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)			M1	or eg $(A=)\cos^{-1}\left(\frac{8^2+8.5^2-8.5^2}{2\times8\times8.5}\right)$ (61.927)
	oe				(other angle = 56.144)
	$8 \times "7.5" \div 2$ oe or $0.5 \times 8 \times 8.5 \times \sin "61.927"$			M1	or eg $0.5 \times 8.5 \times 8 \times \sin^{\circ}61.927$ 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	
	$5x = `120' \text{ or } `120' \div 5$			M1	for correctly simplifying dividing '120' by 5	to $ax = b$ or for
		24		A1	for 24	Total 4 marks

Image: term of the term of the term of the term of te	3	$[\text{chord } AB =]\sqrt{5^2 + 5^2 - 2 \times 5 \times 5 \times \cos 50} \text{ or } 2 \times 5 \times \sin 25$		6	M1	oe
$\begin{bmatrix} \angle APB =]\cos^{-1}(\frac{4^2 + 4^2 - "4.226"^2}{2 \times 4 \times 4}) (= 63.77) \\ \text{or } [\angle OPA =]\sin^{-1}(\frac{0.5 \times "4.226"}{4}) (= 31.88) \\ \text{[Area sector } AOB =] \frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi \text{ or } 10.9) \\ \text{[Area sector } APB =] \frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Working not required, so correct answer scores full marks (unless from obvious incorrect working)} \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \\ \text{[Area sector } APB =] \frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9) \\ \text{[Area sector } AOB =] \frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9) \\ \text{[Area R =]"10.9" + "8.90" - "16.75"} \\ \text{[Working not required, so correct answer scores full marks (unless from obvious incorrect working) } 3.06 \\ \text{[Area R =]"10.9" + "8.90" - "16.75"} \\ \text{[Area R =]"10.9" + "8.90" - "16.75"} \\ \text{[Working not required, so correct answer scores full marks (unless from obvious incorrect working) } 3.06 \\ \text{[Working not required, so correct answer scores full marks (unless from obvious incorrect working) } 3.06 \\ \text{[Mi oe independent]} \\ \text{[Area R =]"10.9" + "8.90" - "16.75"} \\ \text{[Working not required, so correct answer scores full marks (unless from obvious incorrect working) } 3.06 \\ \text{[Mi oe independent]} \\ \text{[Area and marks indegendent]} \\ \text{[Area APB =] 2 \times 12 \times 5 \times 4 \times 80" - 25) (=16.75) \\ \text{[Mi oe independent]} \\ \text{[Area APB =] 3.0" + "8.90" - "16.75"} \\ \text{[Mi ovel independent]} \\ \text{[Area APB =] 3.0" + "16.75" \\ \text{[Mi ovel independent]} \\ [Area APB =] 3.0" + "16.75" \\ \text{[Mi ova$						
or $[\angle OPA =]\sin^{-1}(\frac{0.5 \times "4.226"}{4})(= 31.88)$ or $\angle OPA$ (see below for sine rule)[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi \text{ or } 10.9)$ M1 oe independent[Area sector $APB =]$ $\frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90)$ M1 oe NB: $2 \times "31.88" = "63.77"$ $(\frac{50}{360} \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 50) + (\frac{"63.77"}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin"63.77")$ M1 oe (10.9 9.57) + (8.90 7.17)Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06A1 allow 3 - 3.1Alternative version (using line of symmetry OP in quadrilateral $OAPB$)Total 6 marks trig)[Area sector $APB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6[Area sector $APB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe[Area R =] "10.9" + "8.90" - "16.75"M1 oeM1 oeWorking not required, so correct answer scores full marks (unless from obvious incorrect working)3.06M1 oe	-	× /				
