1	$8.5^2 - (8 \div 2)^2$ (= 56.25) **or** $\cos x = \frac{4}{8.5}$ oe			M1	**or** eg $\cos A = \frac{8^2 + 8.5^2 - 8.5^2}{2 \times 8 \times 8.5}$
	$\sqrt{"56.25"}$ (= 7.5) **or** $x = \cos^{-1}\left(\frac{4}{8.5}\right)$ (= 61.927...) oe			M1	**or** eg $(A =) \cos^{-1}\left(\frac{8^2 + 8.5^2 - 8.5^2}{2 \times 8 \times 8.5}\right)$ (61.927...) (other angle = 56.144...)
	8 × "7.5" ÷ 2 oe **or** 0.5 × 8 × 8.5 × sin "61.927..."			M1	**or** eg 0.5 × 8.5 × 8 × sin"61.927..." oe
		30	4	A1	
					Total 4 marks

2	30 + 4x + 10 + x + 20 (= 5x + 60) **or** 180 – 30 (=150)		4	M1	Allow 5x + 60 = n where $n \neq 180$ or for subtracting 30 from 180	M2 for 5x + 30 = 150 oe
	e.g. 30 + 4x + 10 + x + 20 = 180 **or** 5x + 60 = 180 oe **or** 180 – 30 – 10 – 20 (=120)			M1	for setting up the equation or for subtracting all numerical values of angles from 180	
	5x = '120' **or** '120' ÷ 5			M1	for correctly simplifying to $ax = b$ or for dividing '120' by 5	
		24		A1	for 24	
					Total 4 marks	

3	[chord AB =] $\sqrt{5^2 + 5^2 - 2 \times 5 \times 5 \times \cos 50}$ **or** 2 × 5 × sin25 (= 10sin25 or 4.226...)		6	M1	oe
	[$\angle APB$ =] $\cos^{-1}\left(\frac{4^2 + 4^2 - "4.226..."^2}{2 \times 4 \times 4}\right)$ (=63.77...) **or** [$\angle OPA$ =] $\sin^{-1}\left(\frac{0.5 \times "4.226..."}{4}\right)$ (= 31.88...)			M1	oe may use other methods but must be a complete method for $\angle APB$ **or** $\angle OPA$ (see below for sine rule)
	[Area sector AOB =] $\frac{50}{360} \times \pi \times 5^2$ (= $\frac{125}{36}\pi$ or 10.9...)			M1	oe independent
	[Area sector APB =] $\frac{"63.77..."}{360} \times \pi \times 4^2$ (= 8.90...)			M1	oe NB: 2 × "31.88…" = "63.77…"
	$\left(\frac{50}{360}\pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 50\right) + \left(\frac{"63.77..."}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin"63.77..."\right)$			M1	oe (10.9… – 9.57…) + (8.90… – 7.17…)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	3.06		A1	allow 3 – 3.1
	Alternative version (using line of symmetry OP in quadrilateral $OAPB$)				**Total 6 marks**
	[$\angle OPA$] = $\sin^{-1}\left(\frac{5 \sin 25}{4}\right)$ (= 31.88..)		6	M1	oe (see above for cosine rule & trig)
	[Area sector APB =] $\frac{2 \times "31.88..."}{360} \times \pi \times 4^2$ (= 8.90...)			M1	oe
	[Area $OAPB$ =] 2 × ½ × 5 × 4 × sin(180 – "31.88.." – 25) (=16.75...)			M1	oe
	[Area sector AOB =] $\frac{50}{360} \times \pi \times 5^2$ (= $\frac{125}{36}\pi$ = 10.9...)			M1	oe independent
	[Area **R** =] "10.9..." + "8.90..." – "16.75..."			M1	oe
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	3.06		A1	allow 3 – 3.1
					Total 6 marks

