Arc Length and Areas of Sectors - Edexcel Past Exam Questions MARK SCHEME

Question 1: Jan 05 Q7

Question Number	Scheme	Marks
	(a) $r\theta = 8 \times 0.7, = 5.6 (cm)$ (b) $BC^2 = 8^2 + 11^2 - 2 \times 8 \times 11 \times \cos 0.7$ $\Rightarrow BC = 7.098$ or 7.10 (Awrt) or $\sqrt{(50.4)}$ or better Perimeter $= (a) + (11 - 8) + BC, = 15.7 (cm)$ (c) $\Delta = \frac{1}{2} ab \sin c =, \frac{1}{2} \times 11 \times 8 \times \sin 0.7$ Sector $= \frac{1}{2} r^2 \theta =, \frac{1}{2} \times 8^2 \times 0.7$ Area of $R = 28.345..... - 22.4 = 5.9455 = 5.95 (cm^2)$	M1, A1 (2) M1 A1 M1, A1cao (4) M1, A1 M1, A1 A1 (5) (11)
	(c) Final A1 accept 3sf or better (a) and (c) M1 for quoting and attempting to use correct formula (b) 1st M1 for attempting to use cosine rule (formula given)	

Question 2: June 05 Q7

Question number	Scheme	Marks
	(a) $\frac{\sin x}{8} = \frac{\sin 0.5}{7}$ or $\frac{8}{\sin x} = \frac{7}{\sin 0.5}$, $\sin x = \frac{8 \sin 0.5}{7}$ $\sin x = 0.548$ (b) $x = 0.58$ (α) (This mark may be earned in (a)). $\pi - \alpha = 2.56$	M1 A1ft A1 (3) B1 M1 A1ft (3) **6**
	(a) M: Sine rule attempt (sides/angles possibly the "wrong way round"). A1ft: follow through from sides/angles are the "wrong way round". <u>Too many d.p. given:</u> Maximum 1 mark penalty in the complete question. (Deduct on first occurrence).	

Question 3: Jan 06 Q5

Question number	Scheme	Marks
	(a) $\cos A\hat{O}B = \dfrac{5^2+5^2-6^2}{2\times5\times5}$ or	M1
	$\sin\theta = \frac{3}{5}$ with use of $\cos 2\theta = 1-2\sin^2\theta$ attempted	
	$= \underline{\dfrac{7}{25}}$ *	A1cso (2)
	(b) $A\hat{O}B = 1.2870022...$ radians 1.287 or better	B1 (1)
	(c) Sector $= \frac{1}{2}\times5^2\times(b)$, $=16.087...$ (AWRT) $\underline{16.1}$	M1 A1 (2)
	(d) Triangle $= \frac{1}{2}\times5^2\times\sin(b)$ or $\frac{1}{2}\times6\times\sqrt{5^2-3^2}$	M1
	Segment = (their sector) – their triangle	dM1
	= (sector from c) – 12 = (AWRT)$\underline{4.1}$ (ft their part(c))	A1ft (3) **8**
	(a) M1 for a full method leading to $\cos A\hat{O}B$ [N.B. Use of calculator is M0] (usual rules about quoting formulae)	
	(b) Use of (b) in degrees is M0	
	(d) 1st M1 for full method for the area of triangle AOB	
	2nd M1 for their sector – their triangle. Dependent on 1st M1 in part (d).	
	A1ft for their sector from part (c) – 12 [or 4.1 following a correct restart].	

