

AREA AND CIRCUMFERENCE OF CIRCLES

Pearson Edexcel – Tuesday 19 May 2020 - Paper 1 (Non-Calculator) Higher Tier

1.

22	0.5	P1	derive an algebraic expression for the area of A eg $\frac{1}{8}\pi[(5x-1)^2-(3x-1)^2]$	
		P1	expand and simplify for either area A or area B eg $\frac{1}{8}\pi(16x^2-4x)$ or $\pi(x^2-2x+1)$	
		P1	(dep P2) equate and rearrange into a quadratic eqn of the form $ax^2+bx+c=0$ eg $2x^2+3x-2=0$	
		P1	(dep P3) factorise eg $(2x-1)(x+2)=0$ or use of formula eg $\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -2}}{2 \times 2}$	
		A1	oe	Accept only the single value of 0.5 oe but award 0 marks for a correct answer with no supportive working

Pearson Edexcel - Monday 8 June 2015 - Paper 2 (Calculator) Higher Tier

2.

*11			No supported by working	4	M1 for $\pi \times 7 (= 21.9 \text{ to } 22)$ or $\pi \times 7 \times 2.54 (= 55.5 \text{ to } 56)$ M1 (dep) for a complete method that could lead to two figures that are comparable eg $\pi \times 7 \times 2.54$; $\pi \times 7$ and $50 \div 2.54$ A1 for correct comparable figures eg 55.5 to 56 (cm); 21.9 to 22 (in) and 19.6 to 19.7 (in) C1 (dep M2) for a correct conclusion based on their comparable figures OR M1 for eg $50 \div \pi (= 15.9 \text{ to } 15.92)$ or $50 \div 2.54\pi (= 6.26 \text{ to } 6.27)$ M1 (dep) for a complete method that could lead to two figures that are comparable eg $(50 \div \pi) \div 2.54$; $50 \div \pi$ and 7×2.54 A1 for correct comparable figures eg 6.26 to 6.27 (in); 15.9 to 15.92 (cm) and 17.7 to 17.8 (cm) C1 (dep M2) for a correct conclusion based on their comparable figures
-----	--	--	-------------------------	---	--

Pearson Edexcel - Friday 13 June 2014 - Paper 2 (Calculator) Higher Tier

3.

4			28.3	2	M1 for $\pi \times 9$ or $2 \times \pi \times 4.5$ oe A1 for 28.25 – 28.3
---	--	--	------	---	--

Pearson Edexcel - Friday 8 November 2013 - Paper 2 (Calculator) Higher Tier

4.

12			440	2	M1 for $140 \times \pi$ oe or 439 A1 for 439.6 – 440
----	--	--	-----	---	---

Pearson Edexcel - Monday 4 March 2013 - Paper 2 (Calculator) Higher Tier

5.

5		$\pi \times 5 \times 1.80$	28.27	3	M1 for use of $\pi \times x$ (with $x = 5$ or $x = 2.5$) or $2 \times \pi \times x$ (with $x = 5$ or $x = 2.5$) M1 for $\pi \times 5 \times 1.8(0)$ or $2 \times \pi \times 2.5 \times 1.8(0)$ A1 for 28.26 or 28.27 or 28.28 or 28.3(0) or 28.8(0)
---	--	----------------------------	-------	---	---

Pearson Edexcel - Monday 14 November 2011 - Paper 4 (Calculator) Higher Tier

6.

8	(a)	$\pi \times 6 \times 2$	37.7	2	M1 for $\pi \times 12$ or $\pi \times 2 \times 6$ A1 for 37.6- 37.8
	(b)	$(100 \div 12) \times (50 \div 12) = 8 \times 4$ whole CDs	36	2	B2 for 33, 34, 35, 36 or M1 for $(100 \div 12) \times (50 \div 12)$ oe or 8×4 A1 for 32 SC : B1 for 44

Pearson Edexcel - Tuesday 9 November 2010 - Paper 3 (Non-Calculator) Higher Tier

7.

5		$\pi \times 10^2$	314	2	M1 for $\pi \times 10^2$ oe or 3.14×10^2 oe or 100π A1 for 314 oe
---	--	-------------------	-----	---	---

Pearson Edexcel - Friday 11 June 2010 - Paper 4 (Calculator) Higher Tier

8.

7		$\pi \times 12$	37.7	2	M1 for $\pi \times 12$ accept π as $\frac{22}{7}$ or 3.1 or better A1 for an answer in the range 37.6 to 37.8
---	--	-----------------	------	---	--

Pearson Edexcel - Tuesday 10 November 2009 - Paper 4 (Calculator) Higher Tier

9.

