

<b>1</b>	e.g. $6(x-1) (= 6x-6)$			M1	method to find expression for perimeter of hexagon
	e.g. $2(x+5) + 2x-3 (= 4x+7)$			M1	method to find expression for perimeter of triangle
	“ $6x-6$ ” = “ $4x+7$ ”			M1	(dep on at least M1) for equating both expressions
	e.g. $6x-4x = 7+6$			M1	(dep on previous M1 and equation of the form $ax+b=cx+d$ ) for rearranging the $x$ terms on one side and the numerical terms on the other and all expansions correct.
		5.5	5	A1	oe (dep on M2)
<b>Total 5 marks</b>					

<b>2</b>	$(AC^2 =) 17^2 - 15^2$		5	M1	
	$(AC =) \sqrt{17^2 - 15^2} (= \sqrt{64} = 8)$			M1	
	$\frac{\pi \times '8'}{2} (= 4\pi = 12.566...)$			M1	dep on M2 for $\frac{\pi \times '8'}{2}$ oe or $4\pi$ 12.5663...
	“12.566...” + 15 + 17			M1	for “12.566” + 15 + 17 and no additional values
		44.6		A1	for awrt 44.6
<b>Total 5 marks</b>					

**Alternative mark scheme for 2**

	$\cos^{-1}\left(\frac{15}{17}\right) (= 28.0724)$ or $\sin^{-1}\left(\frac{15}{17}\right) (= 61.9275)$		5	M1	for a correct method to find one of the angles
	$15 \times \tan('28.0724')(= 8)$ or $15 \div \tan('61.9275')(= 8)$			M1	
	$\frac{\pi \times '8'}{2} (= 4\pi = 12.566...)$			M1	dep on M2 for $\frac{\pi \times '8'}{2}$ or 12.5663... or $4\pi$
	“12.566” + 15 + 17			M1	for “12.566” + 15 + 17 and no additional values
		44.6		A1	for awrt 44.6
<b>Total 5 marks</b>					

<b>3</b>	$[ADC =] 180 - 98 (= 82)$		6	M1	may be seen on diagram
	$[AC^2 =] 8^2 + 7.5^2 - 2 \times 8 \times 7.5 \times \cos(98) (= 136.95...)$			M1	correct equation for $AC$ or $AC^2$
	$[AC =] \sqrt{136.95}$ or $\sqrt{64 + 56.25 + 16.7...} (= 11.7...)$ oe			M1	complete method to find $AC$ showing correct order of operations
	eg $[AD =] \frac{11.7 \sin 35}{\sin 82} (= 6.77...)$ or $[DC =] \frac{11.7 \sin 63}{\sin 82} (= 10.5...)$ oe (where “82” = $180 - 98$ , “63” = $180 - “82” - 35$ )			M1	correct calculation for $AD$ or $DC$ dep on 1 <sup>st</sup> M1 and 2 <sup>nd</sup> M1
	eg $[AD =] \frac{11.7 \sin 35}{\sin 82}$ and $[DC =] \frac{11.7 \sin 63}{\sin 82}$ oe or $[AD =] \frac{11.7 \sin 35}{\sin 82}$ and $[DC =] \sqrt{11.7^2 + 6.77^2 - 2 \times 11.7 \times 6.77 \times \cos 63}$ $[DC =] \frac{11.7 \sin 63}{\sin 82}$ and $[AD =] \sqrt{11.7^2 + 10.5^2 - 2 \times 11.7 \times 10.5 \times \cos 35}$ Where “63” = $180 - “82” - 35$			M1	correct calculations for $AD$ and $DC$ ( $AD = 6.77...$ $DC = 10.5...$ ) dep on 1 <sup>st</sup> M1 and 2 <sup>nd</sup> M1
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	32.8		A1	accept 32.7 – 32.9
<b>Total 6 marks</b>					

<b>4</b>	$360 - 40 (= 320)$ or $\frac{320}{360}$ oe		4	M1	
	or $\frac{40}{360} \times 2\pi \times 9 (= 6.28...)$			M1	
	$\frac{320}{360} \times 2\pi \times 9 (= 16\pi = 50.26...)$			M1	
	or $2\pi \times 9 - “6.28” (= 50.26)$			M1	complete method to find perimeter
	“50.26” + $2 \times 9$	68.3		A1	68.2 to 68.3
<b>Total 4 marks</b>					