Question 4: June 06 Q8

Question number	Scheme	Marks
	(a) $r\theta = 2.12 \times 0.65$ 1.38 (m)	M1 A1 (2)
	(b) $\frac{1}{2}r^2\theta = \frac{1}{2} \times 2.12^2 \times 0.65$ 1.46 (m^2)	M1 A1 (2)
	(c) $\frac{\pi}{2} - 0.65$ 0.92 (radians) (α)	M1 A1 (2)
	(d) ΔACD : $\frac{1}{2}(2.12)(1.86)\sin\alpha$ (With the value of α from part (c))	M1
	Area = "1.46" + "1.57", 3.03 (m^2)	M1 A1 (3)
		9
	(a) M1: Use of $r\theta$ with $r = 2.12$ or 1.86, and $\theta = 0.65$, or equiv. method for the angle changed to degrees (allow awrt 37°). (b) M1: Use of $\frac{1}{2}r^2\theta$ with $r = 2.12$ or 1.86, and $\theta = 0.65$, or equiv. method for the angle changed to degrees (allow awrt 37°). (c) M1: Subtracting 0.65 from $\frac{\pi}{2}$, or subtracting awrt 37 from 90 (degrees), (perhaps implied by awrt 53). <u>Angle changed to degrees wrongly and used throughout (a), (b) and (c):</u> Penalise 'method' only once, so could score M0A0, M1A0, M1A0. (d) First M1: Other area methods must be fully correct. Second M1: Adding answer to (b) to their ΔACD. <u>Failure to round to 2 d.p:</u> Penalise only once, on the first occurrence, then accept awrt. <u>If 0.65 is taken as degrees throughout:</u> Only award marks in part (d).	

Question 5: Jan 07 Q9

Question Number	Scheme	Marks
(a)	$\cos PQR = \dfrac{6^2+6^2-(6\sqrt{3})^2}{2\times 6\times 6}$ $\left\{= -\dfrac{1}{2}\right\}$	M1, A1
	$PQR = \dfrac{2\pi}{3}$	A1 (3)
(b)	$\text{Area} = \dfrac{1}{2}\times 6^2 \times \dfrac{2\pi}{3}\ \text{m}^2$	M1
	$= 12\pi\ \text{m}^2$ (✱)	A1cso (2)
(c)	$\text{Area of } \Delta = \dfrac{1}{2}\times 6\times 6\times \sin\dfrac{2\pi}{3}\ \text{m}^2$	M1
	$= 9\sqrt{3}\ \text{m}^2$	A1cso (2)
(d)	$\text{Area of segment} = 12\pi - 9\sqrt{3}\ \text{m}^2$	M1
	$= 22.1\ \text{m}^2$	A1 (2)
(e)	$\text{Perimeter} = 6+6+\left[6\times\dfrac{2\pi}{3}\right]\ \text{m}$	M1
	$= 24.6\ \text{m}$	A1ft (2) **(11)**

Notes

9(a) N.B. $a^2 = b^2 + c^2 - 2bc\cos A$ is in the formulae book.	
Use of cosine rule for $\cos PQR$. Allow A, θ or other symbol for angle. (i) $(6\sqrt{3})^2 = 6^2+6^2-2.6.6\cos PQR$: Apply usual rules for formulae: (a) formula not stated, must be correct, (b) correct formula stated, allow one sign slip when substituting. or (ii) $\cos PQR = \dfrac{\pm 6^2 \pm 6^2 \pm (6\sqrt{3})^2}{\pm 2\times 6\times 6}$ Also allow invisible brackets [so allow $6\sqrt{3}^2$] in (i) or (ii)	M1
Correct expression $\dfrac{6^2+6^2-(6\sqrt{3})^2}{2\times 6\times 6}$ o.e. (e.g. $-\dfrac{36}{72}$ or $-\dfrac{1}{2}$)	A1
$\dfrac{2\pi}{3}$	A1

