 π)	M1	Accept use of 3·14 for π.
$100\pi = \pi r^2$	m1	Equating 'their derived 100π' or equivalent
r = 10 (cm)	A1	CAO

8. One correct evaluation $1 \le x \le 2$ 2 correct evaluations $1{\cdot}55 \le x \le 1{\cdot}75$, one < 0, one > 0. 2 correct evaluations $1{\cdot}55 \le x \le 1{\cdot}65$, one < 0, one > 0. $x = 1{\cdot}6$	 B1 B1 M1 A1	*Correct evaluation regarded as enough to identify if 'too high' or 'too low'. If evaluations not seen accept 'too high' or 'too low'.* x $2x^3 + x - 10$ (or check $2x^3 + x = 10$) 1 −7 1·1 −6·238 1·2 −5·344 1·3 −4·306 1·4 −3·112 1·45 − 2·452... 1·5 −1·75 1·55 − 1·002... **1·6 −0·208 1·65 0·634...** **1·7 1·526** 1·75 2·468... 1·8 3·464 (1·62 0·123..) 1·9 5·618 (1·63 0·291..) 2 8 (1·64 0·461..)
9. 85% ≡ 6154 $\frac{6154}{85} \times 100$ OR $\frac{6154}{0{\cdot}85}$ = 7240	B1 M1 A1	Accept any indication. Implies the B1.
10. x = 54(°) Opposite angles (of a) cyclic quad. (add up to 180°). y = 108(°) Angle at the centre (is twice the angle at the circumference).	B1 E1 B1 E1	 Dependent on an attempt at 180 – 126. FT 2 × 'their 54' only if less than 360° Dependent on an attempt at 2 × 'their 54'.
11. Correct enlargement	B2	Otherwise B1 for 2 correct vertices within a triangle. OR for 3 correct vertices in the correct location not joined to form the triangle OR triangle of correct shape, size and orientation in incorrect position OR consistent correct use of an incorrect negative scale factor.
12(a). $(9p+1)(9p-1)$	B2	B1 for $(9p \ldots 1)(9p \ldots 1)$
12(b). $(7t-2)(t+3)$	B2	B1 for $(7t \ldots 2)(t \ldots 3)$
13. Sight of 297.5 AND 6.5 297.5 ÷ 6.5 = 45.77(km/h)	B1 M1 A1	Accept 6 hours 30 minutes, but not 6.3 hours. If other calculations shown, then the relevant calculation must be identified. Award M1 for their values provided 295≤d<300 AND 6<t≤7 (but not 6 hours 30 minutes). CAO. Correct answer must be clearly identified.
14. sin BAD = (2×70)/(8×19) or equivalent (BAD=) 67(.08…°) (Area of sector ABD=) 67(.08…)/360×π×8^2 Accept answers in the range 37.4(cm^2) to 37.5(cm^2) OR 37(cm^2)	M2 A1 M1 A1	Allow any unambiguous indication of angle BAD. M1 for the correct use of the formula when sinBAD is not the subject, for example: 70 = 1/2×8×19×sinBAD. Allow any answer that rounds to 67(°). Accept 292.9(…)/360×π×8^2 OR 293/360×π×8^2 for the area of the major sector ABD. FT their derived or stated value of angle BAD. Accept an answer in the range 163.5(cm^2) to 163.7(cm^2) OR 164(cm^2) for the area of the major sector ABD.

