1

Alternative method 1: using the radius		
$2\pi r$	M1	
$2\pi r \times \dfrac{x}{360}$	M1dep	oe length of arc
$2\pi r = 2\pi r \times \dfrac{x}{360} + 2r$ or $\pi = \dfrac{\pi x}{360} + 1$ or $2\pi = \dfrac{2\pi x}{360} + 2$	M1dep	oe equation
$\dfrac{360(\pi - 1)}{\pi}$ or $\dfrac{360\pi - 360}{\pi}$ or $360 - \dfrac{360}{\pi}$	A1	oe expression in π with r cancelled throughout

Alternative method 2: using the diameter		
πd	M1	oe
$\pi d \times \dfrac{x}{360}$	M1dep	oe length of arc
$\pi d = \pi d \times \dfrac{x}{360} + d$ or $\pi = \dfrac{\pi x}{360} + 1$	M1dep	oe equation
$\dfrac{360(\pi - 1)}{\pi}$ or $\dfrac{360\pi - 360}{\pi}$ or $360 - \dfrac{360}{\pi}$	A1	oe expression in π with d cancelled throughout

Additional Guidance	
Ignore attempts to simplify, cancel or expand a correct expression	M1M1M1A1

Q	Answer	Mark	Comments
	Alternative method 1 Shows algebraically that the angles are equal		
	$4x + 40$	M1	may be embedded or on the diagram
	$x + 2(2x + 20)$ or $x + 4x + 40$	M1	
	$x + 4x + 40 = 5x + 40$ and Yes	A1	
	Alternative method 2 Derives and solves an equation for angles at a point and substitutes into $5x + 40$ or $x + 2(2x + 20)$		
	$4x + 40$	M1	may be embedded or on the diagram or implied eg implied by $10x + 80 = 360$
2	$x + 2(2x + 20) + 5x + 40 = 360$ or $x + 4x + 40 + 5x + 40 = 360$ or $(x =) 28$	M1	oe equation eg $10x + 80 = 360$ $(x =) 28$ may be on the diagram
	$140 + 40 = 180$ and Yes or $28 + 152 = 180$ and Yes	A1	oe must obtain $(x =) 28$ from one expression and substitute $(x =) 28$ into a different expression
	Alternative method 3 Assumes line is a diameter. Derives and solves an equation for angles on a line using $5x + 40$ and substitutes into $x + 2(2x + 20)$ or $x + 2(2x + 20) + 5x + 40$		
	$5x + 40 = 180$	M1	
	$(x =) (180 - 40) \div 5$ or $(x =) 28$	M1dep	oe $(x =) 28$ may be on the diagram
	$28 + 152 = 180$ and Yes or $28 + 152 + 140 + 40 = 360$ and Yes	A1	oe must obtain $(x =) 28$ from one expression and substitute $(x =) 28$ into a different expression

2 cont	**Alternative method 4** Assumes line is a diameter. Derives and solves an equation for angles on a line using $x + 2(2x + 20)$ and substitutes into $5x + 40$ or $x + 2(2x + 20) + 5x + 40$		
	$x + 2(2x + 20) = 180$ or $x + 4x + 40 = 180$	M1	
	$(x =) (180 - 40) \div 5$ or $(x =) 28$	M1dep	oe $(x =) 28$ may be on the diagram
	$140 + 40 = 180$ and Yes or $28 + 152 + 140 + 40 = 360$ and Yes	A1	oe must obtain $(x =) 28$ from one expression and substitute $(x =) 28$ into a different expression
	Alternative method 5 Assumes line is a diameter. Derives and solves two equations for angles on a line/angles at a point		
	$5x + 40 = 180$ or $x + 2(2x + 20) = 180$ or $x + 4x + 40 = 180$ or $x + 2(2x + 20) + 5x + 40 = 360$ or $x + 4x + 40 + 5x + 40 = 360$	M1	
	$(x =) (180 - 40) \div 5$ or $(x =) 28$	M1dep	oe $(x =) 28$ may be on the diagram
	Obtains $(x =) 28$ from two equations for angles on a line/ angles at a point and Yes	A1	

	Additional Guidance	
	Choose the scheme that favours the student	
	Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts	
	Correct response with other incorrect work	M1M1A0
2 cont	Alt 1 $2(2x + 20) = 4x + 20$ followed by $x + 4x + 20$ Alt 1 $x + 4x + 20$ with $2(2x + 20) = 4x + 20$ not seen Apply marks in a similar way in alts 2, 4 and 5	M0M1 M0M0
	$(x =)$ 28	M1M1
	Allow $(x =)$ 28 to be embedded	M1M1
	No method marks scored with a value of x $(\neq 28)$ substituted into $5x + 40$ and $x + 2(2x + 20)$ giving the same value	M0M0A0
	Yes can be implied eg Alt 1 $x + 4x + 40 = 5x + 40$ and It is a diameter	M1M1A1