4	e.g. $\sin 65 = \frac{16}{AB}$ **or** $\cos 25 = \frac{16}{AB}$ **or** $\frac{AB}{\sin 90} = \frac{16}{\sin 65}$ **or** $\tan 65 = \frac{16}{AD}$ **or** $\tan 25 = \frac{AD}{16}$ **or** $\frac{AD}{\sin 25} = \frac{16}{\sin 65}$		4	M1	for a correct trig ratio for AB **or** AD accept 180 – 90 – 65 for 25
	e.g. $(AB =)\frac{16}{\sin 65}(= 17.654\ldots)$ **or** $(AB =)\frac{16}{\cos 25}(= 17.654\ldots)$ **or** $(AB =)\frac{16\sin 90}{\sin 65}(= 17.654\ldots)$ **and** $(AD =)\frac{16}{\tan 65}(= 7.460\ldots)$ **or** $(AD) = 16\times\tan 25\ (= 7.460\ldots)$ **or** $(AD =)\frac{16\sin 25}{\sin 65}(= 7.460\ldots)$			M1	for finding AB **and** AD Allow use of Pythagoras $(AD =)\sqrt{\text{"}17.654\ldots\text{"}^2 - 16^2}\ (= 7.460\ldots)$ or $(AB =)\sqrt{\text{"}7.460\ldots\text{"}^2 + 16^2}\ (= 17.654\ldots)$
	("17.654…" × 2) + ("7.460…" × 2) oe			M1	for a complete method to find the perimeter
		50.2		A1	accept 49.6 – 50.6
					Total 4 marks

5	$8^2 + 15^2 (= 289)$		5	M1	
	$\sqrt{8^2+15^2}\ (=17)$			M1	
	$\pi\times\left(\frac{\text{"}17\text{"}}{2}\right)^2$ (= 226.98…) **or** 0.5 × 15 × 8 (= 60)			M1	
	$\pi\times\left(\frac{\text{"}17\text{"}}{2}\right)^2 - 0.5\times 15\times 8$ ("226.98" – "60")			M1	
		167		A1	Accept answers which round to 167
					Total 5 marks

6	eg $0.5\times x\times x\times\sin 60\ \left(=\frac{\sqrt{3}}{4}x^2 = 0.433\ldots x^2\right)$ oe where $x = PQ$ eg $0.5\times 2n\times 2n\times\sin 60\left(=\sqrt{3}n^2 = 1.732\ldots n^2\right)$ oe where $2n = PQ$ or use $0.5\times b\times h$ where $h = \sqrt{x^2-(0.5x)^2}\ (=\frac{\sqrt{3}}{2}x)$ oe		4	M1	For expression for area of triangle [using $AB = x$ and $PQ = \frac{2}{3}x$ gives $\frac{\sqrt{3}}{9}x^2 = 0.192\ldots x^2$] (correct expression in 1 variable eg PQ)
	eg $6\times 0.5\times 1.5x\times 1.5x\times\sin 60\ \left(=\frac{27\sqrt{3}}{8}x^2 = 5.845\ldots x^2\right)$ oe eg $6\times 0.5\times 3n\times 3n\times\sin 60\ \left(=\frac{27\sqrt{3}}{2}n^2 = 23.382\ldots n^2\right)$ oe or eg $2(\frac{1}{2}\times 1.5x\times 1.5x\times\sin 120) + 1.5x\times AE$ where $AE = \sqrt{(1.5x)^2+(1.5x)^2-2\times 1.5x\times 1.5x\times\cos 120}$ $\left(=\frac{27\sqrt{3}}{8}x^2 = 5.845\ldots x^2\right)$ or use of $6\times 0.5\times b\times h$, finding h by Pythagoras			M1	for expression for area of hexagon [using $AB = x$ and $PQ = \frac{2}{3}x$ gives $\frac{3\sqrt{3}}{2}x^2 = 2.598\ldots x^2$] (correct expression in 1 variable eg AB)
	eg $6\times 0.5\times 1.5x\times 1.5x\times\sin 60 - 0.5\times x\times x\times\sin 60 = 72\sqrt{3}$ oe **or** $\left(\frac{27\sqrt{3}}{8}-\frac{\sqrt{3}}{4}\right)x^2 = 72\sqrt{3}$ **or** $(5.845\ldots - 0.433\ldots)x^2 = 124.7\ldots$ **or** eg $6\times 0.5\times 3n\times 3n\times\sin 60 - 0.5\times 2n\times 2n\times\sin 60 = 72\sqrt{3}$ oe $\left(\frac{27\sqrt{3}}{2}-\sqrt{3}\right)n^2 = 72\sqrt{3}$ or $(23.382\ldots - 1.732\ldots)n^2 = 124.7\ldots$			M1	for a correct equation for shaded area (correct equation in 1 variable, eg PQ or x etc)
		4.8		A1	

