1)

An object, immersed in a liquid in a tank, experiences an upthrust.

What is the physical reason for this upthrust?

A The density of the body differs from that of the liquid.

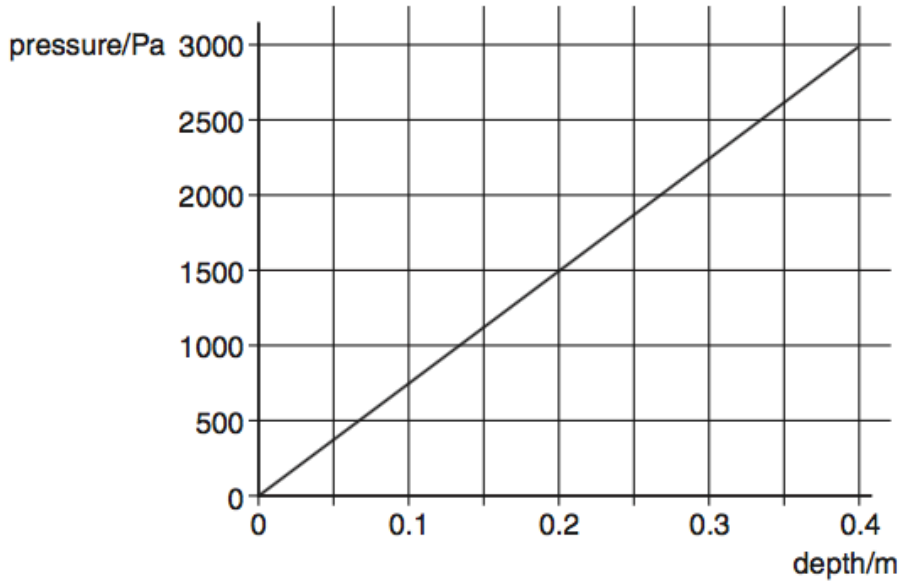
B The density of the liquid increases with depth.

C The pressure in the liquid increases with depth.

D The value of *g* in the liquid increases with depth.

2)

The graph shows how the pressure exerted by a liquid varies with depth below the surface.

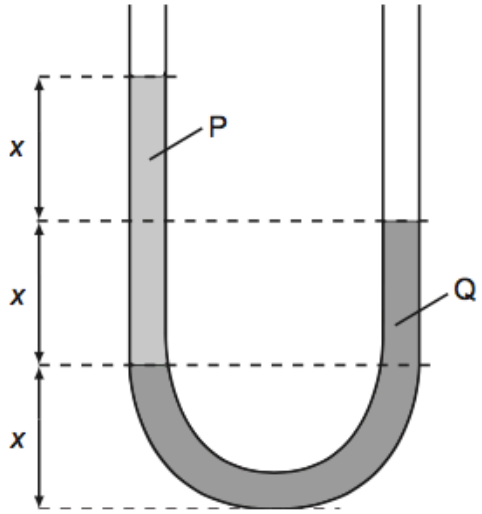


What is the density of the liquid?

A 600 kg m^{-3} **B** 760 kg m^{-3} **C** 5900 kg m^{-3} **D** 7500 kg m^{-3}

3)

The diagram shows two liquids, labelled P and Q, which do **not** mix. The liquids are in equilibrium in an open U-tube.



What is the ratio $\frac{\text{density of P}}{\text{density of Q}}$?

A $\frac{1}{2}$ **B** $\frac{2}{3}$ **C** $\frac{3}{2}$ **D** 2

4)

A sphere has volume V and is made of metal of density .

(a) Write down an expression for the mass m of the sphere in terms of V and .

.....[1]

(b) The sphere is immersed in a liquid. Explain the apparent loss in the weight of the sphere.

.....

.....

.....

.....[3]

5)

(a) **(i)** Define *density*.

.....

.....

(ii) State the base units in which density is measured.

.....

[2]

(b) The speed v of sound in a gas is given by the expression

$$v = \sqrt{\left(\frac{\gamma p}{\rho}\right)},$$

where p is the pressure of the gas of density ρ. γ is a constant.

Given that p has the base units of $\text{kg m}^{-1}\text{ s}^{-2}$, show that the constant γ has no unit.
[3]

6)

(a) **(i)** Define *pressure*.

.....

..... [1]

(ii) State the units of pressure in base units.

..... [1]

(b) The pressure p at a depth h in an incompressible fluid of density ρ is given by

$$p = \rho g h,$$

where g is the acceleration of free fall.
Use base units to check the homogeneity of this equation.

.....

.....

.....

..... [3]

7)

(a) Define *density*.

.....

.....

..... [1]

(b) A U-tube contains some mercury. Water is poured into one arm of the U-tube and oil is poured into the other arm, as shown in Fig. 4.1.

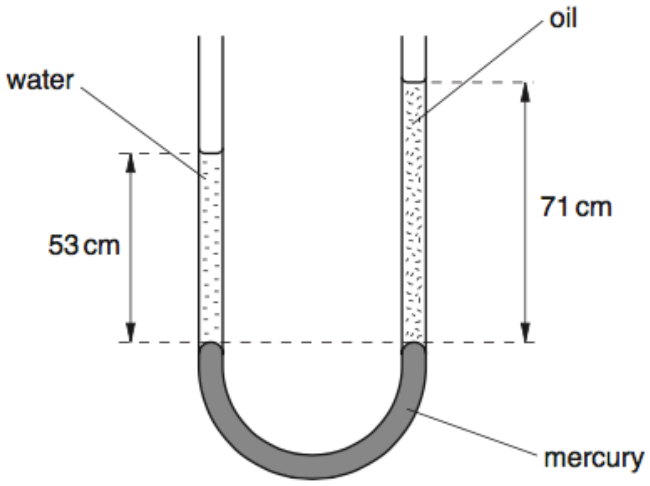


Fig. 4.1

The amounts of oil and water are adjusted until the surface of the mercury in the two arms is at the same horizontal level.

(i) State how it is known that the pressure at the base of the column of water is the same as the pressure at the base of the column of oil.

.....

..... [1]

(ii) The column of water, density 1.0×10^3 kg m^{-3}, is 53 cm high. The column of oil is 71 cm high.

Calculate the density of the oil. Explain your working.

density = ... kg m^{-3} [3]

8)

(a) (i) Define the terms

1. tensile stress,

.....

.....[1]

2. tensile strain,

.....

.....[1]

3. the Young modulus.

.....

.....[1]

(ii) Suggest why the Young modulus is not used to describe the deformation of a liquid or a gas.

.....

.....[1]

(b) The change ΔV in the volume V of some water when the pressure on the water increases by Δp is given by the expression

$$\Delta p = 2.2 \times 10^9 \frac{\Delta V}{V},$$

where Δp is measured in pascal.
In many applications, water is assumed to be incompressible.
By reference to the expression, justify this assumption.

.....

.....

.....[2]

(c) Normal atmospheric pressure is 1.01×10^5 Pa.

Divers in water of density $1.08 \times 10^3\,\text{kg}\,\text{m}^{-3}$ frequently use an approximation that every 10 m increase in depth of water is equivalent to one atmosphere increase in pressure. Determine the percentage error in this approximation.

error = ... % [3]