Question 6: Jan 08 Q8

Question Number	Scheme	Marks
(a)	$(x-\ 6)^2 + (y-\ 4)^2 =;\ 3^2$	B1; B1 (2)
(b)	Complete method for MP: $= \sqrt{(12-6)^2+(6-4)^2}$	M1
	$= \sqrt{40}$ or awrt 6.325	A1
	[These first two marks can be scored if seen as part of solution for (c)]	
	Complete method for $\cos\theta$, $\sin\theta$ or $\tan\theta$	M1
	e.g. $\cos\theta = \frac{\text{MT}}{\text{MP}} = \frac{3}{candidate's\sqrt{40}}$ $(= 0.4743)$ $(\theta = 61.6835^\circ)$	
	[If TP = 6 is used, then M0]	
	$\theta = 1.0766$ rad **AG**	A1 (4)
(c)	Complete method for area TMP; e.g. $= \frac{1}{2}\times 3\times\sqrt{40}\sin\theta$	M1
	$= \frac{3}{2}\sqrt{31}$ $(= 8.3516..)$ allow awrt 8.35	A1
	Area (sector) MTQ $= 0.5\times 3^2\times 1.0766$ $(= 4.8446\ldots)$	M1
	Area TPQ = candidate's $(8.3516.. - 4.8446..)$	M1
	$= 3.507$ awrt [Note: 3.51 is A0]	A1 (5) **[11]**
Notes	(a) Allow 9 for 3^2. (b) First M1 can be implied by $\sqrt{40}$ or $\sqrt{31}$ For second M1: May find TP $= \sqrt{(\sqrt{40})^2 - 3^2} = \sqrt{31}$, then either $\sin\theta = \frac{TP}{MP} = \frac{\sqrt{31}}{\sqrt{40}}$ $(= 0.8803\ldots)$ *or* $\tan\theta = \frac{\sqrt{31}}{3}$ $(1.8859..)$ or cos rule **NB. Answer is given, but allow final A1 if all previous work is correct.** (c) First M1: (alternative) $\frac{1}{2}\times 3\times\sqrt{40-9}$ Second M1: allow even if candidate's value of θ used. (Despite being given !)	

Question 7: June 08 Q7

Question Number	Scheme	Marks
(a)	$r\theta = 7 \times 0.8 = 5.6$ (cm)	M1 A1 (2)
(b)	$\frac{1}{2}r^2\theta = \frac{1}{2} \times 7^2 \times 0.8 = 19.6$ (cm^2)	M1 A1 (2)
(c)	$BD^2 = 7^2 + (\text{their } AD)^2 - (2 \times 7 \times (\text{their } AD) \times \cos 0.8)$	M1
	$BD^2 = 7^2 + 3.5^2 - (2 \times 7 \times 3.5 \times \cos 0.8)$ (or awrt 46° for the angle)	A1
	Perimeter = (their DC) + "5.6" + "5.21" = 14.3 (cm)	M1 A1 (4)
(d)	$\Delta ABD = \frac{1}{2} \times 7 \times (\text{their } AD) \times \sin 0.8$ (ft their AD) (= 8.78…)	M1 A1 ft
	Area = "19.6" − "8.78…" = 10.8 (cm^2)	M1 A1 (4)
		(12 marks)

Question 8: Jan 09 Q7

Question Number	Scheme	Marks
(a)	$\frac{1}{2}r^2\theta = \frac{1}{2}\times 6^2 \times 2.2 = 39.6 \quad (\text{cm}^2)$	M1 A1 (2)
(b)	$\left(\frac{2\pi - 2.2}{2} =\right)\ \pi - 1.1 = 2.04 \quad (\text{rad})$	M1 A1 (2)
	(c) $\Delta DAC = \frac{1}{2}\times 6\times 4\sin 2.04 \qquad (\approx 10.7)$	M1 A1ft
	Total area = sector + 2 triangles = 61 $\quad (\text{cm}^2)$	M1 A1 (4) **[8]**
(a)	**M1**: Needs θ in radians for this formula. Could convert to degrees and use degrees formula. **A1**: Does not need units. Answer should be 39.6 exactly. Answer with no working is **M1 A1**. This **M1A1** can only be awarded in part (a).	
(b)	**M1**: Needs full method to give angle in radians **A1**: Allow answers which round to 2.04 (Just writes 2.04 – no working is 2/2)	
(c)	**M1**: Use $\frac{1}{2}\times 6\times 4\sin A$ (if any other triangle formula e.g. $\frac{1}{2}b\times h$ is used the method must be complete for this mark) (No value needed for A, but should not be using 2.2) **A1**: ft the value obtained in part (b) – need not be evaluated- could be in degrees **M1**: Uses Total area = sector + 2 triangles or other complete method **A1**: Allow answers which round to 61. (Do not need units) Special case degrees: Could get M0A0, M0A0, M1A1M1A0 Special case: Use $\Delta\ BDC - \Delta\ BAC$ Both areas needed for first **M1** Total area = sector + area found is second **M1** NB Just finding lengths BD, DC, and angle BDC then assuming area BDC is a sector to find area BDC is 0/4	