14. *EBC* or *ECB* = (180 – 58) / 2 = 61(°)	 M1 A1	Check diagram. Angles in an isosceles triangle.
BAC = 61(°)	B1	Alternate segment theorem. FT 'their *EBC* or *ECB*'.
ABC (= 180 – 35 – 61) = 84(°)	B1	FT 180 – 35 – 'their *BAC*'.
Alternative method 1 *EBC or ECB = (180 – 58) / 2* *= 61(°)*	 *M1* *A1*	*Check diagram.* *Angles in an isosceles triangle.*
DBA = 35(°)	*B1*	*Alternate segment theorem.*
ABC (= 180 – 35 – 61) = 84(°)	*B1*	*Angles on a straight line* *FT 180 – 'their EBC' – 'their DBA'.*
Alternative method 2 *EBC or ECB = (180 – 58) / 2* *= 61(°)*	 *M1* *A1*	*Check diagram.* *Angles in an isosceles triangle.*
ACF (=180 – 35 – 61) = 84(°)	*B1*	*Angles on a straight line.* *FT 180 – 35 – 'their ECB'.*
ABC = 84(°)	*B1*	*Alternate segment theorem.* *FT 'their ACF'.*
Alternative method 3 *(using isosceles triangle BOC, where O is the centre of the circle)* *BOC = 360 – 90 – 90 – 58* *= 122*	 *M1* *A1*	*Check diagram.* *Angles in kite BOCE*
BAC = 61	*B1*	*Use of angle in the centre* *FT 'their BOC' ÷ 2*
ABC (= 180 – 35 – 61) = 84(°	*B1*	*FT 180 – 35 – 'their BAC'*

11. $I \propto 1/d^2$ OR $I = k/d^2$ or equivalent $5 = k/2^2$ OR $k = 20$ $I = 20/d^2$ OR $I = 20/0{\cdot}5^2$ or equivalent $I = 80$ (lux)	B1 M1 M1 A1	Allow $I \propto k/d^2$ M1 implies B1. F.T. (for possible B0 M2 A0) for use of $I \propto d^2$ or $I \propto 1/d^n$ with $n > 0$ and $n \neq 2$. CAO. Use of $I \propto 1/d$, leading to $I = 10/d$ (or an answer of $I = 20$ (lux)) is awarded B0 FT M2 A0. Use of $I \propto d^2$, leading to $I = 1{\cdot}25\,d^2$ (or an answer of $I = 0{\cdot}3125$ (lux)) is awarded B0 FT M2 A0. Use of $I \propto 1/\sqrt{d}$, leading to $I = 5\sqrt{2}/\sqrt{d}$, (or an answer of $I = 10$ (lux)) is awarded B0 FT M2 A0.
12. $CAD = 2x$ (Reason =) Alternate segment (theorem) $BCD = 180 - 3x$ OR $BCD = 3(60 - x)$ (Reason =) Opposite angles in a cyclic quadrilateral (add up to 180°)	B1 E1 B1 E1	Check diagram. (If this is the only B mark awarded, then $2x$ marked on diagram must be unambiguous. Otherwise, ignore spurious angles on diagram.) Dependent on B1. Allow 'opposite segments'. Do not accept 'alternate angles' or 'opposite angles'. F.T. $180 - (x$ + 'their CAD'). Must be in simplest form. Mark final answer e.g. do not accept $60 - x$ or $x = 60$ If B0, E mark may be awarded provided there is a clear attempt to apply the circle theorem.
13.(a) $48x^2 + 6x - 48x^2 + 12x - 12x + 3$ OR $48x^2 + 6x - 48x^2 + 3$. $6x + 3$	B2 B1	Accept $48x^2 + 6x - (48x^2 - 12x + 12x - 3)$ or $48x^2 + 6x - (48x^2 - 3)$ B1 for $16x^2$ [$- 4x + 4x$] $- 1$ or $48x^2$ [$- 12x + 12x$] $- 3$ or $- 48x^2$ [$+ 12x - 12x$] $+ 3$. OR B1 if one error or incorrect (or extra or missing) term within entire expression. (An incorrect term may be implied e.g. $- 24x$ implies $- 12x - 12x$). Must be convincing. For last B1, do not accept $48x^2 + 6x - (48x^2 - 12x + 12x - 3)$ or $48x^2 + 6x - (48x^2 - 3)$ without further correct work seen before final $6x + 3$. If no work seen in (a), allow marks in (a) for work shown in (b)
13.(b) $-\frac{1}{2}$ or $-\frac{3}{6}$ or -0.5 or equivalent	B1	Mark final answer.

