Mark scheme for 1MA1 Higher themed papers: Area and perimeter: Arcs, Sectors and Circles

GCSE Mathematics (1MA1)

Themed papers – Area and perimeter: Arcs, Sectors and Circles

Compiled from student-friendly mark schemes

Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn't show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.

NOTES ON MARKING PRINCIPLES

Guidance on the use of codes within this mark scheme
M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect. P1 – process mark. This mark is generally given for setting up an appropriate process to find a solution in the context of the question. A1 – accuracy mark. This mark is generally given for a correct answer following correct working. B1 – working mark. This mark is usually given when working and the answer cannot easily be separated. C1 – communication mark. This mark is given for explaining your answer or giving a conclusion in context supported by your working. Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

Question 1 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi \times 4^2 \div 2 = 25.13$		This mark is given for finding the area of the semi-circle
	$64 - 25.13 = 38.86$		This mark is given for finding the area of the trapezium
	$38.86 \div 5 \times 2 = 15.54$		This mark is given for finding the sum of *AB* and *DC*
	$15.54 - 8 = 7.546$		This mark is given for a complete process to find the missing length
	7.5		This mark is given for an answer in the range of 7.5 to 7.6

Question 2 (Total 5 marks)

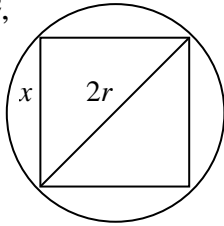| Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi \times 54$ (= 169.6460033) or $(\pi \times 54) \div 2$ (= 84.82300165)	P1	This mark is given for process to find the distance around one or both ends of the track
	$40 \times 2 + 169.6460033$ (= 249.6460033)	P1	This mark is given for complete process to find the total length of the track
	e.g. $\pi \times 590$ (= 1853.539666 mm) or $\pi \times 0.59$ (= 1.8539666 m)	P1	This mark is given for process to find the circumference of wheel
	$249.64\ldots \div 1.85\ldots$ or unrounded answer of 134.6860863	P1	This mark is given for complete process to find the number of revolutions in consistent units
	135	A1	This mark is given for the correct answer only

Question 3 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi \times 7^2 = 49\pi = 153.938\ldots$	P1	This mark is given for a process to find the area of the circle that the sector is part of
	$\dfrac{40}{49\pi} \times 360 = 93.54$	P1	This mark is given for a process to find the angle of the sector at O
	$\dfrac{93.54}{360} \times 2 \times \pi \times 7 = 11.43$	P1	This mark is given for a process to find the length of the arc AB
	$11.43 + 7 + 7 = 25.43$	A1	This mark is given for a correct answer in the range 25 to 25.44

Question 4 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$AOB = 60°$	B1	This mark is given for recognising an angle of 60 at AOB
	$\pi r^2 \times \dfrac{60}{360} = \dfrac{121\pi}{6} = 63.3\ldots$	P1	This mark is given for a process to find the area of the sector NOQ
	$\dfrac{1}{2} ab \sin C = \dfrac{1}{2} \times 7^2 \times \sin 60$ $= 24.5 \times \dfrac{\sqrt{3}}{2} = 21.2\ldots$	P1	This mark is given for a process to find the area of the triangle AOB
	$\dfrac{63.3 - 21.2}{63.3} \times 100$	P1	This mark is given for a process to find the percentage of the sector which is shaded
	66.5	A1	This mark is given for the correct answer only (in the range 66.5 to 66.6)

Question 5 (Total 4 marks)

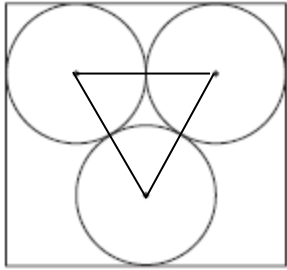| Part	Working or answer an examiner might expect to see	Mark	Notes
	Square with side x and circle with radius r $\pi r^2 = 49$, $r^2 = \dfrac{49}{\pi}$	M1	This mark is given for a method to find r
	$(2r)^2 = x^2 + x^2$, $4r^2 = 2x^2$ $2r^2 = x^2$	M1	The mark is given for use of Pythagoras to set up an equation in x^2
	$\dfrac{98}{\pi} = x^2$	M1	This mark is given for a method to rearrange to find a value for x^2
	5.59	A1	5.5 to 5.6

Question 6 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	circumference of **A** : circumference of **B** = 10 : 9	M1	This mark is given for a method to find the ratio of the circumferences of circles **A** and **B**
	area of **A** : area of **B** $= 10^2 : 9^2$ = 100 : 81	A1	This mark is given for correctly finding the ratio of the areas of circles **A** and **B**
(b)	area of **E** : area of **F** = 144 : 100	P1	This mark is given for a method to find the ratio of the area of the squares **E** and **F**
	side of **E** : side of **F** $= \sqrt{144} : \sqrt{100}$ = 12 : 10 = 6 : 5	A1	This mark is given for correctly finding the ratio of the sides of the squares **E** and **F**