7	$\cos 30 = \frac{24}{(AC)}$ or $\sin '60' = \frac{24}{(AC)}$ or $\frac{\sin '60'}{24} = \frac{\sin 90}{(AC)}$ oe		5	M1 for correct trig ratio involving *AC*	M2 for use of tan **and** Pythagoras to obtain *AC* $(AB =)\ 24\tan 30\ (= 13.856...)$ **and** $\sqrt{'13.856...'^2 + 24^2}\ (= 27.712...)$ If not M2, then M1 for use of tan and Pythagoras to obtain AC^2 $(AB =)\ 24\tan 30\ (= 13.856...)$ **and** $'13.856...'^2 + 24^2\ (= 768)$
	$(AC =)\frac{24}{\cos 30}\ (= 16\sqrt{3} = 27.712\ldots)$ or $(AC =)\frac{24}{\sin '60'}\ (= 16\sqrt{3} = 27.712\ldots)$ or $(AC =)\frac{24 \times \sin 90}{\sin '60'}$			M1 for a correct trig ratio for *AC*	
	$\frac{1}{2} \times 2 \times \pi \times 3\ (= 3\pi = 9.424\ldots)$			M1 for using $\pi \times 2 \times 3$ or $2\pi \times 3$	
	'27.712…' + '9.424…' – 2×3			M1 for a complete method to find the length *AFEDC*	
		31		A1 accept answers in range from 31 to 31.15	
				Total 5 marks	

8	$\frac{1}{2} \times 45 \times 36 \times \sin 'C'\ \ (= 405)$	**alternative** $\frac{2 \times 405}{36}\ (= 22.5)$ **or** $\frac{2 \times 405}{45}\ (= 18)$		5	M1 correct substitution into the sine area formula, with their choice of symbol to represent *C*. **or** work out the perpendicular height with *BC* or *CD* as the base.
	$\sin 'C' = \left(\frac{405 \times 2}{45 \times 36}\right)\ ('C' = 30)$ oe	$\sqrt{45^2 - 22.5^2}\ \left(= \sqrt{1518.75} = 38.97\right)$ or $\sqrt{36^2 - 18^2}\ \left(= \sqrt{972} = 31.17\right)$			M1 correct rearrangement to make sin *C* the subject **or** use Pythagoras with their found perpendicular height.
	$(BD =)\sqrt{45^2 + 36^2 - 2 \times 45 \times 36 \times \cos '30'}$ $\left(= \sqrt{3321 - 3240 \times \cos '30'}\right)$ $\left(= \sqrt{515.077...} = 22.695...\right)$	$\sqrt{('38.97' - 36)^2 + 22.5^2}\ \left(= \sqrt{515.077...}\right)$ or $\sqrt{('45' - 31.17)^2 + 18^2}\ \left(= \sqrt{515.077...}\right)$			M1 (dep on 1st M1, ft 30) correct expression for *BD* ft their *C* (must be less than 90°). **or** use Pythagoras to find an expression for *BD*.
	$\cos 'ABD' = \left(\frac{'22.695...'^2 + 19^2 - 28^2}{2 \times '22.695...' \times 19}\right)$ leading to '*ABD*' = **or** $(BAD =)\ \cos^{-1}\left(\frac{28^2 + 19^2 - '22.695...'^2}{2 \times 28 \times 19}\right)$ $(= 53.7\ldots)$ **and** $\sin 'ABD' = \frac{\sin '53.7'}{'22.695...'} \times 28$ leading to '*ABD*' =				M1 for a complete method to find angle *ABD*
			83.9		A1 accept 83.85 – 83.9
					Total 5 marks