Question 9: June 09 Q9

Question Number	Scheme	Marks
Q (a)	(Arc length =) $r\theta = r \times 1 = r$. Can be awarded by implication from later work, e.g. $3rh$ or $(2rh + rh)$ in the S formula. (Requires use of $\theta = 1$).	B1
	(Sector area =) $\frac{1}{2}r^2\theta = \frac{1}{2}r^2 \times 1 = \frac{r^2}{2}$. Can be awarded by implication from later work, e.g. the correct volume formula. (Requires use of $\theta = 1$).	B1
	Surface area = 2 sectors + 2 rectangles + curved face $(= r^2 + 3rh)$ (See notes below for what is allowed here)	M1
	Volume = 300 = $\frac{1}{2}r^2h$	B1
	Sub for h: $S = r^2 + 3 \times \frac{600}{r} = r^2 + \frac{1800}{r}$ (*)	A1cso (5)
(b)	$\frac{dS}{dr} = 2r - \frac{1800}{r^2}$ or $2r - 1800r^{-2}$ or $2r + -1800r^{-2}$	M1A1
	$\frac{dS}{dr} = 0 \Rightarrow r^3 = \ldots, \quad r = \sqrt[3]{900}$, or AWRT 9.7 (NOT -9.7 or ± 9.7)	M1, A1 (4)
(c)	$\frac{d^2S}{dr^2} = \ldots$ and consider sign, $\frac{d^2S}{dr^2} = 2 + \frac{3600}{r^3} > 0$ so point is a minimum	M1, A1ft (2)
(d)	$S_{\min} = (9.65\ldots)^2 + \frac{1800}{9.65\ldots}$ (Using their value of r, however found, in the given S formula)	M1
	$= 279.65\ldots$ (AWRT: 280) (Dependent on full marks in part (b))	A1 (2) [13]
(a)	M1 for attempting a formula (with terms added) for surface area. May be incomplete or wrong and may have extra term(s), but must have an r^2 (or $r^2\theta$) term and an rh (or $rh\theta$) term.	
(b)	In parts (b), (c) and (d), ignore labelling of parts 1st M1 for attempt at differentiation (one term is sufficient) $r^n \to kr^{n-1}$ 2nd M1 for setting their derivative (a 'changed function') = 0 and solving as far as $r^3 = \ldots$ (depending upon their 'changed function', this could be $r = \ldots$ or $r^2 = \ldots$, etc., but the algebra must deal with a negative power of r and should be sound apart from possible sign errors, so that $r^n = \ldots$ is consistent with their derivative).	
(c)	M1 for attempting second derivative (one term is sufficient) $r^n \to kr^{n-1}$, and considering its sign. Substitution of a value of r is not required. (Equating it to zero is M0). A1ft for a correct second derivative (or correct ft from their first derivative) and a valid reason (e.g. > 0), and conclusion. The actual value of the second derivative, if found, can be ignored. To score this mark as ft, their second derivative must indicate a minimum. Alternative: M1: Find value of $\frac{dS}{dr}$ on each side of their value of r and consider sign. A1ft: Indicate sign change of negative to positive for $\frac{dS}{dr}$, and conclude minimum. Alternative: M1: Find value of S on each side of their value of r and compare with their 279.65. A1ft: Indicate that both values are more than 279.65, and conclude minimum.	