Question 7 (Total 3marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\dfrac{44}{\pi} = 14.0056$	P1	This mark is given for a process to find the diameter of the circle
	$\frac{1}{2} \times 14.0056 \times 14.0056 \times \sin 60°$ $= \frac{1}{2} \times 14.0056 \times 14.0056 \times \dfrac{\sqrt{3}}{2}$	P1	This mark is given for a process to use $\frac{1}{2}ab \sin C$ to find the area of the triangle
	84.9	A1	This mark is given for an answer in the range 84.8 – 85

Question 8 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$24 \times 4 = 96$	P1	This mark is given for a process to find the length of the rectangle
	$48 \sin 60° = 48 \times \dfrac{\sqrt{3}}{2} = 24\sqrt{3}$ or $\sqrt{(48^2 - 24^2)} = 24\sqrt{3}$	P1	This mark is given for a process to find the perpendicular height of an equilateral triangle of side 48 cm
	$24 + 24 + 24\sqrt{3} = 89.569\ldots$	P1	This mark is given for a complete process to find the width of rectangle
	8600 (to 3 significant figures)	A1	This mark is given for a correct answer only

Question 9 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi \times 10^2 \div 2 = 50\pi$	M1	This mark is given for a method to find the area of the semicircle
	$\pi \times 20^2 \div 4 = 100\pi$	M1	This mark is given for a method to find the area of the quarter circle
	$100\pi - 50\pi = 50\pi$ $20 \times 20 = 400$	M1	This mark is given for a method to find the shaded area and the area of the square
	$\dfrac{50\pi}{400} = \dfrac{\pi}{8}$	A1	This mark is given for a correct conclusion supported by correct working.

Question 10 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\dfrac{360-140}{360} \times \pi \times 2r = \dfrac{360-140}{360} \times \pi \times 12$ $= 23.038\ldots$	P1	This mark is given for a process to find the length of the major arc
	$\dfrac{14}{\sin 140} = \dfrac{OD}{\sin 24}$	P1	This mark is given for a process to use the sine rule to find the distance OD
	$OD = \dfrac{14\sin 24}{\sin 140} = \dfrac{5.6943\ldots}{0.6427\ldots} = 8.858\ldots$	P1	This mark is given for finding the length OD
	$23.038 + 14 + (8.858 - 6) = 39.896$	P1	This mark is given for a complete process to find the perimeter
	39.9 (3 s.f.)	A1	This mark is given for an answer to three significant figures in the range 39.8 to 40

Question 11 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi \times 16$ $\pi \times 49$ $\pi \times 100$	1	This mark is given for process to find the area of any relevant circle
	$\pi \times 7^2 - \pi \times 4^2$ $= \pi \times 33$	1	This mark is given for complete method to find the shaded area
	$\pi \times 33$ and $\pi \times 100$	1	This mark is given for for 2 comparable figures,
	Daisy is wrong since it should be $\dfrac{33}{100}$ which is $\neq \dfrac{1}{3}$	1	This mark is given for a correct statement supported by their figures

Question 12 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\pi (2n + 6)^2$ or $\pi (n - 1)^2$ or $\pi (n + 13)^2$	P1	This mark is given for a process to find the area of at least one of the circles in algebraic form
	$\pi (2n + 6)^2 - \pi (n - 1)^2 > \pi (n + 13)^2$	P1	This mark is given for a process to set up an inequality in n
	$4n^2 + 24n + 36 - n^2 + 2n - 1$ $> n^2 + 26n + 169$	P1	This mark is given for a process to remove all brackets
	$n^2 > 67$	P1	This mark is given for isolating the n^2 term
	9	A1	This mark is given for the correct answer only

Question 13 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\dfrac{80}{360} \times \pi \times 30^2 \ (= 628.32\ldots)$	P1	This mark is given for a process to find the area of sector AOB
	$\dfrac{1}{2} \times 30^2 \times \sin 80° \ (= 443.16...)$	P1	This mark is given for a process to find the area of triangle AOB
	$628.32\ldots - 443.16\ldots \ (= 185.16\ldots)$	P1	This mark is given for a process to process to find the area of the segment
	$\dfrac{185.16...}{\pi \times 30^2} \times 100$	P1	This mark is given for a process to find the area shaded as a percentage of the area of the circle
	6.55	A1	This mark is given for an answer in the range 6.5 – 6.6