or $[\angle OPA =]\sin^{-1}(\frac{0.5 \times "4.226"}{4})(= 31.88)$ or $\angle OPA$ (see below for sine rule)[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi \text{ or } 10.9)$ M1 oe independent[Area sector $APB =]$ $\frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90)$ M1 oe NB: $2 \times "31.88" = "63.77"$ $(\frac{50}{360} \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 50) + (\frac{"63.77"}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin"63.77")$ M1 oe (10.9 9.57) + (8.90 7.17)Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06A1 allow 3 - 3.1Alternative version (using line of symmetry OP in quadrilateral $OAPB$)Total 6 marks trig)[Area sector $APB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6[Area sector $APB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe[Area R =] "10.9" + "8.90" - "16.75"M1 oeM1 oeWorking not required, so correct answer scores full marks (unless from obvious incorrect working)3.06M1 oe		$\left[\angle APB = \right]\cos^{-1}\left(\frac{4^2 + 4^2 - "4.226"^2}{4.226"^2}\right) (=63.77)$			M1	2
of $[2OPA =]\sin^{-1}(\frac{4}{2})(= 31.88)$ M1 oe independent [Area sector $AOB =]\frac{50}{360} \times \pi \times 5^2(=\frac{125}{36} \pi \text{ or } 10.9)$ M1 oe NB: $2 \times "31.88" = "63.77"$ $\left(\frac{50}{360} \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 50\right) + \left(\frac{"63.77"}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin"63.77"\right)$ M1 oe NB: $2 \times "31.88" = "63.77"$ Working not required, so correct answer scores full marks (unless from obvious incorrect working) 3.06 Alternative version (using line of symmetry OP in quadrilateral OAPB) Total 6 marks [Area sector $APB =]\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6 [Area sector $APB =]\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6 [Area sector $APB =]\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6 [Area sector $AOB =]\frac{50}{360} \times \pi \times 5^2 (=\frac{125}{36} \pi = 10.9)$ 6 [Area R =] "10.9" + "8.90" - "16.75" 7 Working not required, so correct answer scores full marks (unless from obvious incorrect working) 3.06						
[Area sector $AOB =] \frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90)$ M1 oe NB: $2 \times "31.88" = "63.77"$ [Area sector $APB =] \frac{"63.77"}{360} \times \pi \times 4^2 (= 8.90)$ M1 oe (10.99.57) + (8.909.57) + (8.90) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.909.57) + (8.90) + (8.909.57) + (8		or $[\angle OPA =]\sin^{-1}(\frac{0.5 \times "4.226"}{4})(=31.88)$				or $\angle OPA$ (see below for sine rule)
$\begin{bmatrix} \text{Area sector } APB = \end{bmatrix} \xrightarrow{360} \times \pi \times 4^{2} (= 8.90) \\ \hline \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) \\ \hline Working not required, so correct answer scores full marks (unless from obvious incorrect working) \\ \hline Alternative version (using line of symmetry OP in quadrilateral OAPB) \\ \hline (\angle OPA] = \sin^{-1} \left(\frac{5 \sin 25}{4}\right) (= 31.88) \\ \hline (Area sector APB =] \frac{2 \times "31.88"}{360} \times \pi \times 4^{2} (= 8.90) \\ \hline (Area sector AOB =] \frac{50}{360} \times \pi \times 5^{2} (= \frac{125}{36}\pi = 10.9) \\ \hline (Area R =] "10.9" + "8.90" - "16.75" \\ \hline Working not required, so correct answer scores full marks (unless from obvious incorrect working) \\ \hline M1 \text{ oe} \\ \hline M1 $		[Area sector $AOB =$] $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi \text{ or } 10.9)$			M1	oe independent
$\begin{bmatrix} \frac{36}{360} \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 50 \\ \frac{1}{2} \times \frac{5}{2} \times \sin 50 \\ \frac{1}{2} \times \frac{5}{2} \times \sin 50 \\ \frac{1}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin^2 63.77^n \\ \frac{1}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin^2 63.77^n \\ \frac{1}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin^2 63.77^n \\ \frac{1}{360} \times \pi \times 4^2 = \frac{1}{2} \times \frac{1}{2}$		[Area sector $APB =$] $\frac{"63.77"}{360} \times \pi \times 4^2$ (= 8.90)			M1	oe NB: 2 × "31.88" = "63.77"
Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06A1allow 3 - 3.1Alternative version (using line of symmetry OP in quadrilateral OAPB)Total 6 marks $[\angle OPA] = \sin^{-1}(\frac{5 \sin 25}{4}) (= 31.88)$ 6M1oe (see above for cosine rule & trig)[Area sector $APB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6M1oe[Area sector $AOB =]$ $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ M1oe[Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1oe[Area R =] "10.9" + "8.90" - "16.75"M1oeM1oeM1oeM1oeM1oeM1oeM1[Area R =] "10.9" + "8.90" - "16.75"3.06Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06M1		(50 - 2 + 1 - 2 + 2 - 2) $("63.77" - 2 + 1 - 2 + 2 - 2 - 2 - 2)$			M1	oe (10.99.57) +
obvious incorrect working)Total 6 marksAlternative 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[Area sector APB =] $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ 6[Area sector APB =] $2 \times \frac{1}{2} \times 5 \times 4 \times \sin(180 - "31.88" - 25) (=16.75)$ M1[Area sector AOB =] $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1[Area R =] "10.9" + "8.90" - "16.75"M1Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06		$\left(\frac{360}{360}\pi \times 5^{2} - \frac{1}{2} \times 5^{2} \times \sin 50\right) + \left(\frac{360}{360} \times \pi \times 4^{2} - \frac{1}{2} \times 4^{2} \times \sin^{2} 63.77^{n}\right)$				(8.90 – 7.17)
Alternative version (using line of symmetry OP in quadrilateral OAPB)Total 6 marks $[\angle OPA] = \sin^{-1}\left(\frac{5\sin 25}{4}\right) (= 31.88)$ 6M1 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 $[Area OAPB =]$ $2 \times \frac{1}{2} \times 5 \times 4 \times sin(180 - "31.88" - 25) (=16.75)$ M1 oe $[Area sector AOB =]$ $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe $[Area R =]$ "10.9" + "8.90" - "16.75"M1 oe $Working not required, so correct answer scores full marks (unless from obvious incorrect working)3.06$		Working not required, so correct answer scores full marks (unless from	3.06		A1	allow 3 – 3.1
$\begin{bmatrix} \angle OPA \end{bmatrix} = \sin^{-1} \left(\frac{5 \sin 25}{4} \right) (= 31.88)$ $\begin{bmatrix} Area sector APB = \end{bmatrix} \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90) \begin{bmatrix} Area OAPB =] 2 \times \frac{1}{2} \times 5 \times 4 \times \sin(180 - "31.88" - 25) (=16.75) \begin{bmatrix} Area sector AOB =] \frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9) \begin{bmatrix} Area R =] "10.9" + "8.90" - "16.75" Working not required, so correct answer scores full marks (unless from obvious incorrect working) \begin{bmatrix} Area R =] "10.9" + "8.90" - "16.75"$		obvious incorrect working)				
$\begin{bmatrix} \angle OPA \end{bmatrix} = \sin^{-1} \left(\frac{OHA}{4} \right) (= 31.88)$ [Area sector $APB = \frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$ [Area $OAPB = \frac{2 \times \sqrt{3}.88"}{360} \times \pi \times 4^2 (= 8.90)$ [Area sector $AOB = \frac{1}{3} \frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ [Area sector $AOB = \frac{1}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ [Area R = "10.9" + "8.90" - "16.75" [Area R = "10.9" + "8.90" - "16.75" [Area variable of the total that the the tright of the total that the tright of the total the tright of the total that the tright of the total		Alternative version (using line of symmetry OP in quadrilateral OAPB)				Total 6 marks