5		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. $(AB =) \frac{16}{\sin 65} (= 17.654\dots)$ or $(AB =) \frac{16}{\cos 25} (= 17.654\dots)$ or $(AB =) \frac{16 \sin 90}{\sin 65} (= 17.654\dots)$ and $(AD =) \frac{16}{\tan 65} (= 7.460\dots)$ or $(AD) = 16 \times \tan 25 (= 7.460\dots)$ or $(AD =) \frac{16 \sin 25}{\sin 65} (= 7.460\dots)$			M1 for finding $AB$ and $AD$ Allow use of Pythagoras $(AD =) \sqrt{17.654\dots^2 - 16^2} (= 7.460\dots)$ or $(AB =) \sqrt{7.460\dots^2 + 16^2} (= 17.654\dots)$
		$(17.654\dots \times 2) + (7.460\dots \times 2)$ oe			M1 for a complete method to find the perimeter
			50.2		A1 accept $49.6 - 50.6$
					<b>Total 4 marks</b>

6	(b)	$(AB =) \sqrt{(1 - -4)^2 + (10 - -2)^2}$ $(= \sqrt{5^2 + 12^2} (= 13))$		3	M1
		$(BC =) \sqrt{(19 - 1)^2 + (10 - 2.5)^2}$ $(= \sqrt{18^2 + 7.5^2} (= 19.5))$ or $\sqrt{(19 - 1)^2 + (10 - \text{their } a)^2}$ or $1.5 \times 13$			M1 fit their value of $a$
			65		A1

7		eg $2 \times \pi \times 5.2 (= 32.6\dots \text{or } \frac{52}{5} \pi)$ oe $\frac{67}{360} \times 2 \times \pi \times 5.2 (= 6.08\dots \text{or } \frac{871}{450} \pi)$ oe		3	M1 for finding the whole circumference or the arc length
		$\frac{67}{360} \times 2 \times \pi \times 5.2 + 2 \times 5.2$ oe			M1 for a complete method
			16.5		A1 accept $16.4 - 16.5$ (not in terms of $\pi$ )
					<b>Total 3 marks</b>

8		$4.3^2 + 6.4^2$ or $59.45$		4	M1 for squaring and adding
		$\sqrt{4.3^2 + 6.4^2}$ or $\sqrt{59.45}$ or $7.71(038\dots)$ or $7.7$			M1 dep 1st M1 for square rooting
		e.g. $(7.71 + 4.3 + 6.4) \times 22$ or $18.4 \times 22 (= 404.8)$ or $(8 + 4.3 + 6.4) \times 22$ or $18.7 \times 22$ or $19 \times 22$ or $20 \times 22$			M1 dep M2 for a non-rounded perimeter $\times 22$ or $19 \times 22$ accept $20 \times 22$ oe
			\$418		A1 cao
					<b>Total 4 marks</b>

9	$12.8^2 + x^2 = 16^2$ oe or $163.84 + x^2 = 256$ or $(x^2 =) 16^2 - 12.8^2 (= 92.16)$ or $(x^2 =) 256 - 163.84 (= 92.16)$		4	M1 for applying Pythagoras theorem correctly Allow $\cos^{-1}\left(\frac{12.8}{16}\right) (= 36.9\dots)$ <b>and</b> $\frac{x}{\sin(36.9\dots)} = \frac{16}{(\sin 90)}$
	$(x =) \sqrt{16^2 - 12.8^2} (= \sqrt{92.16}) (= 9.6)$ or $(x =) \sqrt{256 - 163.84} (= \sqrt{92.16}) (= 9.6)$			M1 for square rooting Allow $x = \frac{16}{(\sin 90)} \times \sin(36.9\dots)$
	$(12.8 - "9.6") + "9.6" + "9.6" + 16 + 16 + 16$ oe			M1 (dep on M1) for a complete method to find the perimeter A1 oe e.g. $\frac{352}{5}$
		70.4		
				<b>Total 4 marks</b>