Question 14 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Arc length $= 25 - 9 - 9 = 7$	P1	This mark is given for a process to find the arc length
	$\dfrac{7}{2\pi r} = \dfrac{7}{18\pi} = \dfrac{x}{360}$	P1	This mark is given for a process linking the arc length to the circumference
	$x = \dfrac{7 \times 360}{18\pi}$	P1	This mark is given for a complete process to find the value of x
	$= 44.6°$	A1	This mark is given for the correct answer only

Question 15 (Total 5 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$OAB = 90°$; $OCB = 90°$	1	This mark is given for identifying a right angle in the diagram
	$AB = CB = 10 \times \tan 60° = 10\sqrt{3}$	1	Thismark is given for finding the length of AB or CB
	Area $OAC = \dfrac{120}{360} \times \pi \times 10^2 =$ 104.72…	1	This mark is given finding the area of the sector
	Area $OAB = OBC$ $= \dfrac{1}{2} \times 10 \times 10\sqrt{3} = 50\sqrt{3}$	1	This mark is given for finding the area of the right angled triangle OAB or OBC
	Shaded area = area $OABC$ – area OAC $= (2 \times 50\sqrt{3}) - 104.72 = 68.5$	1	This mark is given for a correct answer in the range 68.4 – 68.6

Question 16 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\dfrac{1}{8} \times \pi \times 10^2 \times 10$ $(=\dfrac{1000\pi}{8})$ or $\dfrac{1}{6} \times \pi \times 10^2 \times 5$ $(=\dfrac{500\pi}{6})$	P1	This mark is given for a process to find the volume of the shape.
	$40\pi \div \dfrac{1000\pi}{8}$ or $50\pi \div \dfrac{500\pi}{6}$	P1	This mark is given for a process to find the density of the shape.
	$40\pi \times \dfrac{8}{1000\pi} = \dfrac{320}{1000}$ $(= 0.32)$ **and** $50\pi \times \dfrac{6}{500\pi} = \dfrac{300}{500}$ $(= 0.6)$ oe	P1	This mark is given for a complete process to find the densities.
	$\dfrac{"0.6" - "0.32"}{"0.32"}$ or $\dfrac{"0.6"}{"0.32"}$	P1	This mark is given for a process to find percentage.
	87.5	A1	This mark is given for the correct answer only

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Performance data:

Q	Taken from			Total Marks available	TOPIC	Spec Ref	AO	% Mean marks	Edexcel mean averages Marks of candidates who achieved grade:										
	Q	Series	Paper						ALL	9	8	7	6	5	4	3	2	1	U
1	6	Mock Set 4	2H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	5	Mock Set 2	2H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	12	June 2019	2H	4	Geometry	G18, R10	3	55	2.20	3.81	3.64	3.21	2.29	1.17	0.47	0.21	-	-	0.13
4	17	June 2017	2H	5	Geometry	R9, G18	3	37	1.87	4.50	3.90	2.89	1.68	0.75	0.24	0.06	-	-	0.03
5	8	June 2017	3H	4	Geometry	G17, G20	3	36	1.42	3.42	2.56	1.86	1.32	0.84	0.40	0.11	-	-	0.02
6a	9a	June 2019	2H	2	Ratio	R12	1	36	0.72	1.64	1.25	0.88	0.62	0.42	0.25	0.11	-	-	0.06
6b	9b	June 2019	2H	2	Ratio	R12	1	37	0.74	1.68	1.36	0.98	0.67	0.39	0.18	0.05	-	-	0.02
7	13	Nov 2018	2H	3	Geometry	G17, G23	3	24	0.72	2.60	2.21	2.07	1.47	1.10	0.43	0.15	-	-	0.04
8	21	June 2017	2H	4	Geometry	, G20, G16	3	19	0.74	1.98	1.16	0.85	0.68	0.50	0.31	0.15	-	-	0.08
9	7	Nov 2018	1H	4	Geometry	N8, R3, G17, G18	2	17	0.67	3.80	3.27	2.66	1.64	0.92	0.25	0.05	-	-	0.02
10	16	Nov 2018	3H	5	Ratio	G22, G18	3	12	0.58	4.80	4.50	2.79	1.57	0.61	0.08	0.01	-	-	0.00
11	4	Nov 2017	1H	4	Geometry	N1, R3, G17	3	12	0.47	3.50	3.32	2.24	1.69	0.93	0.32	0.12			0.02
12	12	Mock Set 3	1H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	15	Mock Set 1	2H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	19	Mock Set 3	2H	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	20	Nov 2017	2H	5	Geometry	G10 G16 G18 G20	3	5	0.26	3.38	2.65	1.59	0.96	0.43	0.15	0.04			0.02
16	19	Mock Set 4	1H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				71					10.39	35.11	29.82	22.02	14.59	8.06	3.08	1.06	0	0	0.44