Question 10: Jan 10 Q4

Question Number	Scheme	Marks
(a)	**Either** $\frac{\sin(A\hat{C}B)}{5}=\frac{\sin 0.6}{4}$	M1
	$\therefore\ A\hat{C}B=\arcsin(0.7058...)$ $=[0.7835..\ \text{ or }\ 2.358]$	M1
	Use angles of triangle $A\hat{B}C=\pi-0.6-A\hat{C}B$	M1,
	(But as AC is the longest side so) $A\hat{B}C=1.76$ (*)(3sf) [Allow $100.7°\to 1.76$]	A1
	In degrees $0.6=34.377°$, $A\hat{C}B=44.9°$	(4)
	or $4^2=b^2+5^2-2\times b\times 5\cos 0.6$	M1
	$\therefore b=\frac{10\cos 0.6\pm\sqrt{(100\cos^2 0.6-36)}}{2}$ $=[6.96\ \text{ or }\ 1.29]$	M1
	Use sine / cosine rule with value for b: $\sin B=\frac{\sin 0.6}{4}\times b$ or $\cos B=\frac{25+16-b^2}{40}$	M1,
	(But as AC is the longest side so) $A\hat{B}C=1.76$ (*)(3sf)	A1
(b)	$[C\hat{B}D=\pi-1.76=1.38]$ Sector area $=\frac{1}{2}\times 4^2\times(\pi-1.76)=[11.0\sim 11.1]$ $\frac{1}{2}\times 4^2\times 79.3$ is M0	M1
	Area of $\Delta ABC=\frac{1}{2}\times 5\times 4\times\sin(1.76)=[9.8]$ or $\frac{1}{2}\times 5\times 4\times\sin 101$	M1
	Required area = awrt 20.8 or 20.9 or 21.0 or gives 21 (2sf) after correct work.	A1 (3) [7]
(a)	1st M1 for correct use of sine rule to find ACB or cosine rule to find b (M0 for ABC here or for use of sin x where x could be ABC) 2nd M1 for a correct expression for angle ACB (This mark may be implied by .7835 or by arcsin (.7058)) and needs accuracy. In second method this M1 is for correct expression for b – may be implied by 6.96. [Note $10\cos 0.6\approx 8.3$] (do not need two answers) 3rd M1 for a correct method to get angle ABC in method (i) or sinABC or cosABC, in method (ii) (If $\sin B>1$, can have M1A0) A1cso for correct work leading to 1.76 3sf. Do not need to see angle 0.1835 considered and rejected.	
(b)	1st M1 for a correct expression for sector area or a value in the range 11.0 – 11.1 2nd M1 for a correct expression for the area of the triangle or a value of 9.8 Ignore 0.31 (working in degrees) as subsequent work. A1 for answers which round to 20.8 or 20.9 or 21.0. No need to see units.	
(a)	<u>Special case</u> If answer 1.76 is assumed then usual mark is M0 M0 M0 A0. A Fully checked method may be worth M1 M1 M0 A0. A maximum of 2 marks. The mark is either 2 or 0. <u>Either</u> **M1** for $A\hat{C}B$ is found to be 0,7816 (angles of triangle) then **M1** for checking $\frac{\sin(A\hat{C}B)}{5}=\frac{\sin 0.6}{4}$ with conclusion giving numerical answers **This gives a maximum mark of 2/4** <u>OR</u> **M1** for b is found to be 6.97 (cosine rule) **M1** for checking $\frac{\sin(ABC)}{b}=\frac{\sin 0.6}{4}$ with conclusion giving numerical answers **This gives a maximum mark of 2/4** Candidates making this assumption need a complete method. They cannot earn M1M0. So the score will be 0 or 2 for part (a). Circular arguments earn 0/4.	