7.(a) Correct framework 	B1	
Suitable labelling on both 1st pair of branches AND on both of at least one pair of 2nd set of branches. e.g. 'Car', 'No car', 'Before 8', 'After 8'. OR Titles of 'Car' and 'Before 8' with branch endings of 'Yes' and 'No'.	B1	Accept any unambiguous wording.
Correct probabilities on first pair of branches 0·7 AND 0·3 (for 'Car', 'No car') OR 0·4 AND 0·6 (for 'Before 8', 'After 8')	B1	Must be consistent with their labelling. Allow this B1 if no headings given, unless contradicted by, or inconsistent with, further labelling.
Correct probabilities on second two sets of branches 0·4 AND 0·6 correctly placed (following 0·7 and 0·3) OR 0·7 AND 0·3 correctly placed (following 0·4 and 0·6)	B1	Allow this B1 if no headings given, unless contradicted by, or inconsistent with, further labelling. Allow this B1 if only shown on one set of branches. Provided not contradicted on the other set of branches.
7.(b) 0·7 × 0·4 or equivalent. = 0·28 or equivalent.	M1 A1	No FT. M1A0 for a final answer of 0·28%. Mark final answer.
8.(a) PA = 12(cm) AND correct theorem given, e.g. 'tangents from an external point are equal in length'.	E1	Must use the words 'tangents' AND 'equal (identical/same)'. Do not accept e.g. 'PA = PB'. (E0) Accept alternative correct answers.
8.(b) PÂO = 90(°) AND correct theorem given, e.g. 'the tangent at any point on a circle is perpendicular to the radius at that point'.	E1	Must use the words 'tangent' AND 'radius (diameter)' Allow e.g. 'radius and tangent meet at 90'. (E1) Do not accept e.g. 'PA and OA meet at 90'. (E0)
8.(c) (Area PAOB =) $2 \times \frac{12 \times 4}{2}$ or equivalent. = 48 (cm^2)	M1 A1	OR FT 'their PA' × 4 + $\frac{12 \times 4}{2}$ M0 for 48 × 2 or 12 × 4 × 2 (= 96) An unsupported final answer of 48 gains both marks. If no marks gained allow SC1 for sight of 24(cm^2) OR a correct evaluation of ('their PA' × 4) / 2.
9.(a) y = 2·5x + 3	B1	
9.(b) y = 3x − 5	B1	
9.(c) Line D	B1	
10.(a) $t \propto 1/g$ OR $t = k/g$ 36 = k / 25 OR k = 900 t = 900 / g	B1 M1 A1	Allow $t \propto k/g$ FT from $y \propto 1/x^n$ with $n \neq 1$, n>0 No FT from direct proportion M1 implies B1. May be seen explicitly in part *(b)*. Do not allow $t \propto 900/g$ for the A mark
10.(b) (900/20 =) 45 (days)	B1	FT 'their formula' only if non-linear.
10.(c) Sight of 900/40 22 (goats)	M1 A1	FT 'their formula' only if non-linear and of equivalent difficulty M1 A0 for an answer of 22·5 or 23 For A1, FT for equivalent difficulty i.e. need to round down an answer with a decimal part of 0.5 or over. Allow use of trial and improvement for M1, provided 22 or 23 seen. A0 for incorrect working e.g. 90/4 given as 22.2, leading to 22.
11. (a) $(\sqrt[3]{m})^2$	B1	
11. (b) $p^{\frac{1}{4}}$	B1	