7		$\pi \times 5 \times 5$	78.5	2	M1 for $\pi \times 5 \times 5$ (accept π as 3.1 or better) A1 for 77.5 to 78.6 or 25π
---	--	-------------------------	------	---	--

OCR GCSE – Monday 9 November 2020 – Paper 6 (Calculator) Higher Tier

10.

16	(a)	[angle in a] semi-circle oe	1		Accept other reasoning if fully justified
	(b)	13.5 to 13.6	4	<p>B1 for angle BAC = 58° or angle ABC = 32°</p> <p>M2 for 16sin(<i>their</i> 58) or 16cos(<i>their</i> 32) or</p> <p>M1 for $\sin(\textit{their } 58) = \frac{BC}{\textit{their } 16}$ or $\cos(\textit{their } 32) = \frac{BC}{\textit{their } 16}$ or better</p> <p>If 0 or B1 scored then instead award SC2 for 6.7 to 6.8 as final answer</p> <p><u>Grads or rads:</u> If 0, 1 or 2 scored then instead award SC3 for 15.8[8...] to 15.9 or 12.6[4...] as final answer or If 0 scored award SC1 for 7.9[4...] or 6.3[2...]</p>	<p>May be seen on diagram or implied by use of sin58 or cos32</p> <p>Only award M marks if <i>their</i> angle and trig ratio are consistent ie do not accept 16sin32 unless angle BAC previously seen as 32.</p>

OCR GCSE – Thursday 24 May 2018 – Paper 4 (Calculator) Higher Tier

11.

8		145.2 to 146.2	5	<p>B1 for angle CBD = 28 soi or for angle BCD = 90 soi</p> <p>and</p> <p>M2 for $\frac{6.4}{\sin 28}$ oe or 13.6[3...] nfw</p> <p>or M1 for $\sin [28] = \frac{6.4}{[.]}$ oe</p> <p>and</p> <p>M1 for $\pi \times (\textit{their radius})^2$</p>	<p>B1 implied by e.g. 28 or 62 correctly used in trigonometry or 28, 62 or 90 (or symbol) marked in the correct place in the diagram</p> <p>13.6... can imply B1 however if it is marked on the wrong side, e.g. on AC, then it scores 0 marks</p>
---	--	----------------	---	---	---

OCR GCSE – Thursday 8 June 2017 – Paper 5 (Non - Calculator) Higher Tier

12.

16	(a)	104 <u>Angle at centre is twice</u> angle at <u>circumference</u>	2	B1 for 104	With no incorrect statement Must use underlined terms. Accept reverse: <u>angle</u> at <u>circumference</u> is <u>half</u> angle at <u>centre</u> Accept arc for circumference but not edge
	(b)	128 <u>Opposite angles in a cyclic quadrilateral</u> [are supplementary oe]	2	B1 for 128	With no incorrect statement Must use underlined terms Condone opp angles in cyclic quad = 180

OCR GSCE – Sample Papers – Paper 5 (Non - Calculator) Higher Tier

13.

12		$\frac{2}{3}$	3 1 AO1.3a 1 AO3.1b 1 AO3.2	B1 for radius of large circle = 3 × radius of small circle M1 for $\frac{9\pi r^2 - 3(\pi r^2)}{9\pi r^2}$ oe	
----	--	---------------	--------------------------------------	--	--

AQA GSCE – Tuesday 19 May 2020 – Paper 1 (Non - Calculator) Higher Tier

14.

12(a)	21 ÷ 7 × 2 (= 6) or 21 ÷ 3 = 7 and 6 ÷ 3 = 2 or 21 ÷ 7 = 3 and 6 ÷ 2 = 3 or 7 × 3 = 21 and 2 × 3 = 6	B1	oe eg 6 ÷ 2 = 3 and 7 × 3 = 21
	Additional Guidance		
	3 × 2 (= 6)		B0
	7 : 2 (=) 21 : 6 with no other working		B0
	7 : 2 (=) 21 : 6 with multiplication by 3 shown by arrow(s)		B1
	7 : 2 (=) 14 : 4 (=) 21 : 6		B1
	Do not condone incorrect representation of a division eg 7 ÷ 21 = 3		B0
	Do not condone incorrect mathematical representation eg 21 ÷ 7 = 3 × 2 = 6		B0
	21 ÷ 6 = 3.5, 3.5 × 2 = 7		B1
	21 × 2 = 42, 42 ÷ 7 = 6		B1