9	$\frac{1}{2} \times 7 \times h = 42$ oe or $(h =)\frac{42 \times 2}{7}\ (= 12)$ oe or $3.5^2 + h^2 = y^2$ or $h = \sqrt{y^2 - 3.5^2}$ oe		4	M1	A correct equation involving the height or a correct expression for height – could be in terms of *y*
	$y^2 = \left(\frac{7}{2}\right)^2 + ("12")^2$ oe or $\frac{1}{2} \times 7 \times "\sqrt{y^2 - 3.5^2}" = 42$ oe			M1	(indep) use of *their* height (any found value that they have called 'height')
	$y = \sqrt{\left(\frac{7}{2}\right)^2 + ("12")^2}$ oe			M1	**all values must come from a correct method**
	Correct answer scores full marks (unless from obvious incorrect working)	12.5		A1	oe eg $\frac{25}{2}$
					Total 4 marks

10	$12=\frac{1}{2}\times 4.6\times 8.3\times \sin ABC$ or $\frac{4.6h}{2}=12$ $(h=5.217....)$		5	M1 a correct equation for the area to find angle ABC or to find the perpendicular height of the triangle.
	$ABC=\sin^{-1}\left(\frac{12}{\frac{1}{2}\times 4.6\times 8.3}\right)$ $(=38.947\ldots)$ oe or $ABC=\sin^{-1}(0.6286)$ $(=38.947...)$ or $ABC=\sin^{-1}\left(\frac{\text{"}5.217...\text{"}}{8.3}\right)(=38.947...)$ or $BM^2=8.3^2-\text{"}5.217...\text{"}^2$			M1 A correct method to find angle ABC or a correct method to find BM^2 where CMB is 90º
	$AC^2=4.6^2+8.3^2-2\times 4.6\times 8.3\times\cos(\text{"}38.947\text{"})$ [allow cos39º] or $AC^2=30.6(627...)$ $BM=\sqrt{8.3^2-\text{"}5.217...\text{"}^2}$ (=6.455…)			M1 a correct start to the cosine rule to find length AC or a fully correct method for BM
	or $AC=\sqrt{\text{"}30.6(6...)\text{"}}$ **or** 5.5(3739…)			A1 A correct value for AC which can be the square root of 30.6(6…)
	Correct answer scores full marks (unless from obvious incorrect working)	18.4		A1 Allow answers in range 18.4 to 18.45
				Total 5 marks

11	$\pi\times 4.8^2\times\frac{72}{360}$ (= 14.4(76…)) oe		5	M1 for finding the area of the sector
	$\frac{1}{2}\times 4.8^2\times\sin 72$ (= 10.9(56…) or 11) oe or $\frac{1}{2}\times 5.6(4...)\times 3.8(8...)$ oe			M1 for finding the area of the triangle (Allow use of cosine rule/sine rule/SOHCAHTOA/Pythagoras to find AC (5.6(427.8…)) and OM (3.8(8328…)) where M is the midpoint of AC)
	"14.4(76…)" – "10.9(56…)" (= 3.520…)			M1 for finding the shaded area with all figures from correct working
	"3.5(20…)" × 14 × 3 × 60 "3.5(20…)" × 2520			M1
	Award marks within the range from correct working	8870		A1 accept 8820 – 8950 from correct working
				Total 5 marks