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'	E1	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'.
10.(a)(ii) $\tan x = \frac{7{\cdot}5}{4{\cdot}7}$ $x = \tan^{-1}(7{\cdot}5 / 4{\cdot}7)$ or $\tan^{-1} 1.6$ or $\tan^{-1} 1.59(\ldots)$ $= 57{\cdot}9(\ldots)(°)$ or $57{\cdot}8(\ldots)(°)$ or $58(°)$	M1 m1 A1	 Implies M1. C.A.O. *Alternative method to find x* *A correct and complete method (using Pythagoras's theorem and a trigonometric relationship). M2* *x = 57·9(…)(°) or 57·8(…)(°) or 58(°) CAO A1*
10.(b) (y =) 58(°) 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)'.	B1 E1	Strict 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.
11. 2^{400}	B2	B1 for $(2^{100})^4$ OR sight of 2^4
12. (Height =) $\frac{3\times5533}{825}$ OR $\frac{5533}{\frac{1}{3}\times825}$ = 20·1(2 cm)	M2 A1	M1 for $5533 = 1/3 \times$ height $\times 825$ or equivalent. Allow an answer of 20(cm) from correct working.
Alternative method (finding the radius first): *Use $A = \pi r^2$ to evaluate r or r^2.* *(Height =)* $\frac{3\times5533}{\pi\times16.2(05\ldots)^2}$ *OR* $\frac{5533}{\frac{1}{3}\times\pi\times16.2(05\ldots)^2}$ *OR* $\frac{3\times5533}{\pi\times262.6(\ldots)}$ *OR* $\frac{5533}{\frac{1}{3}\times\pi\times262.6(\ldots)}$ *= 20·1(2… cm)*	 *M2* *A1*	*Allow use of π = 3·14, 3·142 or 3·14(59…).* *When using the π button on the calculator,* *r = 16·2(05…) OR r^2 = 262·6(…).* *There will be no FT for any radius other than r = 16cm, from working seen.* *M1 for* $5533 = 1/3 \times$ *height* $\times \pi \times 16.2(05\ldots)^2$ *or equivalent.* *Allow M1 for use of r = 16 (cm)* Allow an answer of 20(cm) from correct working. *Accept an answer in the range 20·10 to 20·143(cm)* *FT base radius = 16 cm: Allow an answer in the range 20·6(cm) to 20·65(cm) OR 21(cm) from correct working.*
13.(a) $(2x+9)(2x-9)$	B2	B1 for $(2x \ldots 9)(2x \ldots 9)$
13.(b) $(7x-4)(x+2)$	B2	B1 for $(7x \ldots 4)(x \ldots 2)$
13.(c) $(x+2)^2(x+7)$ OR $(x+2)(x+2)(x+7)$	B2	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.
14. $-\frac{1}{2}$ or equivalent	B2	B1 for -2 or $\frac{1}{2}$.
15. $2n^2+1$ or equivalent = 20 001	B2 B1	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 20 001 gains all 3 marks. If no marks, award SC1 for an unsupported answer of 20 000.

= 1·8(…m²)	*A1*	*Allow 1·9(…m²) from correct working.*
14.(a) 68(°) AND alternate segment theorem.	B2	Do not accept 'alternate (angle) theorem' or 'alternate angles' only as the given angle property. 68(°) may be seen on the diagram at *ACB*. B1 for 68(°) Award B0 for any angle other than *ACB* clearly identified as 68(°)
Alternative method *Allow a **correct and complete method** that results in an angle of 68(·219…°) AND relevant angle property (e.g. angles on a straight line OR angles in a triangle OR using the sine rule).*	*B2*	*Allow B1 for a **correct and complete method** that results in an angle of 68(·219…°).*
14.(b) 1/2 × 7 × 13 × sin 68(°) = 42·1(86… cm²) OR 42·2(cm²)	M1 A1	FT 'their 68' identified as their *ACB* from part (a). Award M1 for a complete alternative method leading to a correct answer of 42·1(… cm²) OR 42·2(cm²).