12(b)	Alternative method 1		
	$2 \times \pi \times 21$ or $\pi \times 42$ or 42π or [131.88, 132]	M1	oe condone [3.14, 3.142] for π
	$2 \times \pi \times 6 \div 4$ or $\pi \times 12 \div 4$ or 3π or [9.4, 9.43]	M1	oe arc length of quarter circle condone [3.14, 3.142] for π
	$2 \times \pi \times 6 \div 4 + 2 \times 6$ or $3\pi + 12$ or [21.4, 21.43]	M1dep	oe dep on 2nd M1 this does not imply M1M1M1
	$45\pi + 12$	A1	
	Alternative method 2		
	$2 \times \pi \times 21$ or $\pi \times 42$ or 42π or [131.88, 132]	M1	oe condone [3.14, 3.142] for π
	$2 \times \pi \times 21$ and $2 \times \pi \times 6 \div 4$ or 42π and 3π or $2 \times \pi \times 21 + 2 \times 6$ or $42\pi + 12$ or [143.88, 144]	M1dep	oe eg 42π and [9.4, 9.43] or [131.88, 132] and 3π
	$2 \times \pi \times 21 + 2 \times \pi \times 6 \div 4$ or $42\pi + 3\pi$ or 45π or [141, 141.43] or [153, 153.43]	M1dep	oe eg $42\pi + [9.4, 9.43]$ or [131.88, 132] + 3π
	$45\pi + 12$	A1	

Additional guidance for this question is on the next page

12(b) cont	Additional Guidance	
	Condone $3(15\pi + 4)$	M1M1M1A1
	Condone, for example, $\pi 42$ for up to M1M1M1	
	$21\pi + 3\pi + 12$	M0M1M1A0 on alt 1
	$441\pi + 3\pi + 12$	M0M1M1A0 on alt 1
	$42\pi + 36\pi + 12$	M1M1M0A0 on alt 2
	$441\pi + 36\pi + 12$	M0M0M0A0
	Using πr^2 instead of $2\pi r$ throughout	M0M0M0A0
	$45\pi + 12$ in working with incorrect further work, eg $45\pi + 12 = 57\pi$	M1M1M1A0

AQA GCSE – Thursday 8 June 2020 – Paper 3 (Calculator) Higher Tier

15.

Q	Answer	Mark	Comments
21(a)	Angle $ABP = 71$ or $180 - 2 \times 71$ or $180 - 142$ or $(180 - 90 - 71) \times 2$	M1	oe may be marked on diagram in correct position
	38	A1	
	Additional Guidance		
	71 or 38 in working with either angle correctly identified, 180 on answer line		M1A0
	71 or 38 in working with neither angle correctly identified, 180 on answer line		M0A0

Q	Answer	Mark	Comments
21(b)	Alternative method 1		
	(Angle $CXD =$) $360 - 204$ or 156	M1	may be marked on diagram in correct position
	$156 \div 2 = 78$ and Yes or $78 \times 2 = 156$ and Yes	A1	
	Alternative method 2		
	(Angle $CXD =$) $78 \times 2 = 156$	M1	may be marked on diagram in correct position
	$204 + 156 = 360$ and Yes or $360 - 156 = 204$ and Yes	A1	
	Additional Guidance		
Angle CXD should be double angle CED		M0A0	

AQA GCSE – Tuesday 21 May 2019 – Paper 1 (Non - Calculator) Higher Tier

16.

3	6π	B1	
---	--------	----	--

AQA GCSE – Tuesday 21 May 2019 – Paper 1 (Non - Calculator) Higher Tier

17.

