Q1.

7 (i)	$\sin \frac{1}{2}\theta - \frac{6}{10}$	M1	Use of trig with/without radians
	Angle $DOE = 1.287$ radians.	A1 [2]	co – answer given.
(ii)	$P = 12 + 12 + 2 \times 10 \times$ angle BOD	M1	Use of $s = r\theta$ for arc length.
	Angle $BOD = (\pi - 1.287)$	M1	Correct angle
	$\rightarrow 61.1$	A1 [3]	co
(iii)	Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$	M1	Correct formula used with radians.
	Triangle $DOE = \frac{1}{2} \times 10^2 \times \sin 1.287$	M1	Correct formula used with radians.
	Area $= \pi \times 10^2 -$ (2 sectors – 2 triangles)		
	(or $48 + 48 + 2 \times \frac{1}{2} \times 10^2 \times (\pi - 1.287)$) M1 M1		
	$\rightarrow 281$ or 282	A1 [3]	co

Q2.

9 (i)	$AS = r\tan\theta$	M1	$O(AP) = 2r\tan\theta$ or $(AO) = \frac{r}{\cos\theta}$
	Area $OAB = r^2\tan\theta$ or $(OAS) = \frac{1}{2}r^2\tan\theta$	A1	Or $OAB = \frac{1}{2}\frac{r^2}{\cos 2\theta}\sin 2\theta$
	Area of sector $= \frac{1}{2}r^2 \times 2\theta \; (= r^2\theta)$	B1	Or area sector $(OPS) = \frac{1}{2}r^2\theta$
	Shaded area $= r^2(\tan\theta - \theta)$ **OE**	A1 [4]	Allow e.g. $r^2\tan\theta - \frac{1}{2}r^2 2\theta$
(ii)	$\cos\frac{\pi}{3} = \frac{6}{OA} \Rightarrow OA = 12$	M1	
	$AP = 6$	A1	
	$AS = 6\tan\frac{\pi}{3} (\Rightarrow AB = 12\sqrt{3})$	B1	
	Arc $(PST) = 12\frac{\pi}{3}$	B1	Or arc $(PS) = 6\frac{\pi}{3}$ or arc $(ST) = 6\frac{\pi}{3}$
	Perimeter $= 12 + 12\sqrt{3} + 4\pi$	A1 [5]	Allow unsimplified 4π

Q3.

7 **(i)** $AX = 6\tan\frac{\pi}{3} = 6\sqrt{3}$	B1 [1]	ag
(ii) Area of triangle = ½ × 6 × 6√3	M1	Use of ½bh
Area of sector = $\frac{1}{2}6^2 \times \frac{\pi}{3}$	M1	Use of $\frac{1}{2}r^2\theta$
Area shaded = $18\sqrt{3} - 6\pi$	A1 [3]	co
(iii) Arc $AB = 6 \times \frac{\pi}{3} = 2\pi$	M1	Use of $r\theta$
$OX = 6 \div \cos\frac{\pi}{3} = 12$, $BX = 6$	B1	Use of trig to find (OX and then) BX.
Perimeter = $6\sqrt{3} + 2\pi + 6$	M1 A1 [4]	

Q4.

3 AO (or r) = $\sqrt{3}$	**B1**	soi Allow 1.73
Area Δ = $\sqrt{3}$ (or area Δ AQC = $\frac{\sqrt{3}}{2}$)	**B1**√	soi ft *their* $\sqrt{3}$ Allow 1.73
Area sector $APR = \frac{1}{2}(\sqrt{3})^2 \times \frac{\pi}{3} - \frac{\pi}{2}$	**M1A1**√	ft *their* $\sqrt{3}$. Allow 1.57. SCA1 for π/4 from $\frac{1}{2}(\sqrt{3})^2 \times \frac{\pi}{6}$ provided $\Delta - \frac{\sqrt{3}}{2}$
Shaded region = $\sqrt{3} - \frac{\pi}{2}$ oe cao	**A1** **[5]**	

Q5.

