Density & Pressure

Mark Scheme

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Forces, Density & Pressure
Sub Topic	Density & Pressure
Paper Type	Theory
Booklet	Mark Scheme

Time Allowed: **71 minutes**

Score: **/59**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** pressure = force / area B1 [1]

(b) molecules collide with object / surface and rebound B1
molecules have change in momentum hence force acts B1
fewer molecules per unit volume on top of mountain / temperature is less
hence lower speed of molecules B1
hence less pressure A0 [3]

(c) **(i)** $\rho = m / V$ C1
$W = V\rho g = 0.25 \times 0.45 \times 9.81 \times 13600$ C1
$= 15000\ (15009)$ N A1 [3]

(ii) $p = W / A$ (or using $p = \rho gh$) $= 15009 / 0.45$
$= 3.3 \times 10^4$ Pa A1 [1]

(iii) pressure will be greater due to the air pressure (acting on the surface of the liquid)
B1 [1

2 **(a)** $V = h \times A$
$m = V \times \rho$ B1
$W = h \times A \times \rho \times g$ B1
$P = F / A$ B1
$P = h\rho g$
P is proportional to h if ρ is constant (and g) B1 [4]

(b) density changes with height B1
hence density is not constant with link to formula B1 [2]

3	**(a)**	density = mass / volume	B1	[1]
	(b)	density of liquids and solids same order as spacing similar / to about 2× density of gases much less as spacing much more	B1	
		or density of gases much lower hence spacing much more	B1	[2]
	(c) (i)	density = 68 / [50 × 600 × 900 × 10^{-9}]	C	
		= 2520 (allow 2500) kg m^{-3}	A1	[2]
	(ii)	$P = F / A$	C1	
		= 68 × 9.81 / [50 × 600 × 10^{-6}]	C	
		= 2.2 × 10^4 Pa	A1	[3]
4	**(a**	mass / volume (ratio idea essential)	B1	[1]
	(b) (i)	mass = $Ah\rho$	B1	[1]
	(ii)	pressure = force/area	B1	
		weight (of liquid)/force (on base) = $Ah\rho g$	B1	
		pressure = $h\rho g$	A0	[2]
	(c) (i)	ratio = 1600 or 1600:1	A1	[1]
	(ii)	ratio = $\sqrt[3]{1600}$		
		= 11.7 (*allow 12*)	A	[2]
	(d) **(i)**	<u>density</u> of solids and liquids are (about) equal	B1	[1]
	(ii)	strong forces: fixed volume	B1	
		rigid forces: retains shape / does not flow / little deformation	B1	[2]
		(allow 1 mark for fixed volume, fixed shape)		

5	**(a)**	mass per unit volume (*ratio idea must be clear, not units*)	B1	**[1]**
	(b) (i)	pressure is same at the surface of <u>mercury</u> because at same horizontal level	B1	**[1]**
	(ii)	$h\rho g$ is same for both	B1	
		$53 \times 10^{-2} \times 1.0 \times 10^{3} \times g = 71 \times 10^{-2} \times \rho \times g$	C1	
		$\rho = 7.5 \times 10^{2}$ kg m^{-3}	A1	[3]

6	**(a) (i)**	force per unit area (ratio idea essential)	B1	
	(ii)	kg m^{-1} s^{-2}	B1	**[2]**
	(b)	ρ has base unit kg m^{-3}	B1	
		g has base unit m s^{-2}	B1	
		$h\rho g$ has base unit m $\times$ kg m^{-3} $\times$ m s^{-2}	M1	
		same as pressure QED	A0	**[3]**

7	**(a**	pressure = force / area (normal to the force) [clear ratio essential]	B1	[1]
	(b) (i)	$P = mg / A = (5.09 \times 9.81) / A$	C1	
		$A = (\pi d^2 / 4) = \pi \times (9.4 \times 10^{-2})^2 / 4$ (= 0.00694 m^2)	C1	
		$P = 49.93 / 0.00694$		
		= 7200 (7195) Pa (minimum of 2 s.f. required)	A1	[3]
	(ii)	$\Delta P / P = \Delta m / m + 2\Delta d / d$	C1	
		= 0.01 / 5.09 + (2 $\times$ 0.1) / 9.4 (= 0.0020 + 0.021 or 2.3%)	C1	
		ΔP = 170 (165 to 167) Pa		[3]
	(iii)	P = 7200 $\pm$ 200 Pa		[1]

8 **(a)** **(i)** 26 protons B1

(ii) 30 neutrons ..... B1 [2]

(b) **(i)** mass = 56 x 1.66 x 10^{-27} C1
(allow x 1.67 x 10^{-27} but 0/2 for use of 26 or 30)
= 9.3 x 10^{-26} kg A1

(ii) density = mass/volume where volume = 4/3 x π x r^3 ..... C1
= (9.3 x 10^{-26})/(4/3 x π x {5.7 x 10^{-15}}^{3})
= 1.2 x 10^{17} kg m^{-3} ..... A1 [4]

(c) nucleus occupies only very small fraction of <u>volume of atom</u>
or 'lot of empty space inside atom' B1
(do not allow spacing between atoms)
any further good physics e.g. nuclear material is very dense ..... B1 [2]

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