9	Alternative method 1: areas		
	$\pi \times 10^2$ or 100π	M1	implied by [314, 314.2]
	$\pi \times (8 \div 2)^2$ or $\pi \times 4^2$ or 16π or $\pi \times (8 \div 2)^2 \div 2$ or $\pi \times 4^2 \div 2$ or $16\pi \div 2$ or 8π	M1	implied by [50.2, 50.3] or [25.12, 25.14] 92π or 84π or $92 : 8$ or $8 : 92$ or $84 : 16$ or $16 : 84$ implies M1M1
	(their $100(\pi) - \text{their } 8(\pi)$) \div their $8(\pi)$ or $92(\pi) \div 8(\pi)$ or their $100(\pi) \div \text{their } 8(\pi) (-1)$ or $12\frac{1}{2} (-1)$ or $12.5 (-1)$	M1dep	dep on M2 absence of π must be consistent condone $16(\pi)$ as their $8(\pi)$ in first calculation only, ie condone (their $100(\pi) - \text{their } 16(\pi)$) \div their $16(\pi)$ or $84(\pi) \div 16(\pi)$, but not their $100(\pi) \div \text{their } 16(\pi) (-1)$
	$11\frac{1}{2}$ or 11.5	A1	condone $\frac{23}{2}$
	Alternative method 2: scale factor		
	$\frac{10}{8 \div 2}$ or $\frac{10}{4}$ or $\frac{5}{2}$ or $\frac{10 \times 2}{8}$ or $\frac{20}{8}$ or 2.5	M1	oe scale factor of lengths eg $\frac{2}{5}$ or 0.4 accept $2 : 5$ or $5 : 2$ oe ratio π may be present, but must be consistent in numerator and denominator
	(their $\frac{5}{2}$) ² or $\frac{25}{4}$	M1dep	oe scale factor of areas eg $\frac{4}{25}$ accept $4 : 25$ or $25 : 4$ oe ratio
	$2 \times \text{their } \frac{25}{4} (-1)$ or $\frac{25}{2} (-1)$ or $12\frac{1}{2} (-1)$ or $12.5 (-1)$	M1dep	oe eg $2 \div \text{their } \frac{4}{25} (-1)$
	$11\frac{1}{2}$ or 11.5	A1	condone $\frac{23}{2}$
Additional Guidance is on the following page			

Additional Guidance		
9 (cont)	Accept, for example, $\pi 8$ or $\pi \times 8$ or $8 \times \pi$ for 8π	
	An answer of 11.5π with no incorrect working	M1M1M1A0
	Consistent use of πd^2 for the area of a circle gives the area of the circle as 400π , the area of the semicircle as 32π and the area of the shaded part as 368π . This also gives the answer 11.5, but scores zero	M0M0M0A0
	Irrespective of where their answer comes from and the presence of other measures such as circumference, students can gain the first two marks of alternative method 1 if it is clear that the methods or values given are for area eg 1 Big area = 100π , little area = 8π , big circumference = 20π , little circumference = 4π , $20 \div 4 = 5$ eg 2 100π , 8π , 20π , 4π	M1M1M0A0 M0M0
	Do not award the second mark if the value of 8π comes from πd This is implied by, eg, 'Area of circle = 20π , area of semi-circle = 8π '	M?M0 M0M0
	$\frac{100(\pi) - 16(\pi)}{16(\pi)}$ (which may give an answer of 5.25)	M1M1M1A0
	$\frac{100(\pi)}{16(\pi)}$ (which may give an answer of 6.25)	M1M1M0A0

AQA GCSE – Tuesday 6 November 2018 – Paper 1 (Non - Calculator) Higher Tier

18.

20	Alternative method 1		
	angle $QPR = 27$	M1	may be seen on diagram
	angle $XPS = \frac{180 - 50}{2}$ or 65	M1	may be seen on diagram
	angle $QPR = 27$ and angle $XPS = 65$ and angle $QPS = 92$ and angle in a semicircle is a right angle	A1	oe accept $92 \neq 90$
	all reasons for angle facts: angles in same segment (are equal) and angle sum of triangle (is 180) and base angles of isosceles triangle (are equal)	A1	oe oe oe

20 cont	Alternative method 2		
	angle $SXR = 180 - 50$ or 130 and angle $XRS = 180 - \text{their } 130 - 27$ and angle $PQS = \text{their } 23$	M1	may be seen on diagram angle $XRS = 23$
	angle $XSP = \frac{180 - 50}{2}$ or 65	M1	may be seen on diagram
	angle $SXR = 130$ and angle $XRS = 23$ and angle $PQS = 23$ and $XSP = 65$ and angle $QPS = 92$ and angle in a semicircle is a right angle	A1	oe accept $92 \neq 90$
	all reasons for angle facts: angles on a straight line (add up to 180) and angle sum of triangle (is 180) and angles in same segment (are equal) and base angles of isosceles triangle (are equal)	A1	oe oe oe oe

AQA GCSE – Thursday 8 November 2018 – Paper 2 (Calculator) Higher Tier

19.

	Pi or π	B1	accept a value in range [3.14, 3.142]
	Additional Guidance		
5	Accept incorrect spelling if intention is clear eg accept pie		
	Answer ($C =$) πd		B0
	Answer ($C =$) πd ($k =$) π		B1

AQA GCSE – Monday 24 May 2018 – Paper 1 (Non - Calculator) Higher Tier

20.