10	$12 = \frac{1}{2} \times 4.6 \times 8.3 \times \sin ABC$ or $\frac{4.6h}{2} = 12$ ( $h = 5.217\dots$ )		5	M1 a correct equation for the area to find angle $ABC$ or to find the perpendicular height of the triangle.
	$ABC = \sin^{-1}\left(\frac{12}{\frac{1}{2} \times 4.6 \times 8.3}\right) (= 38.947\dots)$ oe or $ABC = \sin^{-1}(0.6286) (= 38.947\dots)$ or $ABC = \sin^{-1}\left(\frac{"5.217\dots"}{8.3}\right) (= 38.947\dots)$ or $BM^2 = 8.3^2 - "5.217\dots"^2$			M1 A correct method to find angle $ABC$ or a correct method to find $BM$ where $CMB$ is $90^\circ$
	$AC^2 = 4.6^2 + 8.3^2 - 2 \times 4.6 \times 8.3 \times \cos("38.947")$ [allow $\cos 39^\circ$ ] or $AC^2 = 30.6(627\dots)$ $BM = \sqrt{8.3^2 - "5.217\dots"^2} (= 6.455\dots)$			M1 a correct start to the cosine rule to find length $AC$ or a fully correct method for $BM$
	or $AC = \sqrt{"30.6(6\dots)"}$ <b>or</b> 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
				<b>Total 5 marks</b>

11	$(\angle AOC =) 132 \times 2 (= 264)$		3	M1 for method to find angle at the centre. Do not award this mark if contradicted on the diagram eg if obtuse $AOC$ is labelled as 264
	eg $\frac{"264"}{360} \times 2 \times \pi \times 8.5$ ( $= 39.1\dots$ or $\frac{187}{15} \pi$ ) <b>or</b> $2 \times \pi \times 8.5 - \frac{360 - "264"}{360} \times 2 \times \pi \times 8.5$ ( $= 39.1\dots$ or $\frac{187}{15} \pi$ ) <b>or</b> $\frac{"264"}{360} \times 2 \times \pi \times 8.5 + 2 \times 8.5$ <b>or</b> $2 \times \pi \times 8.5 - \frac{360 - "264"}{360} \times 2 \times \pi \times 8.5 + 2 \times 8.5$			M1 for a method to find the length of arc $AC$ or perimeter of the sector – allow use of their $AOC$ as long as clearly labelled
	Correct answer scores full marks (unless from obvious incorrect working)	56.2		A1 accept 56.1 – 56.2
				<b>Total 3 marks</b>

12	eg $5x - 1 = 3x + 7.4$ oe <b>or</b> eg $10x - 2 + 48$ <b>or</b> $6x + 14.8 + 48$ <b>or</b> $24 + 24 + 5x - 1 + 3x + 7.4$ oe		4	M1 a correct equation to find $x$ <b>or</b> a correct expression for the perimeter in terms of $x$
	$x = 4.2$			A1 the correct value of $x$ (implies previous mark)
	$2 \times 24 + 2(5 \times "4.2" - 1)$ oe <b>or</b> $2 \times 24 + 2(3 \times "4.2" + 7.4)$ oe <b>or</b> $2 \times 24 + (5 \times 4.2 - 1) + (3 \times 4.2 + 7.4)$ oe eg $24 + 24 + 20 + 20$ oe			M1 dep on a correct method to find the perimeter – use of positive $x$ from correct working (1 <sup>st</sup> M1 awarded for an equation) <b>and</b> only if used the same measurement for $AD$ and $BC$
	working required	88		A1 can dep on either M1 or $x = 4.2$
				<b>Total 4 marks</b>