10.(a) (*AOY* =) 36(°)	B1	Check diagram.
(% shaded =) $\frac{36}{360}$ (× 100) or equivalent	M1	FT 'their derived or stated angle *AOY*' provided not 54°. Award M0A0 for $\frac{360(°)}{36(°)} = 10$, but award M1A1 if a final answer of 10% is seen.
= 10(%)	A1	If no marks awarded, award: • SC2 for unsupported 10% (*AOY* not shown or stated to be 36(°)) • SC1 for a final answer of 15% (from using 54(°)).
10.(b) Statement explaining that, 'The **tangent** at any point on a circle is **perpendicular** (or equivalent) to the **radius** at that point'.	E1	Accept unambiguous similar wording. e.g. 'Radius and tangent 90(°)'. Diameter could be used in place of radius. Must refer to tangent and radius by name (not simply *AY* and *OA* or description).

10. (*AOB* =) 180 – 90 – 42 or 90 – 42 48(°) x = 24(°)	M1 A1 B1	Check diagram for answers. Note: 180 – 132 May be implied by sight of a final answer of 24. FT 'their 48' ÷ 2, provided 'their 48' ≠ 42.
10. Alternative method $(x =) \frac{180 - 90 - 42}{2}$ or $\frac{90 - 42}{2}$ x = 24(°)	*M2* *A1*	*Check diagram for answers.* *Award M2 for complete method.*

Unit 1: Higher Tier	Mark	Comments
13. $D\hat{A}F = x$	B1	Check diagram. Must be unambiguous.
(Reason:) Alternate segment (theorem)	E1	Dependent on B1. Allow 'opposite segments (theorem)'.
$B\hat{A}D$ (= 180 – 114) = 66(°) [OR $B\hat{A}D = 180 - 3x = 180 - 114$]	B1	Check diagram. Must be unambiguously identified.
(Reason:) (Opposite angles in a) cyclic quadrilateral (add up to 180°)	E1	Dependent on clearly attempting [or stating] 180 – 114. (Sight of equation $66 + 2x + x = 180$ may imply previous B marks.)
x = 38(°)	B1	FT 'their 180 – 114'. An unsupported answer of 38 is awarded B3.
13. Alternative method 1: $A\hat{D}B = 2x$ *(Reason:) Alternate segment (theorem)*	*B1* *E1*	*Check diagram. Must be unambiguous.* *Dependent on B1. Allow 'opposite segments (theorem)'.*
$B\hat{A}D$ (= 180 – 114) = 66(°) [OR $B\hat{A}D = 180 - 3x = 180 - 114$]	*B1*	*Check diagram. Must be unambiguously identified.*
(Reason:) (Opposite angles in a) cyclic quadrilateral (add up to 180°)	*E1*	*Dependent on clearly attempting [or stating] 180 – 114.* *(Sight of equation $66 + 2x + x = 180$ may imply previous B marks.)*
x = 38(°)	*B1*	*FT 'their 180 – 114'.*
13. Alternative method 2: (using additional line AC) $A\hat{D}B = 2x$ *(Reason:) Alternate segment (theorem)*	*B1* *E1*	*Check diagram. Must be unambiguous.* *Dependent on B1.* Allow 'opposite segments (theorem)'.
$A\hat{C}D = x$ and $A\hat{C}B = 2x$ *(Reason:) Angles in the same segment (are equal) or Angles on the same arc (are equal)*	*B1* *E1*	*Check diagram. Must be unambiguous.* *Dependent on B1* *$(A\hat{C}D + A\hat{C}B = B\hat{C}D)$* *(Sight of equation $2x + x = 114$ may imply previous B marks.)*
x = 38(°)	*B1*	

13. (CD̂E=) 20(°)	B2	All angles should be clearly stated or seen on the diagram. Answer line takes precedence. An unsupported answer of 20(°) gains full marks, but must be clearly stated or seen on the diagram in the correct place. Award B1 for CED = 50(°) OR BEF = 70(°)

15. Angle CAB = x (Reason) Alternate segment theorem.	B1 E1	May be indicated on the diagram. E1 dependent on previous B1.
Angle ABC = $\frac{180 - x}{2}$ $\left(= 90 - \frac{1}{2}x\right)$	B1	
(Reason) isosceles triangle.	E1 4	E1 dependent on previous B1.

End of solutions