[Area sector $APB =]$ $360 \times \pi \times 4^{2} (= 8.90)$ M1 oe [Area $OAPB =] 2 \times \frac{1}{2} \times 5 \times 4 \times sin(180 - ``31.88'' - 25) (=16.75)$ M1 oe [Area sector $AOB =]$ $\frac{50}{360} \times \pi \times 5^{2} (= \frac{125}{36} \pi = 10.9)$ M1 oe [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		$[\angle OPA] = \sin^{-1}\left(\frac{5\sin 25}{4}\right) (= 31.88)$		6	M1	
[Area sector $AOB =$] $\frac{50}{360} \times \pi \times 5^2 (= \frac{125}{36} \pi = 10.9)$ M1 oe independent[Area $\mathbf{R} =$] "10.9" + "8.90" - "16.75"M1 oeWorking not required, so correct answer scores full marks (unless from obvious incorrect working)3.06		[Area sector $APB =$] $\frac{2 \times "31.88"}{360} \times \pi \times 4^2 (= 8.90)$			M 1	oe
[Area sector $AOB -]$ $\frac{1}{360} \times \pi \times 5$ (= $\frac{\pi}{36} \pi = 10.9$)[Area $\mathbf{R} =]$ "10.9" + "8.90" - "16.75"M1 oeWorking not required, so correct answer scores full marks (unless from obvious incorrect working)3.06		[Area $OAPB =$] $2 \times \frac{1}{2} \times 5 \times 4 \times \sin(180 - 31.88 25)$ (=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					M1	oe independent
obvious incorrect working)		[Area \mathbf{R} =] "10.9" + "8.90" – "16.75"			M1	oe
			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 <i>AB</i> or <i>AD</i> accept 180 – 90 – 65 for 25
	e.g. $(AB =) \frac{16}{\sin 65} (= 17.654)$ or $(AB =) \frac{16}{\cos 25} (= 17.654)$ or $(AB =) \frac{16\sin 90}{\sin 65} (= 17.654)$ and $(AD =) \frac{16}{\tan 65} (= 7.460)$ or $(AD) = 16 \times \tan 25 (= 7.460)$ or $(AD =) \frac{16\sin 25}{\sin 65} (= 7.460)$			Ml	for finding <i>AB</i> and <i>AD</i> Allow use of Pythagoras $(AD =)\sqrt{17.654^{2}-16^{2}} (= 7.460)$ or $(AB =)\sqrt{7.460^{2}+16^{2}} (= 17.654)$
	$(``17.654" \times 2) + (``7.460" \times 2)$ 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
	$\pi \times \left(\frac{17}{2} \right)^2 (= 226.98) \text{ or } 0.5 \times 15 \times 8 (= 60)$			M1
	$\pi \times \left(\left\ \frac{17}{2} \right\ \right)^2 - 0.5 \times 15 \times 8$			M1
	("226.98" – "60")			
		167		A1 Accept answers which round to 167
				Total 5 marks

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

7 $\cos 30 = \frac{24}{(AC)} \text{ or } \sin 60' = \frac{24}{(AC)}$ $\cos \frac{\sin 60'}{24} = \frac{\sin 90}{(AC)} \text{ or }$ $(AC =) \frac{24}{\cos 30} (= 16\sqrt{5} = 27.712) \text{ or }$ $(AC =) \frac{24}{\sin 60'} (= 16\sqrt{5} = 27.712)$ $\cos (AC =) \frac{24}{\sin 60'} \text{ sin } 60'$		5	M1 for correct trig ratio involving AC M1 for a correct trig ratio for 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 $(13.856)^2 + 24^2 (= 768)$	
$\frac{1}{2} \times 2 \times \pi \times 3 (= 3\pi = 9.424)$			M1 for using $\pi \times 2 \times 3$ or $2\pi \times 3$ M1 for a complete method to find the length <i>AFEDC</i>		
°27.712' + '9.424' − 2×3					
	31		A1 accept answer	s in range from 31 to 31.15	
				Total 5 marks	

8	$\frac{1}{2} \times 45 \times 36 \times \sin'C' \ (= 405)$	$\frac{\frac{2\times405}{36}(=22.5) \text{ or } \frac{2\times405}{45}(=18)$		5	M1 correct substitution into the sine area formula, with their choice of symbol to represent <i>C</i> . or work out the perpendicular height with <i>BC</i> or <i>CD</i> 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 <i>C</i> the subject or use Pythagoras with their found perpendicular height.
	$(BD =)\sqrt{45^2 + 36^2 - 2 \times 45 \times 36 \times \cos' 30'}$ $(=\sqrt{3321 - 3240 \times \cos' 30'})$ $(=\sqrt{515.077} = 22.695)$	$\sqrt{('38.97'-36)^2+22.5^2} \left(=\sqrt{515.077}\right)$ or $\sqrt{('45'-31.17)^2+18^2} \left(=\sqrt{515.077}\right)$			M1 (dep on 1st M1, ft 30) correct expression for <i>BD</i> ft their <i>C</i> (must be less than 90°). or use Pythagoras to find an expression for <i>BD</i> .