12	eg $\begin{pmatrix}7\\-2\end{pmatrix}+\begin{pmatrix}-3\\5\end{pmatrix}$ **or** $\begin{pmatrix}4\\3\end{pmatrix}$ **or** $-\begin{pmatrix}7\\-2\end{pmatrix}-\begin{pmatrix}-3\\5\end{pmatrix}$ **or** $\begin{pmatrix}-4\\-3\end{pmatrix}$		5	M1 for a method for finding $\overrightarrow{AC}$ or $\overrightarrow{CA}$ or for sight of $\begin{pmatrix}4\\3\end{pmatrix}$ or $\begin{pmatrix}-4\\-3\end{pmatrix}$
	eg $(\overrightarrow{AC}=)\sqrt{\text{"}4\text{"}^2+\text{"}3\text{"}^2}\left(=\sqrt{25}=5\right)$			M1 (dep on previous M1) for a method to find the magnitude of $\overrightarrow{AC}$ or $\overrightarrow{CA}$
	eg $(\overrightarrow{AB}=)\sqrt{7^2+(\pm 2)^2}\left(=\sqrt{53}=7.28(010)\right)$ **or** $(\overrightarrow{BC}=)\sqrt{(\pm 3)^2+5^2}\left(=\sqrt{34}=5.83(095)\right)$			M1 (indep) for a method to find the magnitude of either $\overrightarrow{AB}$ **or** $\overrightarrow{BC}$
	$\text{"}\sqrt{7^2+(\pm 2)^2}\text{"}+\text{"}\sqrt{(\pm 3)^2+5^2}\text{"}$ **or** $\text{"}\sqrt{53}\text{"}+\text{"}\sqrt{34}\text{"}(=13.1(110))$ **or** "7.28" + "5.83" (= 13.1(110))			M1 (dep on previous M1) for a complete method to find Pru's distance travelled
	Correct answer scores full marks (unless from obvious incorrect working)	8.1		A1 accept 8.1 – 8.2, to award full marks $\overrightarrow{AC}$ must be correct
				Total 5 marks

13	eg $\frac{1}{2}(2x-1)(2x+1)\sin 30 = x^2 + x - 3.75$ oe		6	M1	for equating area of triangle with the given area
		3.5		A1	for the value of x
	$(BC^2 =)"6"^2 + "8"^2 - (2\times"6"\times"8"\times\cos 30)(=16.8(615...))$ oe or $(BC =)\ \sqrt{"16.8..."}\ (= 4.10(628\ldots))$			M1	ft dep on M1 for a correct method to find BC^2 or BC ($AB = 6$ and $AC = 8$)
	$\frac{\sin(ABC)}{"8"} = \frac{\sin 30}{\sqrt{"16.8"}}$ oe or $\frac{\sin(BCA)}{"6"} = \frac{\sin 30}{\sqrt{"16.8"}}$ oe or $"6"^2 = "8"^2 + \left(\sqrt{"16.8"}\right)^2 - \left(2\times"8"\times\sqrt{"16.8"}\times\cos(BCA)\right)$ oe or $"8"^2 = "6"^2 + \left(\sqrt{"16.8"}\right)^2 - \left(2\times"6"\times\sqrt{"16.8"}\times\cos(ABC)\right)$ oe			M1	ft dep on previous M1 for a correct method to find angle ABC or angle BCA
	$(\sin ABC =)\frac{\sin 30\times"8"}{\sqrt{"16.8"}}(=0.974...)$ oe or $ABC = 76.9\ldots$ or $(\sin BCA =)\frac{\sin 30\times"6"}{\sqrt{"16.8"}}(=0.730...)$ oe or $BCA = 46.9\ldots$ or $(\cos BCA =)\frac{"8"^2 + \left(\sqrt{"16.8"}\right)^2 - "6"^2}{2\times"8"\times\left(\sqrt{"16.8"}\right)}(=0.682...)$ oe or $BCA = 46.9\ldots$ or $(\cos ABC =)\frac{"6"^2 + \left(\sqrt{"16.8"}\right)^2 - "8"^2}{2\times"6"\times\left(\sqrt{"16.8"}\right)}(=-0.226...)$ oe or $ABC = 103.0\ldots$			M1	ft dep on previous M1 for a correct rearrangement for sin ABC or sin BCA or cos BCA or cos ABC
	Correct answer scores full marks (unless from obvious incorrect working)	103		A1	accept awrt 103
					Total 6 marks