

Circles, arcs and sectors

Foundation and Higher tiers | Total marks: 70

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Parts of a circle	G9	Foundation	1	No	2
2	Segments and tangents	G9	Common	3	No	2
3	Circles in terms of π	G17 N8	Common	4	No	3
4	Exact area, show that	G17 N8	Common	5	No	3
5	Sector in terms of π	G18 N8	Common	7	No	4
6	Diameter and circumference	G17 G9	Foundation	2	Yes	3
7	Area and circumference of a circle	G17	Foundation	3	Yes	4
8	Comparing areas of a circle and a square	G17	Foundation	3	Yes	3
9	Perimeter of a semicircle	G17	Foundation	4	Yes	3
10	Diameter from a circumference	G17 N13	Foundation	4	Yes	3
11	Circumference in context, a decision	G17	Foundation	5	Yes	3
12	Compound area with a semicircle	G17	Foundation	5	Yes	3
13	Area to circumference	G17	Foundation	5	Yes	3
14	Perimeter of a sector, spot the error	G18	Common	6	Yes	4
15	Sector, finding the angle	G18	Common	6	Yes	3
16	Area of a segment	G18 G23	Higher	7	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Sector: arc length to area	G18	Common	7	Yes	4
18	Perimeter of a segment	G18 G20	Common	8	Yes	5
19	Area of a major segment, finding the angle first	G18 G22 G23	Higher	9	Yes	5
20	Area of overlap of two circles	G18 G22 G23	Higher	9	Yes	6
	Total					70

Question 1 G9 · Foundation · Grade 1 · 2 marks

Q	Answer	Mark	Comments
1(a)	radius	B1	
1(b)	chord	B1	

Question 2 G9 · Common · Grade 3 · 2 marks

Q	Answer	Mark	Comments
2(a)	segment	B1	
2(b)	a straight line touching the circle at P	B1	not crossing the circle, by eye at 90° to OP

Question 3 G17 N8 · Common · Grade 4 · 3 marks

Q	Answer	Mark	Comments
3(a)	$\pi \times 6^2$	M1	oe
	36π	A1	
3(b)	20	B1	

Question 4 G17 N8 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
4	4×4 or 16	M1	the square
	$4 \times \frac{1}{4} \times \pi \times 2^2$ or 4π	M1	oe, the four quarter circles make one circle
	$16 - 4\pi$	A1	a full method with no errors

Question 5 G18 N8 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
5	$\frac{120}{360} \times \pi \times r^2 = 12\pi$	M1	oe
	$r = 6$	A1	or $r^2 = 36$
	$\frac{120}{360} \times 2 \times \pi \times \text{their } 6$	M1	oe
	4π	A1	

Question 6 G17 G9 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
6(a)	9.5	B1	
6(b)	$\pi \times 9.5$ or $2 \times \pi \times 4.75$	M1	oe, ft their diameter
	29.8	A1	accept 29.8 or [29.84, 29.85]

Question 7 G17 · Foundation · Grade 3 · 4 marks

Q	Answer	Mark	Comments
7(a)	$\pi \times 0.9^2$	M1	oe
	2.54	A1	accept 2.54 or [2.544, 2.545]
7(b)	$\pi \times 1.8$	M1	oe, $2 \times \pi \times 0.9$
	5.65	A1	accept 5.65 or [5.654, 5.655]

Question 8 G17 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
8	$\pi \times 1.24^2$ or 4.831...	M1	oe
	2.2×2.2 or 4.84	M1	
	square rug and 4.83 and 4.84	A1	accept [4.83, 4.831] for the circle

Question 9 G17 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
9	$\pi \times 12 \div 2$ or 18.85...	M1	oe
	their 18.85 + 12	M1	the diameter added
	30.8	A1	accept 30.8 or [30.84, 30.85]

Question 10 G17 N13 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
10	$1700 \div 850$ or 2 (m), or $170\,000 \div 850$ or 200 (cm)	M1	oe, the circumference
	their $2 \div \pi$ or 0.637...	M1	oe
	64	A1	accept [63.6, 63.7]

Question 11 G17 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
11	$\pi \times 66$ or 207.3...	M1	oe
	their 207.3×500 and a correct conversion	M1	oe, 103 673 cm or 1036.7 m
	Yes and 1036.7 m	A1	oe, Yes and 103 673 cm compared with 100 000 cm

