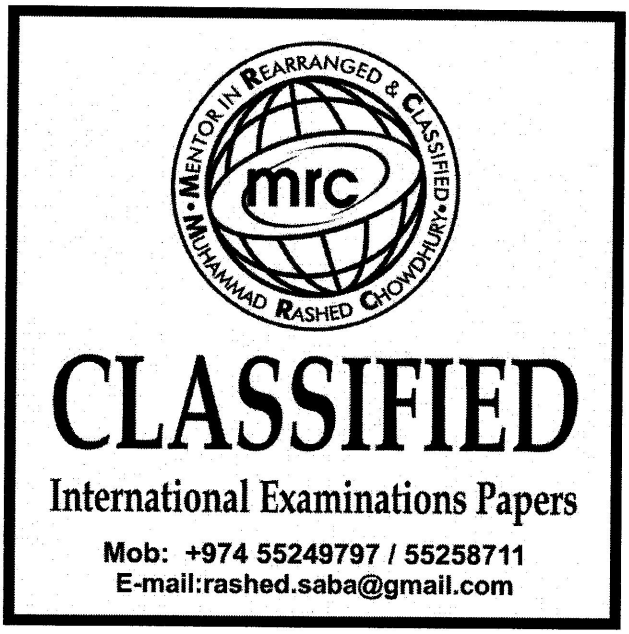

Matter and materials: 7

TOPIC- Density, pressure, compressive and tensile forces, **HOOKE'S LAW,** modulus of elasticity (Young), Experiment, elastic potential energy

Answer **all** the questions in the spaces provided.

For Examiner's Use

(a) Define *density*.

.....

..... [1]

(b) Explain how the difference in the densities of solids, liquids and gases may be related to the spacing of their molecules.

.....

.....

.....

..... [2]

(c) A paving slab has a mass of 68 kg and dimensions 50 mm × 600 mm × 900 mm.

(i) Calculate the density, in $kg\,m^{-3}$, of the material from which the paving slab is made.

density = ... $kg\,m^{-3}$ [2]

(ii) Calculate the maximum pressure a slab could exert on the ground when resting on one of its surfaces.

pressure = ... Pa [3]

A spring balance is used to weigh a cylinder that is immersed in oil, as shown in Fig. 4.1.

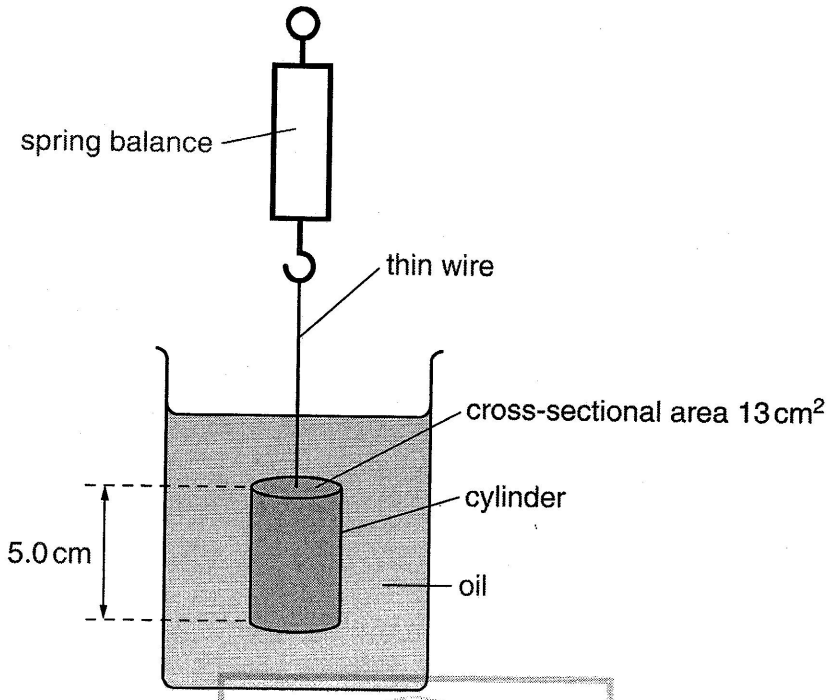

Fig. 4.1

The reading on the spring balance is 4.8 N. The length of the cylinder is 5.0 cm and the cross-sectional area of the cylinder is 13 cm^2. The weight of the cylinder is 5.3 N.

