5.2 Forces: Equilibrium, Density & Pressure

Question Paper

Course	CIE A Level Physics (9702) 2019-2021
Section	5. Forces, density and pressure
Topic	5.2 Forces: Equilibrium, Density & Pressure
Difficulty	Hard

Time allowed: **10**

Score: **/10**

Percentage: **/100**

Question 1

Icebergs typically float with a large volume of ice beneath the water. Ice has a density of 917 kg m^{-3} and a volume V_i

The density of seawater is 1020 kg m^{-3}

What fraction of the ice is submerged underwater?

A 0.05 V_i **B** 0.10 V_i **C** 0.90 V_i **D** 0.95 V_i

[1 mark]

Question 2

A child drinks a liquid of density ρ through a vertical straw.

Atmospheric pressure is p_0 and the child is capable of lowering the pressure at the top of the straw by 10%. The acceleration of free fall is g.

What is the maximum length of straw that would enable the child to drink the liquid?

A $\frac{p_0}{10\rho g}$ **B** $\frac{9p_0}{10\rho g}$ **C** $\frac{p_0}{\rho g}$ **D** $\frac{10p_0}{\rho g}$

[1 mark]

Question 3

Liquid Q has twice the density of liquid R.

At depth *x* in liquid R, the pressure due to the liquid is 4 kPa.

At what depth in liquid Q is the pressure due to the liquid 7 kPa?

A $\frac{2x}{7}$ **B** $\frac{7x}{8}$ **C** $\frac{8x}{7}$ **D** $\frac{7x}{2}$

[1 mark]

Question 4

Two solid substances P and Q have atoms of mass M_P and M_Q respectively. They have n_P and n_Q atoms per unit volume.

The density of P is greater than the density of Q.

Which expression **must** be correct?

A $M_P > M_Q$

B $n_P > n_Q$

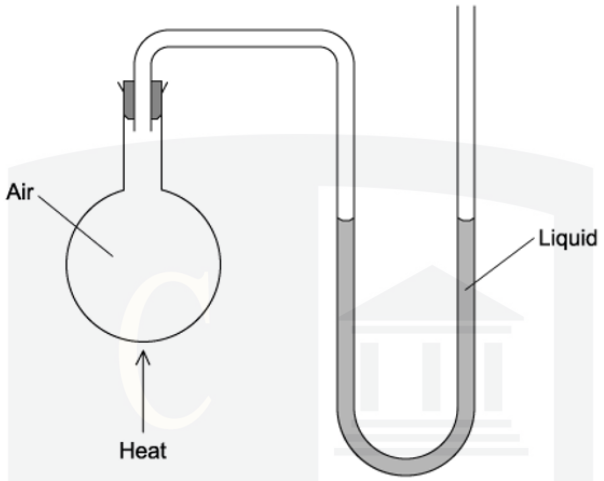
C $M_P n_P > M_Q n_Q$

D $\frac{M_P}{n_P} > \frac{M_Q}{n_Q}$

[1 mark]

Question 5

The diagram shows a flask connected to a U-tube containing liquid. The flask contains air at atmospheric pressure.



The flask is now gently heated and the liquid level in the right-hand side of the U-tube rises through a distance *h*. The density of the liquid is *ρ*.

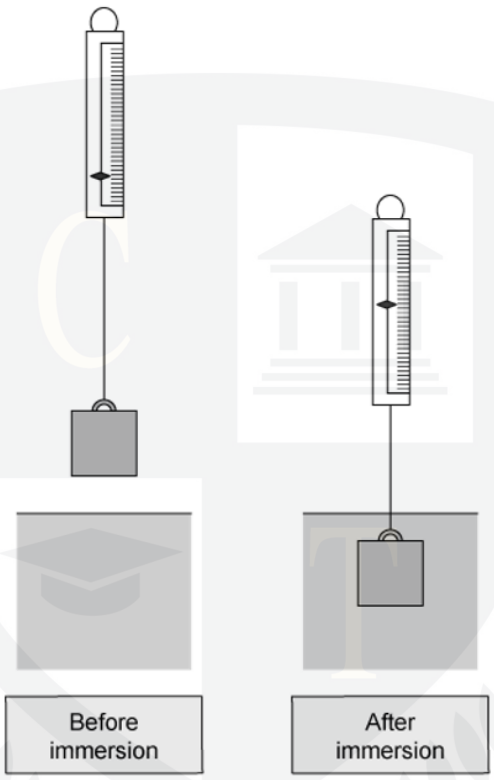
What is the increase in pressure of the heated air in the flask?