Question 11: June 10 Q6

Question Number	Scheme	Marks
	(a) $r\theta = 9 \times 0.7 = 6.3$ (Also allow 6.30, or awrt 6.30)	M1 A1 (2)
	(b) $\frac{1}{2}r^2\theta = \frac{1}{2} \times 81 \times 0.7 = 28.35$ (Also allow 28.3 or 28.4, or awrt 28.3 or 28.4) (Condone 28.35^2 written instead of $28.35\,\text{cm}^2$)	M1 A1 (2)
	(c) $\tan 0.7 = \frac{AC}{9}$ $AC = 7.58$ (Allow awrt) NOT 7.59 (see below)	M1 A1 (2)
	(d) Area of triangle $AOC = \frac{1}{2}(9 \times \text{their } AC)$ (or other complete method) Area of R = "34.11" – "28.35" (triangle – sector) or (sector – triangle) (needs a value for each) $= 5.76$ (Allow awrt)	M1 M1 A1 (3) 9
	(a) M: Use of $r\theta$ (with θ in radians), or equivalent (could be working in degrees with a correct degrees formula). (b) M: Use of $\frac{1}{2}r^2\theta$ (with θ in radians), or equivalent (could be working in degrees with a correct degrees formula). (c) M: Other methods must be fully correct, e.g. $\frac{AC}{\sin 0.7} = \frac{9}{\sin\left(\frac{\pi}{2} - 0.7\right)}$ $(\pi - 0.7)$ instead of $\left(\frac{\pi}{2} - 0.7\right)$ here is not a fully correct method. Premature approximation (e.g. taking angle C as 0.87 radians): This will often result in loss of A marks, e.g. $AC = 7.59$ in (c) is A0.	

Question 12: Jan 11 Q2

Question Number	Scheme	Marks
(a)	$11^2 = 8^2 + 7^2 - (2\times 8\times 7\cos C)$	M1
	$\cos C = \dfrac{8^2+7^2-11^2}{2\times 8\times 7}$ (or equivalent)	A1
	$\{\hat{C} = 1.64228...\} \Rightarrow \hat{C} = \text{awrt } 1.64$	A1 cso
		(3)
(b)	Use of Area $\Delta ABC = \frac{1}{2}ab\sin(\text{their } C)$, where a, b are any of 7, 8 or 11.	M1
	$= \frac{1}{2}(7\times 8)\sin C$ using the value of their C from part (a).	A1 ft
	$\{= 27.92848... \text{ or } 27.93297...\} = \text{awrt } 27.9$ (from angle of either 1.64^c or 94.1°)	A1 cso
		(3) [6]
	Notes	
(a)	M1 is also scored for $8^2 = 7^2 + 11^2 - (2\times 7\times 11\cos C)$ or $7^2 = 8^2 + 11^2 - (2\times 8\times 11\cos C)$ or $\cos C = \dfrac{7^2+11^2-8^2}{2\times 7\times 11}$ or $\cos C = \dfrac{8^2+11^2-7^2}{2\times 8\times 11}$ 1^{st} A1: Rearranged correctly to make $\cos C = ...$ and numerically correct (possibly unsimplified). Award A1 for any of $\cos C = \dfrac{8^2+7^2-11^2}{2\times 8\times 7}$ or $\cos C = \dfrac{-8}{112}$ or $\cos C = -\dfrac{1}{14}$ or $\cos C = \text{awrt } -0.071$. SC: Also allow 1^{st} A1 for $112\cos C = -8$ or equivalent. Also note that the 1^{st} A1 can be implied for $\hat{C} = \text{awrt } 1.64$ or $\hat{C} = \text{awrt } 94.1^\circ$. **Special Case:** $\cos C = \dfrac{1}{14}$ or $\cos C = \dfrac{11^2-8^2-7^2}{2\times 8\times 7}$ scores a SC: M1A0A0. 2^{nd} A1: for awrt 1.64 cao **Note that** $A = 0.6876...^c$ (or $39.401...^\circ$), $B = 0.8116...^c$ (or $46.503...^\circ$)	
(b)	M1: alternative methods must be fully correct to score the M1. For any (or both) of the M1 or the 1^{st} A1; their C can either be in degrees or radians. Candidates who use $\cos C = \dfrac{1}{14}$ to give $C = 1.499...$, can achieve the correct answer of awrt 27.9 in part (b). These candidates will score M1A1A0cso, in part (b). Finding $C = 1.499...$ in part (a) and achieving awrt 27.9 with no working scores M1A1A0. Otherwise with no working in part (b), awrt 27.9 scores M1A1A1. **Special Case: If the candidate gives awrt 27.9 from any of the below then award M1A1A1.** $\frac{1}{2}(7\times 11)\sin(0.8116^c \text{ or } 46.503^\circ) = \text{awrt } 27.9$, $\frac{1}{2}(8\times 11)\sin(0.6876...^c \text{ or } 39.401...^\circ) = \text{awrt } 27.9$. **<u>Alternative: Hero's Formula:</u>** $A = \sqrt{13(13-11)(13-8)(13-7)} = \text{awrt } 27.9$, where M1 is attempt to apply $A = \sqrt{s(s-11)(s-8)(s-7)}$ and the first A1 is for the correct application of the formula.	