<b>13</b>	$(54 - 24) \div 2 (=15)$ [may be marked on diagram]		5	M1	
	$"15" \div 2 - (24 \div 2)^2 (=81)$			M1	ft their "15" (if > 12)
	[height =] $\sqrt{"15" \div 2 - (24 \div 2)^2} (=9)$			M1	ft their "15" (if > 12)
	$(24 \times "9") \div 2$ oe			M1	figures must be from correct working
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	108		A1	allow 107.9 – 108.1
	<b>ALTERNATIVES BELOW</b>				<b>Total 5 marks</b>
<b>13</b>	$(54 - 24) \div 2 (=15)$ [may be marked on diagram]		5	M1	
	or $x = \cos^{-1}\left(\frac{"12"}{"15"}\right) (=36.86\dots)$ or $y = \sin^{-1}\left(\frac{24 \div 2}{"15"}\right) (=53.13\dots)$ or $A = \cos^{-1}\left(\frac{15^2 + 15^2 - 24^2}{2 \times 15 \times 15}\right) (=106.2\dots)$ or $B = \cos^{-1}\left(\frac{15^2 + 24^2 - 15^2}{2 \times 15 \times 24}\right) (=36.8\dots)$			M1	ft their "15" (if > 12)
	or "12"tan"36.86..." (=9) (allow 8.9... for these) or "12" ÷ tan"53.13..." (=9) or "15" × sin "36.86..." (=9) or "15" × cos "53.13..." (=9)			M1	fit their "15" (if > 12) [ using Hero's formula $S = 0.5 \times 54 (=27)$ and ] $27 \times (27 - 24) \times (27 - "15") \times (27 - "15")$ $\sqrt{"27"}("27" - 24)("27" - "15")("27" - "15")$
	$(24 \times "9") \div 2$ oe			M1	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	108		A1	allow 107.9 – 108.1
					<b>Total 5 marks</b>

<b>14</b>	eg $(AB^2 =) 6^2 + 6^2 (=72)$ or $\sin 45 = \frac{6}{(AB)}$ or $\cos 45 = \frac{6}{(AB)}$ or or $(AB^2 =) 6^2 + 6^2 - 2 \times 6 \times 6 \times \cos 90$		5	M1	for a correct start to the method to find $AB$
	eg $(AB =) \sqrt{6^2 + 6^2} (= \sqrt{72} \text{ or } 6\sqrt{2} \text{ or } 8.48\dots)$ or $(AB =) \frac{6}{\sin 45} (= \sqrt{72} = 6\sqrt{2} = 8.48\dots)$ or $(AB =) \frac{6}{\cos 45} (= \sqrt{72} = 6\sqrt{2} = 8.48\dots)$ or $(AB =) \sqrt{6^2 + 6^2 - 2 \times 6 \times 6 \times \cos 90}$			M1	for a complete method to find the length of $AB$
	eg $\pi \times 6 (=6\pi \text{ or } 18.8\dots)$ or $\pi \times 6 \div 2 (=3\pi \text{ or } 9.42\dots)$ or $\pi \times "8.48\dots" (=26.6\dots)$ or $\pi \times "8.48\dots" \div 2 (=13.3\dots)$			M1	(indep) for a method to find the circumference of one whole circle or the arc length of one semicircle seen (may be embedded)
	eg $2 \times "3\pi" + "13.3\dots"$ or "9.42" + "9.42" + "13.3" or "18.8" + "13.3"			M1	for a complete correct method to find the perimeter of the shape
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	32.2		A1	accept answers in the range 32.1 – 32.3
					<b>Total 5 marks</b>

15	$7.2^2 + 5.4^2 (= 81)$		4	M1 for correct first step using Pythagoras	M1 for reaching one step from the length of $AB$ if using trig eg $(EAB \Rightarrow) \tan^{-1}\left(\frac{5.4}{7.2}\right) (= 36.8\dots)$ <b>and</b> $\sin("36.8\dots") = \frac{5.4}{AB}$
	$\sqrt{7.2^2 + 5.4^2} (= 9)$			M1 for complete Pythagoras method to find length of $AB/DC$ check the diagram for sight of 9, $DC$ marked as 9 implies M2	M1 for complete method to find the length of $AB/DC$ eg $\frac{5.4}{\sin("36.8\dots")} (= 9)$
	$7.2 + 5.4 + 6 + "9" + 6$ oe			M1 for a complete method to find the perimeter	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	33.6		A1 oe	
<b>Total 4 marks</b>					