A $h\rho$ **B** $\frac{1}{2}h\rho g$ **C** $h\rho g$ **D** $2h\rho g$

[1 mark]

Question 6

The diagram shows a metal cube of density ρ suspended from a spring balance before and during immersion in water. Each face of the cube has a surface area A and each edge has length h.



A reduction in the balance reading occurs as a consequence of the immersion. The cube experiences pressures p_1 and p_2 at its top and bottom surfaces respectively.

What is the value of the upthrust on the metal cube during immersion?

A $Ah\rho g$

B $Ah\rho g + p_1 A$

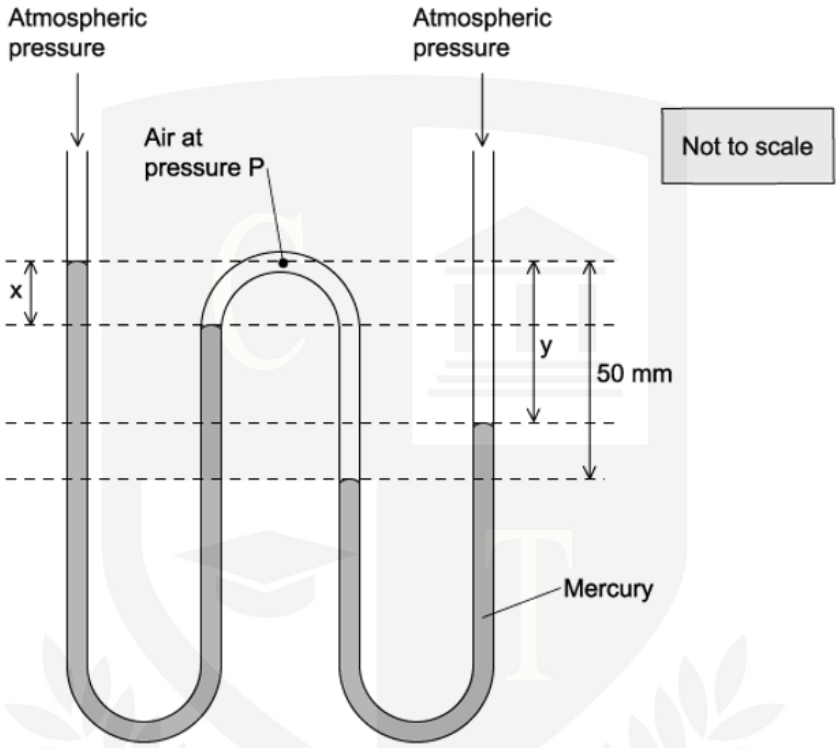
C $p_2 A$

D $p_2 A - p_1 A$

[1 mark]

Question 7

A W-shaped tube contains two amounts of mercury, each open to the atmosphere. Air at pressure *P* is trapped in between them. The diagram shows two vertical distances *x* and *y*.



Atmospheric pressure is equal to the pressure that would be exerted by a column of mercury of height 760 mm. The pressure *P* is expressed in this way.

Which values of *x*, *y* and *P* are possible?

	x / mm	*y* / mm	*P* / mm of Mercury
A	20	20	780
B	20	30	780
C	30	20	810
D	30	30	790

[1 mark]

Question 8

Full-fat milk is made up of fat-free milk mixed with fat.

A volume of 1.000×10^{-3} m^3 of full-fat milk has a mass of 1.035 kg. It contains 4.00% fat by volume.

The density of fat-free milk is 1.040×10^3 kg m^{-3}

What is the density of fat?

A 1.25×10^2 kg m^{-3}

B 9.15×10^2 kg m^{-3}

C 9.28×10^2 kg m^{-3}

D 1.16×10^3 kg m^{-3}

[1 mark]

Question 9

A cylindrical block of wood has cross-sectional area *A* and weight *W*. It is totally immersed in water with its axis vertical. The block experiences pressures p_t and p_b at its top and bottom surfaces respectively.

Which expression is equal to the upthrust on the block?

A $(p_b - p_t)A + W$

B $(p_b - p_t)$

C $(p_b - p_t)A$

D $(p_b - p_t)A - W$

[1 mark]

Question 10

The density of water is 1.0 g cm^{-3} and the density of glycerine is 1.3 g cm^{-3}

Water is added to a measuring cylinder containing 40 cm^3 of glycerine so that the density of the mixture is 1.1 g cm^{-3}. Assume that the mixing process does not change the total volume of the liquid

What is the volume of water added?

A 40 cm^3 **B** 44 cm^3 **C** 52 cm^3 **D** 80 cm^3

[1 mark]