Question 13: June 11 Q5

Question Number	Scheme		Marks
(a)	$\frac{1}{2}r^2\theta = \frac{1}{2}(6)^2\left(\frac{\pi}{3}\right) = 6\pi$ or 18.85 or awrt 18.8 (cm)^2	Using $\frac{1}{2}r^2\theta$ (See notes)	M1
		6π or 18.85 or awrt 18.8	A1
			[2]
(b)	$\sin\left(\frac{\pi}{6}\right) = \frac{r}{6-r}$	$\sin\left(\frac{\pi}{6}\right)$ or $\sin 30^\circ = \frac{r}{6-r}$	M1
	$\frac{1}{2} = \frac{r}{6-r}$	Replaces sin by numeric value	dM1
	$6 - r = 2r \Rightarrow r = 2$	$r = 2$	A1 cso
			[3]
(c)	Area $= 6\pi - \pi(2)^2 = 2\pi$ or awrt 6.3 (cm)^2	their area of sector $- \pi r^2$	M1
		2π or awrt 6.3	A1 cao
			[2]
			7
(a)	M1: Needs θ in radians for this formula. Candidate could convert to degrees and use the degrees formula. A1: Does not need units. Answer should be either 6π or 18.85 or awrt 18.8 Correct answer with no working is M1A1. This M1A1 can only be awarded in part (a).		
(b)	M1: Also allow $\cos\left(\frac{\pi}{3}\right)$ or $\cos 60^\circ = \frac{r}{6-r}$. 1st M1: Needs correct trigonometry method. Candidates could state $\sin\left(\frac{\pi}{6}\right) = \frac{r}{x}$ and $x + r = 6$ or equivalent in their working to gain this method mark. dM1: Replaces sin by numerical value. $0.009... = \frac{r}{6-r}$ from working "incorrectly" in degrees is fine here for dM1. A1: For $r = 2$ from correct solution only. **Alternative:** 1st M1 for $\frac{r}{OC} = \sin 30$ or $\frac{r}{OC} = \cos 60$. 2nd M1 for $OC = 2r$ and then A1 for $r = 2$. **Note** seeing $OC = 2r$ is M1M1. **Special Case:** If a candidate states an answer of $r = 2$ (must be in part (b)) as a guess or from an incorrect method then award SC: M0M0B1. Such a candidate could then go on to score M1A1 in part (c).		
(c)	M1: For "their area of sector – their area of circle", where $r > 0$ is ft from their answer to part (b). Allow the method mark if "their area of sector" < "their area of circle". The candidate must show somewhere in their working that they are subtracting the correct way round, even if their answer is negative. Some candidates in part (c) will either use their value of r from part (b) or even introduce a value of r in part (c). You can apply the scheme to award either M0A0 or M1A0 or M1A1 to these candidates. **Note:** Candidates can get M1 by writing "their part (a) answer $- \pi r^2$", where the radius of the circle is not substituted. A1: cao – accept exact answer or awrt 6.3 Correct answer only with no working in (c) gets M1A1 **Beware: The answer in (c) is the same as the arc length of the pendant**		