GCSE Mathematics (1MA1)

Themed papers – Density Problems

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
	apple juice $25 \times 1.05 = 26.25$ fruit syrup $15 \times 1.4 = 21$ water $280 \times 0.99 = 277.2$	P1	This mark is given for finding the mass of at least one of the liquid
	$26.25 + 21 + 277.2 = 324.45$	P1	This mark is given for a complete process to find the total mass of the drink
	$324.45 \div 320 = 1.0139062$	P1	This mark is given for a complete process to find the density of the drink
	1.01	A1	This mark is given for an answer in the range 1.01 to 1.014

Question 2 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$1.09 \times 60 = 65.4$ $0.97 \times 128 = 124.16$	P1	This mark is given for a process to find the mass of 60 litres of ethanol and the mass of 128 litres of propylene
	$65.4 + 124.16 = 189.56$	P1	This mark is given for a process to find the mass of 188 litres of the antifreeze
	$\frac{189.56}{188} = 1.0082978\ldots$	P1	This mark is given for a process to find the density of the antifreeze
	1.01 (to 2 decimal places)	A1	This mark is given for the correct answer only

Question 3 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$1967.5 < \text{mass} \leq 1972.5$	B1	This mark is given for the correct upper and lower bounds for the mass of the block of wood
	Lower bound: $13.15 \times 15.95 \times 21.65 = 4540.92$ Upper bound: $13.25 \times 16.05 \times 21.75 = 4625.41$	P1	This mark is given for a correct process to find the upper and lower bounds for the volume of the block of wood
	Lower bound: $1967.5 \div 4625.41$ Upper bound: $1972.5 \div 4540.92$	P1	This mark is given for a correct process to find the upper and lower bounds for the density of the block of wood
	Lower bound = 0.42537 Upper bound = 0.43438	A1	This mark is given for correct lower and upper bounds
	The upper and lower bounds both round to 0.43 to 2 decimal places	C1	This mark is given for a correct statement about the suitable degree of accuracy

Question 4 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\pi \times r^2 \times 25 = 225\pi$	P1	This mark is given for a process to find the volume of the container C
	Vol of Liquid A: $225\pi \times \frac{2}{(2+13)}$ $= 30\pi$ Vol of Liquid B: $225\pi \times \frac{13}{(2+13)}$ $= 195\pi$	P1	This mark is given for a process to find the volume of Liquid A and the volume of Liquid B
	Mass of Liquid A: $30\pi \times 1.21 = 114.04$ Mass of Liquid B: $195\pi \times 1.02 = 624.86$	P1	This mark is given for a process to find the combined mass of Liquid A and Liquid B
	114.04 + 624.86 = 739 (3 sf)	A1	This mark is given for a correct answer to 3 significant figures

Question 5 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	12.5×1000	1	This mark is given for converting kg to g
	$12\,500 \div 19.3$	1	This mark is given for a method to find the density of the gold bar
	648	1	This mark is given for the correct answer only

Question 6 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Mass of A = $7 \times 1.42 = 9.94$ Mass of C = $(7 + 125) \times 1.05 = 138.6$	P1	This mark is given for a process to find the mass of liquids A and C
	Mass of B = $138.6 - 9.94 = 128.66$ Density of B = $\frac{128.66}{125}$	P1	This mark is given for a process to find the mass and density of liquid B
	1.03	A1	This mark is given for the correct answer only

Question 7 (Total 5 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\frac{1}{3} \times \pi \times (3.6)^2 \times 6.4 - \frac{1}{3} \times \pi \times (1.8)^2 \times 3.2$ $= 76.001\ldots$	P1	This mark is given for a process to work out the volume of the frustum
	$\frac{1}{2} \times \frac{4}{3} \times \pi \times (7.2)^3 = 97.716\ldots$	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
	$= 3.75$ g/cm^3	A1	This mark is given for an answer in the range 3.7 – 3.8

Question 8 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$3 \times 20 \times 120$ (= 7200)	P1	This mark is given for a process to find volume of the piece of wood
	8000 ÷ 7200 or 1030 ÷ 1000	P1	This mark is given for a process to find a density of the piece of wood or the density of the sea water
	1.11… and 1.03…	P1	This mark is given for a complete process to find two densities to be compared
	The piece of wood will not float since it has a greater density than the sea water (1.11 > 1.03)	P1	This mark is given for an answer supported by a comparison of the correct densities

Question 9 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$V_{\mathbf{A}} = \frac{4}{3}\pi \times 2^3$ or $V_{\mathbf{B}} = \frac{4}{3}\pi \times 3^3$	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 × 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 10 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Prism **A**: $\frac{1}{8} \times \pi \times 10^2 \times 10 = \frac{1000\pi}{8}$ Prism **B**: $\frac{1}{6} \times \pi \times 10^2 \times 5 = \frac{500\pi}{6}$	P1	This mark is given for a process to find the volume of at least one of the prisms
	Density = mass ÷ volume Density of Prism **A**: $40\pi \div \frac{1000\pi}{8}$ Density of Prism **B**: $50\pi \div \frac{500\pi}{6}$	P1	This mark is given for a process to find the density of the prisms
	Density of Prism **A**: $\frac{320}{1000} = 0.32$ Density of Prism **B**: $\frac{300}{500} = 0.6$	A1	This mark is given for correctly finding the densities of the prisms
	$\frac{0.6 - 0.32}{0.32}$	P1	This mark is given for a process t find the densities of the prisms as a percentage of prism **A**.
	= 0.875, so 87.5%	A1	This mark is given for the correct answer only

Mark scheme for 1MA1 Higher themed papers: Density Problems

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	June 2017	3H	4	Ratio	R11	3	64	2.56	3.89	3.56	3.10	2.59	2.09	1.54	0.98	-	-	0.55
2	13	June 2019	3H	4	Ratio	R1, R11	3	60	2.40	3.79	3.40	2.89	2.37	1.84	1.29	0.77	-	-	0.47
3	21	June 2018	2H	5	Number	N16, R1, R11	3	28	1.39	3.68	2.76	2.00	1.28	0.65	0.25	0.09	-	-	0.04
4	13	Nov 2019	3H	4	Ratio	R5, R11, G16	3	25	1	4	3.11	2.61	1.91	1.14	0.59	0.24	-	-	0.09
5	3	Nov 2017	3H	3	Ratio	R1, R11	1	20	0.60	3.00	2.44	2.28	1.59	1.03	0.53	0.27	-	-	0.13
6	7	Mock Set 3	3H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	20	Nov 2018	2H	5	Geometry	N2, R11, G17, G19	3	12	0.61	3.8	2.85	1.97	1.57	0.76	0.28	0.09	-	-	0.02
8	12	Mock Set 1	3H	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	16	Mock Set 3	1H	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	19	Mock Set 4	1H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				41					**8.56**	**22.16**	**18.12**	**14.85**	**11.31**	**7.51**	**4.48**	**2.44**	**-**	**-**	**1.3**