

GCSE Mathematics (1MA1)

Themed papers – Spheres and Cones

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 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$\pi r^2 \times 6r$	P1	This mark is given for a process to find volume of cylinder
	$\frac{3 \times \frac{4}{3} \pi r^3}{\pi r^2 \times 6r} = \frac{2}{3}$	P1	This mark is given for complete process to find the volume of 3 spheres divided by the volume of the cylinder
	$\frac{1}{3}$	A1	This mark is given for the correct answer only (the proportion not filled)
(b)	Proportion between number of spheres and relevant height cylinder remains constant	C1	This mark is given for a correct statement

Question 2 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$\frac{4}{3} \times 3 \times 2^3 = 32$	P1	This mark is given for to estimate the volume of a sphere
	$\frac{1500}{32}$ or $\frac{1500}{30}$	P1	This mark is given for a complete process to estimate the number of spheres that can be made
	An estimate in the range 46 – 50	A1	This mark is given for an estimate supported by calculations
(b)	The number of spheres would be less because most divisors have been rounded down	C1	This communication mark is given for a correct statement

Question 3 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Cone: $\frac{1}{3} \times \pi \times 3^2 \times 10 = 30\pi$ Hemisphere: $\frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3 = 18\pi$	M1	This mark is given for a method to use the formulae to find the volumes of the cone and the hemisphere
	$(\frac{1}{3} \times \pi \times 3^2 \times 10) + (\frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3)$	M1	This mark is given for a complete method to find the total volume of the shape
	$30\pi + 18\pi$	M1	This mark is given for a correct partial simplification
	48	A1	This mark is given for the correct answer only

Question 4 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$100 \approx \frac{1}{3} \times 3 \times 25h$	M1	This mark is given for substitution of suitable terms into the formula for the volume of a cone
	$h \approx \frac{100}{25}$	M1	This mark is given for a method to rearrange and solve
	$h \approx 4$	A1	This mark is given for a correct single value from estimate (accept answers in the range 3.5 to 4.5)
(b)	More since the number in the numerator goes up; the numbers in the denominator go down.	C1	This communication mark is given for a correct comment

Question 5 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$V_A = \frac{4}{3}\pi \times 2^3$ or $V_B = \frac{4}{3}\pi \times 3^3$	P1	This mark is given for a process to find the volume of at least one sphere
	Gold: $19\,000 \times \frac{1000}{1000000} = 19$ Silver: $10\,000 \times \frac{1000}{1000000} = 10$	P1	This mark is given for a process to convert density to g/cm^3
	Gold: $\frac{4}{3}\pi \times 2^3 \times 19 = \frac{4}{3}\pi \times 152$ Silver: $\frac{4}{3}\pi \times 3^3 \times 10 = \frac{4}{3}\pi \times 270$	P1	This mark is given for a process to find the mass of each sphere (using the formula for the volume of a sphere $\times$ density)
	The silver sphere has greater mass; $(\frac{4}{3}\pi \times) 270 > (\frac{4}{3}\pi \times) 152$	C1	This mark is given for a correct comparison from two correct values that can be used to compare mass

Question 6 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$576\pi = \frac{1}{4} \times \frac{4}{3}\pi r^3$	P1	This mark is given for substituting into the formula for a sphere to start to find the radius r
	$576 = \frac{1}{3}r^3, \quad r = \sqrt[3]{576 \times 3} = 12$	P1	This mark is given for a complete process to find r , the radius of the sphere
	$\frac{1}{4} \times 4\pi r^2 = \pi r^2 = 144\pi$	P1	This mark is given for a process to find the curved surface area
	$144\pi + (2 \times \frac{1}{2} \times 144\pi)$	P1	This mark is given for process to find the complete surface area
	288π	A1	This mark is given for the correct answer only (accept anything which rounds to 904.9)

Question 7 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{1}{2} \times \frac{4}{3} \times \pi \times (4.2)^3$	P1	These marks is given for a process to find the volume of the hemisphere
	155	A1	This mark is given for the correct answer only (to 3 significant figures)

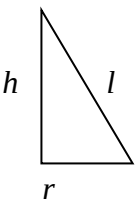
Question 8 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Volume of cylinder = $\pi \times (3x)^2 \times h$ Volume of one sphere = $\frac{4}{3} \pi \times (\frac{1}{2}x)^3$	P1	This mark is given for a process of substituting to find volume of cylinder and volume of sphere
	$9x^2\pi h = 270 \times \frac{4}{3} \pi \times \frac{x^3}{8}$	P1	This mark is given for a process to for forming a correct equation
	Cancelling, $x^2h = 5x^3$ ($h =$) $5x$	A1	This mark is given for a correct answer only