Q	Answer	Mark	Comments
3	$2\sqrt{11}$	B1	

Q	Answer	Mark	Comments
	20^2 $(\times \pi)$ or 400 $(\times \pi)$ or 15^2 $(\times \pi)$ or 225 $(\times \pi)$	M1	oe
	$\dfrac{3}{4} \times 20^2$ $(\times \pi)$ or 300 $(\times \pi)$ or $\dfrac{1}{3} \times 15^2$ $(\times \pi)$ or 75 $(\times \pi)$	M1dep	oe
	$\dfrac{3}{4} \times 20^2$ $(\times \pi)$ or 300 $(\times \pi)$ and $\dfrac{1}{3} \times 15^2$ $(\times \pi)$ or 75 $(\times \pi)$	M1dep	
4	300 $(\times \pi)$ and 75 $(\times \pi)$ and 4	A1	Accept P = 4Q for 4 SC2 40 $(\times \pi)$ and 30 $(\times \pi)$ and 30 $(\times \pi)$ and 10 $(\times \pi)$ and answer 3

Additional Guidance	
Answer 4 with no working	M0A0
Condone inconsistent use of π eg 300π and 75 and 4	M3A1
Condone, for example, $\pi400$ for 400π	
Allow use of a numerical value for π for method marks and for the A mark with answer 4	
Ignore units throughout	

Q	Answer	Mark	Comments
5	**Alternative method 1**		
	$20\pi \div 2\pi$ or 10	M1	oe may be seen on diagram implied by diameter = 20
	$x^2 + x^2 = (\text{their } 10)^2$ or $2x^2 = 100$ or $x^2 = 50$ or their $10 \times \sin 45$ or their $10 \times \cos 45$ or their $10 \times \dfrac{1}{\sqrt{2}}$	M1	oe any letter (condone a) their 10 is their length OQ (the radius of the circle)
	$\sqrt{\text{their } 10^2 \div 2}$ or $\sqrt{50}$ or $5\sqrt{2}$ or $4 \times \sqrt{50}$ or $4 \times$ their $10 \times \sin 45$ or $4 \times$ their $10 \times \cos 45$ or $40 \times \dfrac{1}{\sqrt{2}}$ or $\dfrac{40\sqrt{2}}{2}$ or $20\sqrt{2}$	M1dep	oe value for the length of one side of the square or the perimeter of the square eg $\dfrac{10}{\sqrt{2}}$ dep on previous mark
	2 with full working seen for M3	A1	

	Alternative method 2		
5 cont	$20\pi \div 2\pi$ or 10 or side length of square $= 5\sqrt{a}$	M1	oe may be seen on diagram implied by diameter $= 20$
	(Perimeter of square $= 20\sqrt{a}$ and) side length of square $= 5\sqrt{a}$ and $\left(5\sqrt{a}\right)^2 + \left(5\sqrt{a}\right)^2 = $ (their 10)^2	M1	oe their 10 is their length OQ (the radius of the circle) condone missing brackets if recovered
	$25a + 25a = $ (their 10)^2 or $50a = 100$	M1dep	dep on M1M1
	2 with full working seen for M3	A1	
	Additional Guidance		
	2 with no working		M0M0M0A0
	$\sqrt{2}$ on answer line (may score method marks)		A0

Q	Answer	Mark	Comments
	$0.5 \times \pi \times 45$ or $0.5 \times$ [141, 141.4] or [70.5, 70.7] or $0.5 \times \pi \times 45 + 75$ or [145.5, 145.7]	M1	oe eg 22.5π
	$(0.5 \times \pi \times 45 + 75) \div 18$ or their [145.5, 145.7] $\div$ 18	M1	oe their [145.5, 145.7] can be any value
	8.08(…) or 8.09(…)	A1	may be implied by 8.1
6	8.1	B1ft	ft any answer seen with greater than 2 sf SC2 3.9
	Additional Guidance		
	Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts, B1ft may also be awarded		
	$\dfrac{120}{18} = 6.67$ answer 6.7		M0M1A0B1ft
	$\dfrac{120}{18} = 6.7$		M0M1A0B0ft
	$0.5 \times \pi \times 45$ and $70.7 \div 18 = 3.93$ answer 3.9		M1M1A0B1ft
	SC2 for an answer of 3.9 without working is when 75 is not used		