8 **(i)** $OBX = 90°$, $\cos\theta = \frac{r}{2r}$	M1	Needs 90° + cos (or Pyth + sin or tan)
→ $\theta = \frac{1}{3}\pi$.	A1 [2]	co ag
(ii) Arc length $AB = \frac{1}{3}r\pi$	B1	r + sum of other two
$BX = r\tan(\frac{1}{3}\pi) = r\sqrt{3}$	B1	
$P = r + (\frac{1}{3}r\pi + r\sqrt{3})$	B1 [3]	
(iii) Area = $\frac{1}{2}r^2\sqrt{3} - \frac{1}{6}r^2\pi$	B1√ B1 [2]	√ on tan(⅓π). co

Q6.

3 **(i)** $(OAB) - \frac{1}{2}\times 8^2\alpha$, $(OAC) - \frac{1}{2}\times\pi\times 4^2$	**B1B1**	Accept 25.1 (for *OAC*)
$\alpha - \frac{\pi}{8}$	**B1** [3]	
(ii) $8 + 8\times$ their $\alpha + \frac{1}{2}\times 8\times\pi$	**B1**√	23.7 gets B1B0
$8 + 5\pi$	**B1** [2]	SC B1 for e.g. 5π (omitted *OB*)

Q7.

2 **(i)**	$\frac{1}{2}.3^2\pi = \frac{1}{2}9^2\theta - \frac{1}{2}3^2\theta$	M1 A1		M1 needs $\frac{1}{2}r^2\theta$ once. A1 all correct.
	$\rightarrow \theta = \frac{1}{4}\pi$	A1	[3]	Answer given
(ii)	$P = 6 + 6 + 3\times\frac{1}{4}\pi + 9\times\frac{1}{4}\pi = 21.4$ cm.	M1		M1 is for use of $s = r\theta$ once.
	or $12 + 3\pi$	A1	[2]	

Q8.

5 $r = 6$ cm		
(i) $AB = \sqrt{(6^2 + 6^2)} = \sqrt{72}$	B1	Use of Pythagoras – or trig (8.5 ok)
Angle $BAD = \frac{1}{4}\pi$ or 45°	B1	In degrees or radians
Arc length $= \sqrt{72}\times\frac{1}{4}\pi = 6.66(7)$	M1 A1 [4]	Use of $s = r\theta$ with θ in rads only – or correct with degrees. Use of $r = 6$ M0.
(ii) Sector area $= \frac{1}{2}r^2\theta = \frac{1}{2}\times 72\times\frac{1}{4}\pi$	M1	Use of $\frac{1}{2}r^2\theta$ with θ in rad, and $r \neq 6$.
Area of triangle $= \frac{1}{2}\times 6\times 6$	B1	co
Shaded area = 10.3 or $9\pi - 18$.	A1 [3]	co

Q9.

9 **(i)**	$RS^2 = 10^2 - 6^2$	M1		Use of Pythagoras (or other)
	$\rightarrow RS = 8$ cm.	A1	[2]	Answer given.
(ii)	$\sin\theta = 8/10$ oe	M1		Use of trig – even if with degrees.
	$\rightarrow$ angle $RPQ = 0.9273$ radians	A1	[2]	co in radians. (Accept 0.927)
(iii)	Region = trapezium – 2 sectors			
	Area of trapezium = 40 cm²	B1		co
	Large sector $= \frac{1}{2}\times 8^2\times 0.9273$	M1		Use of $\frac{1}{2}r^2\theta$.
	Small sector angle $= (\pi - 0.9273)$			
	Small sector $= \frac{1}{2}\times 2^2\times 2.214$	M1		Use of $\frac{1}{2}r^2\theta$ with angle $= \pi -$ **(ii)**
	$\rightarrow 5.90$ cm^2	A1	[4]	co

Q10.

8	(i)	$1/2 \times 5^2 \times 1.2$ $1/2 \times 5^2 \times \sin 1.2$ $2[1/2 \times 5^2 \times 1.2 - 1/2 \times 5^2 \times \sin 1.2]$ 6.70	B1 B1 M1 A1	[4]	Subtraction and multiplication by 2 Accept 6.7 or anything rounding to 6.70
	(ii)	$5\cos 0.6$ $5 -$ "$5\cos 0.6$" $10(1 - \cos 0.6)$ 1.75	M1 M1 M1 A1	[4]	Subtraction from 5 Multiplication by 2

Q11.