(a) The cylinder is in equilibrium when it is immersed in the oil. Explain this in terms of the forces acting on the cylinder.

.....

..... [1]

(b) Calculate the density of the oil.

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

[Total: 4]

(a) Show that the pressure P due to a liquid of density ρ is proportional to the depth h below the surface of the liquid.

For Examiner's Use

[4]

(b) The pressure of the air at the top of a mountain is less than that at the foot of the mountain. Explain why the difference in air pressure is not proportional to the difference in height as suggested by the relationship in **(a)**.

.....

.....

.....

.....[2]

(a) Define *density*.

.....[1]

(b) Liquid of density ρ fills a container to a depth h, as illustrated in Fig. 3.1.

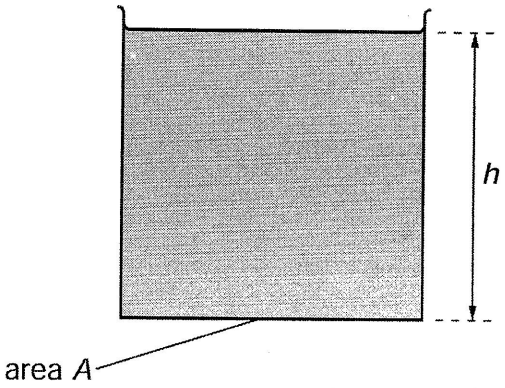

Fig. 3.1

The container has vertical sides and a base of area A.

(i) State, in terms of A, h and ρ, the mass of liquid in the container.

.....[1]

(ii) Hence derive an expression for the pressure p exerted by the liquid on the base of the container. Explain your working.

[2]

For Examiner's Use

(c) The density of liquid water is $1.0\,g\,cm^{-3}$. The density of water vapour at atmospheric pressure is approximately $\frac{1}{1600}\,g\,cm^{-3}$.

Determine the ratio

(i) $\dfrac{\text{volume of water vapour}}{\text{volume of equal mass of liquid water}}$,

ratio = ...[1]

(ii) $\dfrac{\text{mean separation of molecules in water vapour}}{\text{mean separation of molecules in liquid water}}$.

ratio = ...[2]

(d) State the evidence for

(i) the molecules in solids and liquids having approximately the same separation,

.....

.....[1]

(ii) strong rigid forces between molecules in solids.

strong: .....

rigid: .....[2]

(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.

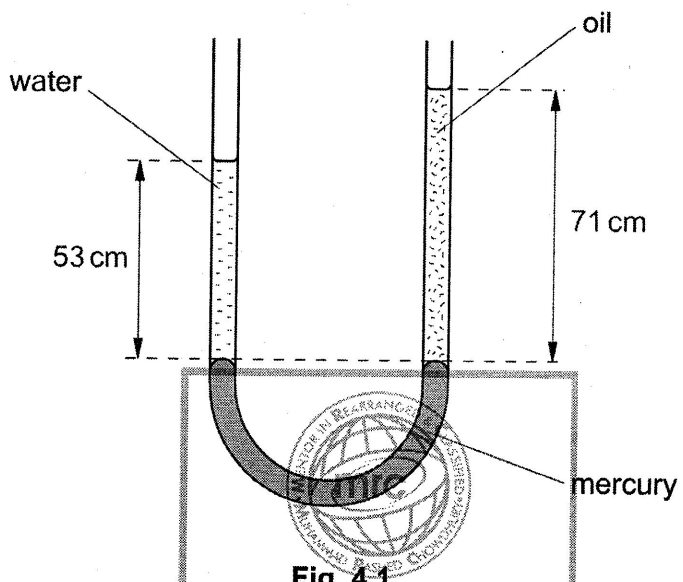

Fig. 4.1

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]

One isotope of iron may be represented by the symbol

$^{56}_{26}Fe$.

(a) State, for one nucleus of this isotope,

(i) the number of protons,

number = ...

(ii) the number of neutrons.

number = ...

[2]

(b) The nucleus of this isotope of iron may be assumed to be a sphere of radius 5.7×10^{-15} m.

Calculate, for one such nucleus,

(i) the mass,

mass = ... kg

(ii) the density.

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

[4]

(c) An iron ball is found to have a density of 7900 kg m^{-3}. By reference to your answer in **(b)(ii)**, suggest what can be inferred about the structure of an atom of iron.

.....

.....

..... [2]