	$\cos' ABD' = \left(\frac{'22.695'^{2} + 19^{2} - 28^{2}}{2 \times '22.695' \times 19}\right)$ leading to 'ABD' =				M1 for a complete method to find angle <i>ABD</i>
	or $(BAD =) \cos \left[\frac{28^2 + 19^2 - '22.695'^2}{2 \times 28 \times 19} \right]$ $(= 53.7) \text{ and} \\ \sin' ABD' = \frac{\sin' 53.7'}{'22.695'} \times 28$ leading to 'ABD' =				
			83.9		A1 accept 83.85 – 83.9 Total 5 marks

9	$\frac{1}{2} \times 7 \times h = 42 \text{ oe or } (h =) \frac{42 \times 2}{7} (= 12) \text{ oe or}$ $3.5^2 + h^2 = y^2 \text{ or } h = \sqrt{y^2 - 3.5^2} \text{ oe}$		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 <i>their</i> 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	1	Al	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
	$12 = \frac{-12}{2} \times 4.0 \times 0.5 \times \sin ABC$ or $\frac{-12}{2} = 12$ $(n = 5.217)$				find angle ABC or to find the
					perpendicular height of the
					triangle.
				M1	A correct method to find angle
					ABC
	$ABC = \sin^{-1} \left \frac{1}{1} \right = (= 38.947)$ oe or				OF.
	$ABC = \sin^{-1}\left(\frac{12}{\frac{1}{2} \times 4.6 \times 8.3}\right)$ (= 38.947) oe or				a correct method to find BM^2
	(where <i>CMB</i> is 90°
	$ABC = \sin^{-1}(0.6286) \ (= 38.947) \text{ or}$				
	$ABC = \sin^{-1}\left(\frac{"5.217"}{8.3}\right) (= 38.947)$ or				
	$ABC = SIII \left(\frac{8.3}{8.3} \right)^{(-50.947)} OF$				
	$BM^2 = 83^2 - 5217$				
	DW = 0.5 = 0.21/				
	$4C^2 = 4C^2 + 8C^2 = 2 + 4C + 8C + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + $			M1	a correct start to the cosine rule to
	$AC^2 = 4.6^2 + 8.3^2 - 2 \times 4.6 \times 8.3 \times \cos("38.947")$ [allow cos39°]			1/11	find length AC
	or $AC^2 = 30.6(627)$				or a fully correct method for <i>BM</i>
	$BM = \sqrt{8.3^2 - "5.217"^2}$ (=6.455)				or a fully correct method for <i>BM</i>
	or $AC = \sqrt{30.6(6)}$ "			A1	A correct value for AC which can
	or				be the square root of $30.6(6)$
	5.5(3739)				
	J.J(J+JZ)				
	Correct answer scores full marks (unless from obvious incorrect	18.4		A1	Allow answers in range 18.4 to
	working)				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
	$\frac{1}{2} \times 4.8^2 \times \sin 72 \ (= 10.9(56) \text{ or } 11) \text{ oe or}$			M1 for finding the area of the triangle
	$\frac{1}{2} \times 5.6(4) \times 3.8(8)$ oe			(Allow use of cosine rule/sine rule/SOHCAHTOA/Pythagoras to find <i>AC</i> (5.6(427.8)) and <i>OM</i> (3.8(8328)) where <i>M</i> is the midpoint of <i>AC</i>)
	"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 \overline{AC} or \overline{CA} or for sight of $\begin{pmatrix} 4\\ 3 \end{pmatrix}$ or $\begin{pmatrix} -4\\ -3 \end{pmatrix}$
	$ eg (\overline{AC} =) \sqrt{"4"^2 + "3"^2} (= \sqrt{25} = 5) $			M1	(dep on previous M1) for a method to find the magnitude of \overline{AC} or \overline{CA}