5	(i)	Arc $AB = r\theta$ $OC = r\sin\theta$ or $BC = r\cos\theta$ $r(1+\theta+\cos\theta+\sin\theta)$ correctly derived	M1 M1 A1	[3]	oe eg $BC = r\sin\dfrac{\theta}{\tan\theta}$ etc OC & BC reversed loses M1A1
	(ii)	Sector $OAB = \dfrac{1}{2}\times 10^2 \times \dfrac{\pi}{5}$ (-31.42) $\Delta OCB = \dfrac{1}{2}\left(10\cos\dfrac{\pi}{5}\right)\left(10\sin\dfrac{\pi}{5}\right)$ (-23.78) Total area $= 55.2$	M1 M1 A1	[3]	oe Δ in terms of π and 10 Allow OC & BC reversed (ie max 4/6)

Q12.

4	(i)	$10^2 \sin 0.8 = 71.7$	M1A1	[2]	Completely correct method for a triangle
	(ii)	sector(s) $= (2) \times \frac{1}{2} \times 10^2 \times 0.8 = (2) \times 40$ Total area $= 80$	M1 A1	[2]	Correct formula used for a sector
	(iii)	arc(s) $= (2) \times 10 \times 0.8$ $16+20 = 36$	M1 A1	[2]	Correct formula used for an arc

Q13.

6	(i) $AC = r - r\cos\theta$	B1 [1]	
	(ii) arc $AB = \frac{4\pi}{3}$	B1	
	arc $AD = \frac{\pi}{2} \times their\ AC = \frac{\pi}{2} \times \left(4 - 4\cos\frac{\pi}{3}\right) = \pi$	M1A1	Allow $\pi \times their\ AC$ for M1. Allow 3.14
	$BD = 4\sin\frac{\pi}{3} - their\ AC = 2\sqrt{3} - 2$	M1A1	Allow 1.46
	Perimeter = $\frac{7\pi}{3} + 2\sqrt{3} - 2$	A1 [6]	cao Accept √12

Q14.

4	area $\Delta = 2\sqrt{3}$	B1	
	$\tan A = \frac{2\sqrt{3}}{2}$ ⍰ $A = \frac{\pi}{3}$	B1	Accept 60°
	Area sector $= \frac{1}{2} \times 2^2 \times \frac{\pi}{3} = \frac{2\pi}{3}$	M1	Use of $\frac{1}{2}r^2\theta$ with θ in radians
	Shaded area	A1 [4]	cao

Q15.

6	(i) $r(2\pi - \alpha)$ $+2r\alpha + 2r$	B1B1	
	$2\pi r + r\alpha + 2r$	B1 [3]	ft for $r\alpha$ instead of $2r\alpha$ or omission $2r$ SC1 for $2r\alpha + 4r$. (Plate = shaded part)
	(ii) $\frac{1}{2}(2r)^2\alpha + \pi r^2 - \frac{1}{2}r^2\alpha$	B1B1	Either B1 can be scored in (iii)
	$\frac{3r^2\alpha}{2} + \pi r^2$	B1 [3]	
	(iii) $\pi r^2 - \frac{1}{2}r^2\alpha - 2r^2\alpha$	M1	For equating *their* 2 parts from (ii)
	$\alpha - \frac{2}{5}\pi$	A1 [2]	

Q16.

6	(i) sector areas are $\frac{1}{2}11^2\alpha, \frac{1}{2}5^2\alpha$	B1	Sight of $11^2, 5^2$
	$k - \frac{\frac{1}{2}\times 11^2\alpha - \frac{1}{2}\times 5^2\alpha}{\frac{1}{2}\times 5^2\alpha}$	M1	Or $\frac{11^2 - 5^2}{5^2}$
	$k - \frac{96}{25}$ or 3.84	A1 [3]	

(ii) perimeter shaded region= $11\alpha + 5\alpha + 6 + 6 = 16\alpha + 12$ perimeter unshaded region = $5\alpha + 5 + 5 = 5\alpha + 10$ $16\alpha + 12 = 2(5\alpha + 10)$ $\alpha = 4/3$ or 1.33	B1 B1 M1 A1 [4]	