18	$\pi \times 10^2 - \pi \times 7^2$ or $100\pi - 49\pi$ or 51π or $\frac{1}{2} \times \pi \times 10^2 - \frac{1}{2} \times \pi \times 7^2$ or $\frac{1}{2} \times 100\pi - \frac{1}{2} \times 49\pi$ or $\frac{1}{2} \times 51\pi$ or 25.5π	M1	oe implied by 102π method to work out front and/or back faces – must not be part of a method to work out volume ($\times 30$) may be taken to be full circles
	$2 \times \pi \times 10 \times 30$ or 600π or $\frac{1}{2} \times 2 \times \pi \times 10 \times 30$ or 300π or $2 \times \pi \times 7 \times 30$ or 420π or $\frac{1}{2} \times 2 \times \pi \times 7 \times 30$ or 210π or 1020π or 510π	M1	oe method to work out outer and/or inner curved surfaces may be taken to be full circles 1122π implies M1M1
	$(\frac{1}{2} \times \pi \times 10^2 - \frac{1}{2} \times \pi \times 7^2) \times 2$ + $\frac{1}{2} \times 2 \times \pi \times 10 \times 30$ + $\frac{1}{2} \times 2 \times \pi \times 7 \times 30$ or $2 \times 25.5\pi + 300\pi + 210\pi$ or 561π	M1dep	oe dep on M1M1 correct method to work out total of front, back, outer curved and inner curved surfaces
	$2 \times 30 \times 3$ or 180	M1	implied by an answer of $n\pi + 180$ do not award if 180 is used as 180π
	$561\pi + 180$	A1	
	Additional Guidance		
	150π and 105π implies use of radius for curved surface areas		max M1M0M0M1A0
Condone use of [3.14, 3.142] for π up to M1M1M0M1A0			

AQA GCSE – Thursday 7 June 2018 – Paper 2 (Calculator) Higher Tier

21.

1	segment	B1	
	Additional Guidance		

AQA GCSE – Thursday 7 June 2018 – Paper 2 (Calculator) Higher Tier

22.

10	Alternative method 1		
	$\frac{4}{3}\pi \times 30^3$ or $36\,000\pi$ or [112 757, 113 112] or $\frac{1}{2} \times \frac{4}{3}\pi \times 30^3$ or $18\,000\pi$ or [55 954, 56 839]	M1	oe allow 1.33... for $\frac{4}{3}$ allow 0.66... or 0.67 for $\frac{2}{3}$
	their [112 757, 113 112] + 4000 or 9π or 28.(...) or their [55 954, 56 839] + 4000 or $\frac{9\pi}{2}$ or [13.9, 14.21] or their [112 757, 113 112] + (4000 × 60) or $\frac{3\pi}{20}$ or [0.46, 0.4713] or their [55 954, 56 839] + (4000 × 60) or $\frac{3\pi}{40}$ or 0.23... or 0.24	M1dep	
[13.9, 14.21] and Yes or 0.23... or 0.24 and Yes	A1		

10 cont	Alternative method 2		
	$\frac{4}{3}\pi \times 30^3$ or 36 000 π or [112 757, 113 112] or $\frac{1}{2} \times \frac{4}{3}\pi \times 30^3$ or 18 000 π or [55 954, 56 839]	M1	oe allow 1.33... for $\frac{4}{3}$ allow 0.66... or 0.67 for $\frac{2}{3}$
	4000 \times 15 or 60 000	M1	
	[55 954, 56 839] and 60 000 and Yes	A1	
	Alternative method 3		
	$\frac{4}{3}\pi \times 30^3$ or 36 000 π or [112 757, 113 112] or $\frac{1}{2} \times \frac{4}{3}\pi \times 30^3$ or 18 000 π or [55 954, 56 839]	M1	oe allow 1.33... for $\frac{4}{3}$ allow 0.66... or 0.67 for $\frac{2}{3}$
	their [112 757, 113 112] + 15 or 2400 π or [7517, 7541] or their [55 954, 56 839] + 15 or 1200 π or [3730, 3790]	M1dep	
	[3730, 3790] and Yes	A1	
	Additional guidance		
	Do not award A1 if incorrect conversion of $\frac{1}{4}$ hour seen		

AQA GCSE – Thursday 8 June 2017 – Paper 2 (Calculator) Higher Tier

23.

12	AD	B1	
	Additional Guidance		

AQA GCSE – Sample Paper 1 (Non - Calculator) Higher Tier

24.

21	angle $ABC = x$	M1	
	angle $BAC = x$ and alternate segment theorem	M1	
	angle $ABC = x$ and angle $BAC = x$ and alternate segment theorem and two equal angles so isosceles ($AC = BC$)	A1	