Question 12 G17 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
12	1.2×1.5 or 1.8	M1	
	$\frac{1}{2} \times \pi \times 0.6^2$ or 0.565...	M1	oe
	2.37	A1	accept 2.37 or [2.365, 2.366]

Question 13 G17 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
13	$\pi r^2 = 100$	M1	oe
	$r = \sqrt{(100 \div \pi)}$ or 5.642...	M1	oe
	35.4	A1	accept 35.4 or [35.44, 35.45]

Question 14 G18 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
14(a)	$\pi \times 9$ should be $\pi \times 18$ (or $2 \times \pi \times 9$)	B1	oe, used the radius in place of the diameter
	she has not added the two radii (18 cm)	B1	oe, she has only found an arc
14(b)	$\frac{140}{360} \times \pi \times 18 + 9 + 9$	M1	oe
	40.0	A1	accept 40.0 or [39.99, 40.00]

Question 15 G18 · Common · Grade 6 · 3 marks

Q	Answer	Mark	Comments
15	$\frac{x}{360} \times \pi \times 7.5^2 = 50$	M1	oe
	$50 \div (\pi \times 56.25) \times 360$	M1	oe
	101.9	A1	accept 101.9 or [101.85, 101.86]

Question 16 G18 G23 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
16	$\frac{70}{360} \times \pi \times 10^2$ or 61.09...	M1	oe, the sector
	$\frac{1}{2} \times 10 \times 10 \times \sin 70$ or 46.98...	M1	oe, the triangle
	their sector – their triangle	M1	dep on M1M1
	14.1	A1	accept 14.1 or [14.10, 14.11]

Question 17 G18 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
17	$\frac{72}{360} \times 2 \times \pi \times r = 15$	M1	oe
	$r = 11.94...$	A1	
	$\frac{72}{360} \times \pi \times \text{their } 11.94^2$	M1	oe, or $\frac{1}{2} \times \text{their } 11.94 \times 15$
	89.5	A1	accept 89.5 or [89.52, 89.53]

Question 18 G18 G20 · Common · Grade 8 · 5 marks

Q	Answer	Mark	Comments
18	$\frac{48}{360} \times \pi \times r^2 = 64$	M1	oe
	$r = 12.36...$	A1	or $r^2 = 152.8...$
	$\frac{48}{360} \times 2 \times \pi \times \text{their } 12.36$	M1	oe, the arc, 10.36...
	$2 \times \text{their } 12.36 \times \sin 24$	M1	oe, the chord AB, 10.06..., or the cosine rule
	20.4	A1	accept 20.4 or [20.41, 20.42]

Question 19 G18 G22 G23 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
19	$\cos AOB = \frac{25^2 + 25^2 - 42^2}{2 \times 25 \times 25}$	M1	oe, or $\sin(\frac{1}{2} AOB) = \frac{21}{25}$
	angle AOB = 114.28...	A1	
	$\frac{\text{their } 114.3}{360} \times \pi \times 25^2 - \frac{1}{2} \times 25 \times 25 \times \sin 114.3$	M1	oe, the segment above AB = 338.4...
	$\frac{\pi \times 25^2 - \text{their segment}}{\pi \times 25^2} \times 100$	M1	oe, water area 1625.0... over 1963.4...
	82.8	A1	accept 82.8 or [82.76, 82.77]

Question 20 G18 G22 G23 · Higher · Grade 9 · 6 marks

Q	Answer	Mark	Comments
20	$\cos A = \frac{5^2 + 9^2 - 7^2}{2 \times 5 \times 9}$	M1	oe, an angle at A in a triangle with sides 5, 7 and 9
	50.70... at A, so 101.4... for the whole angle	A1	oe
	$\cos B = \frac{7^2 + 9^2 - 5^2}{2 \times 7 \times 9}$	M1	oe, 33.56... so 67.1... for the whole angle
	$\frac{\text{their } 101.4}{360} \times \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 101.4$	M1	oe, the segment of the 5 m circle, 9.87...
	$\frac{\text{their } 67.1}{360} \times \pi \times 7^2 - \frac{1}{2} \times 7^2 \times \sin 67.1$	M1	oe, the segment of the 7 m circle, 6.13...
	16.0	A1	accept [15.9, 16.1]