	eg $(\overline{AB} =)\sqrt{7^2 + (\pm 2)^2} (=\sqrt{53} = 7.28(010))$ or $(\overline{BC} =)\sqrt{(\pm 3)^2 + 5^2} (=\sqrt{34} = 5.83(095))$			M1	(indep) for a method to find the magnitude of either \overline{AB} or \overline{BC}
	$\sqrt["]{7^{2} + (\pm 2)^{2}} "+ "\sqrt{(\pm 3)^{2} + 5^{2}} "or$ $\sqrt["]{53} "+ "\sqrt{34} "(=13.1(110)) or$ (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		Al	accept 8.1 – 8.2, to award full marks \overline{AC} must be correct
					Total 5 marks

	I				
13	eg		6	M1	for equating area of
	$\frac{1}{2}(2x-1)(2x+1)\sin 30 = x^2 + x - 3.75$ oe				triangle with the given
					area
		3.5		Al	for the value of <i>x</i>
	$(BC^2 =)$ "6" ² +"8" ² -(2×"6"×"8"×cos 30)(=16.8(615)) oe			M1	ft dep on M1 for a correct
					method to find BC^2 or BC
	or $(BC =) \sqrt{"16.8"} (= 4.10(628))$				(AB = 6 and AC = 8)
	$\frac{\sin(ABC)}{"8"} = \frac{\sin 30}{\sqrt{"16.8"}} \text{ oe or } \frac{\sin(BCA)}{"6"} = \frac{\sin 30}{\sqrt{"16.8"}} \text{ oe or }$			M1	ft dep on previous M1 for
	"8" $-\frac{\sqrt{16.8}}{\sqrt{16.8}}$ "6" $-\frac{\sqrt{16.8}}{\sqrt{16.8}}$ "6"				a correct method to find
	$"6"^{2} = "8"^{2} + \left(\sqrt{"16.8"}\right)^{2} - \left(2 \times "8" \times \sqrt{"16.8"} \times \cos(BCA)\right) \text{ oe or}$				angle <i>ABC</i> or angle <i>BCA</i>
	6 = 8 + ($\sqrt{10.8^{\circ}}$) - (2× 8 × $\sqrt{10.8^{\circ}}$ × cos(BCA)) 0e of				
	$"8"^{2} = "6"^{2} + (\sqrt{"16.8"})^{2} - (2 \times "6" \times \sqrt{"16.8"} \times \cos(ABC))$ oe				
	$(\sin ABC =) \frac{\sin 30 \times "8"}{\sqrt{"16.8"}} (= 0.974)$ oe or $ABC = 76.9$ or			M1	ft dep on previous M1 for
	√"16.8"				a correct rearrangement
	$(\sin BCA =) \frac{\sin 30 \times "6"}{\sqrt{1168"}} (= 0.730)$ oe or $BCA = 46.9$ or				for sin ABC or sin BCA or cos BCA or cos ABC
	$(\sin BCA =) \frac{1}{\sqrt{16.8''}} (-0.750) \cos \cos BCA = 40.5 \sin 1000$				COS BCA OF COS ABC
	$\left(\frac{1}{1000}\right)^2$ $\left(\frac{1}{10000000000000000000000000000000000$				
	$\left(\cos BC 4 - \right)^{-8} \left(\sqrt[4]{16.8}\right)^{-6} - 6^{-6} \left(-0.682\right) \text{ op or } BC 4 = 46.9 \text{ or }$				
	$\left(\cos BCA = \right) \frac{"8"^2 + \left(\sqrt{"16.8"}\right)^2 - "6"^2}{2 \times "8" \times \left(\sqrt{"16.8"}\right)} (= 0.682) \text{ oe or } BCA = 46.9 \text{ or}$				
	$\left(\cos ABC =\right) \frac{"6"^2 + \left(\sqrt{"16.8"}\right)^2 - "8"^2}{2 \times "6" \times \left(\sqrt{"16.8"}\right)} (= -0.226) \text{ oe or } ABC = 103.0$				
	$(\cos ABC =) - \frac{1}{2 \times 6 \cdot (\sqrt{ 16 8 })} (= -0.226) \text{ oe or } ABC = 103.0$				
	2× 0×(¥ 10.0)				
	Correct answer scores full marks (unless from obvious incorrect working)	103		Al	accept awrt 103
					Total 6 marks