Question 9 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\left(\frac{500}{150}\right)^{\frac{1}{3}} \times 5$	P1	This mark is given for a process to find a volume scale factor
	7.47	A1	This mark is given for the correct answer only

Question 10 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$56.8 = \frac{1}{3} \times \pi \times r^2 \times 3.6$	P1	This mark is given for a correct substitution in to the formula for the volume of the cone
	$r^2 = \frac{56.8 \times 3}{3.6\pi} = 15.066\dots$ $r = 3.88\dots$	P1	This mark is given for a process to find the radius of the base of the cone
	 $l^2 = 3.6^2 + (3.88\dots)^2$ $l = 5.29\dots$	P1	This mark is given for a process to use Pythagoras find the sloping length l of the cone
	$\frac{AOB}{360} \times \pi \times 2 \times 5.29 = 2 \times \pi \times 3.88$ $AOB = \frac{3.88 \times 360}{5.29}$	P1	This mark is given for a process to find the size of angle AOB
	264	A1	This mark is given for the correct answer only (to 3 significant figures)

Question 11 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{1}{3}\pi \times 3^2 h + \frac{2}{3}\pi \times 3^3$	P1	This mark is given for substituting into the formulae to find the volume of the hemisphere and cone
	$h (= 4)$	P1	This mark is given for a process to find h
	$l (= 5)$	P1	This mark is given for using Pythagoras to find l
	$2\pi \times 3^2 + \pi \times 3 \times "5"$	P1	This mark is given for a full process to find the surface area
	33π	A1	This mark is given for the correct answer only

Question 12 (Total 5 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\frac{1}{3} \times \pi \times (3.6)^2 \times 6.4 - \frac{1}{3} \times \pi \times (1.8)^2 \times 3.2$ $= 76.001\dots$	P1	This mark is given for a process to work out the volume of the frustum
	$\frac{1}{2} \times \frac{4}{3} \times \pi \times (7.2)^3 = 97.716\dots$	P1	This mark is given for a process to find out the volume of the hemisphere
	$76.00 \times 2.4 = 182.4$ $97.72 \times 4.8 = 469.0$	P1	This mark is given for a process to find the weights of the frustum and the hemisphere
	$\frac{182.4 + 469}{76 + 97.72} = \frac{651.4}{173.72}$	P1	This mark is given for a process to find the mean density from the total weight divided by the total volume
	$= 3.75 \text{ g/cm}^3$	A1	This mark is given for an answer in the range 3.7 – 3.8

Mark scheme for 1MA1 Higher themed papers: Spheres and Cones

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
1a	8a	Mock Set 2	3H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1b	8b	Mock Set 2	3H	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a	14a	Mock Set 2	1H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b	14b	Mock Set 2	1H	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	15	June 2019	1H	4	Geometry	G17, N8	1	57	2.29	3.53	3.17	2.78	2.37	1.78	1.12	0.56	-	-	0.27
4a	15a	June 2017	1H	3	Geometry	G17,N14,A2	1	51	1.52	2.73	2.44	2.06	1.61	1.07	0.48	0.13	-	-	0.05
4b	15b	June 2017	1H	1	Number	N14	3	6	0.06	0.29	0.14	0.06	0.02	0.01	0.00	0.00	-	-	0
5	16	Mock Set 3	1H	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	19	June 2018	2H	5	Geometry	G17	1	29	1.46	3.92	2.89	2.05	1.31	0.71	0.29	0.08	-	-	0.03
7	19	Nov 2019	2H	2	Geometry	G17	1	40	0.80	1.56	1.38	1.45	1.48	1.20	0.58	0.15	-	-	0.07
8	17	Mock Set 1	3H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	17	Mock Set 3	2H	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	23	Nov 2019	3H	5	Geometry	G17, G18, G20	3	14	0.69	3.00	2.35	1.98	1.54	0.90	0.27	0.05	-	-	0.01
11	19	Mock Set 4	3H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	20	Nov 2018	2H	5	Geometry	N2, R11, G17, G19	3	12	0.61	3.80	2.85	1.97	1.57	0.76	0.28	0.09	-	-	0.02
				47					7.43	18.83	15.22	12.35	9.9	6.43	3.02	1.06	0	0	0.45