Pressure in a Liquid

1.

(a) Fig. 3.1 shows an oil can containing only air at atmospheric pressure.

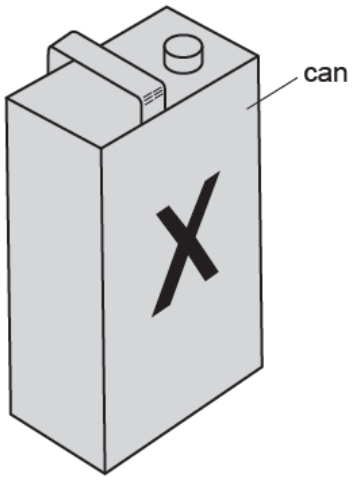

Fig. 3.1

Atmospheric pressure is 1.0×10^5 Pa.

The pressure of the air in the can is reduced by means of a pump. The can collapses when the pressure of the air in the can falls to 6000 Pa.

(i) Explain why the can collapses.

.....

.....[1]

(ii) The surface area of face X of the can is $0.12\,m^2$.

Calculate the resultant force on face X when the can collapses.

force = ...[3]

(b) Mercury is poured into a U-shaped glass tube. Water is then poured into one of the limbs of the tube. Oil is poured into the other limb until the surfaces of the mercury are at the same level in both limbs.

Fig. 3.2 shows the result.

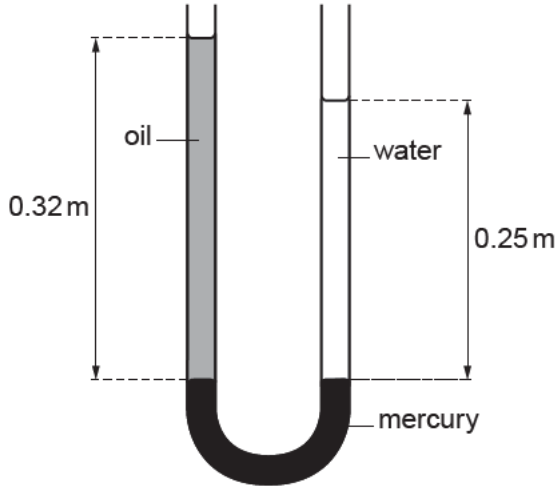

Fig. 3.2

(i) State a condition that must be true in order for the mercury surfaces to be at the same level in both limbs of the tube.

.....[1]

(ii) The height of the water column is 0.25 m. The height of the oil column is 0.32 m. The density of water is 1000 kg / m^3.

Calculate

1. the pressure exerted by the water on the surface of the mercury,

pressure = ...[2]

2. the density of the oil.

density = ...[2]

2.

A large stone block is to be part of a harbour wall. The block is supported beneath the surface of the sea by a cable from a crane. Fig. 2.1 shows the block with its top face a distance *h* beneath the surface of the sea.

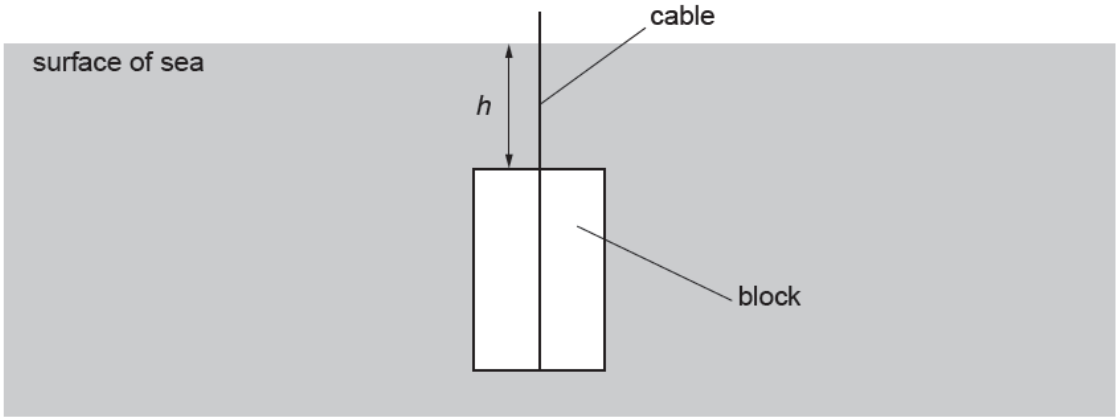

Fig. 2.1

The force acting downwards on the top face of the block, due to the atmosphere and the depth *h* of water, is 3.5×10^4 N.

(a) The top face of the block has an area of $0.25\,m^2$.

(i) Calculate the pressure on the top face of the block.

pressure = ... [2]

(ii) The atmospheric pressure is 1.0×10^5 Pa.

Calculate the pressure on the top face of the block due to the depth *h* of water.

pressure = ... [1]

(iii) The density of sea water is $1020\,kg/m^3$.

Calculate the depth *h*.

h = ... [2]

(b) Suggest two reasons why the tension force in the cable is not 3.5×10^4 N.

1. .....

2. .....

[2]

(c) The block is lowered so that it rests on the sea-bed.

State what happens to the tension force in the cable.

..... [1]

3.

(a) A water tank has a rectangular base of dimensions 1.5 m by 1.2 m and contains 1440 kg of water.

Calculate

(i) the weight of the water,

weight = ... [1]

(ii) the pressure exerted by the water on the base of the tank.

pressure = ... [2]

(b) Fig. 5.1 shows two water tanks **P** and **Q** of different shape. Both tanks are circular when viewed from above. The tanks each contain the same volume of water. The depth of water in both tanks is 1.4 m.

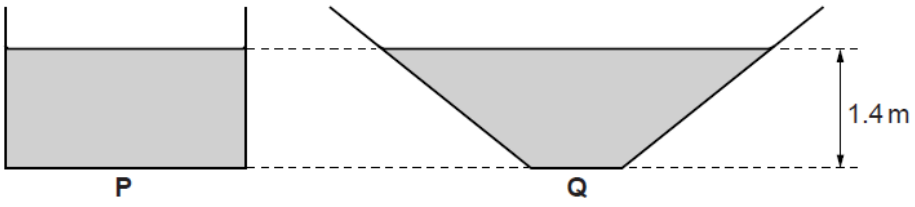

Fig. 5.1

(i) The density of water is 1000 kg / m^3. The pressures exerted by the water on the base of the two tanks are equal.

Calculate this pressure.

pressure = ... [2]

(ii) Equal small volumes of water are removed from each tank.

State which tank, **P** or **Q**, now has the greater water pressure on its base. Explain your answer.

.....

.....

..... [2]

4.

(a) A deep-sea diver descends into deeper water. The pressure on him increases as the height of the water above him increases.

(i) State the equation which relates the density of the water, the acceleration of free fall, g, the height of the water above the diver and the pressure difference.

.....

(1)

(ii) The diver descends from a depth of 15 m to a depth of 135 m.
Calculate the increase in pressure and give the unit.
The density of the water is 1025 kg/m^3.

.....

.....

Increase in pressure = ...

(3)

(iii) The water is not moving. In which direction does the pressure act on the diver?

.....

(1)

(b) A pressure is exerted on everyone on the Earth. Explain what causes this pressure.

.....

.....

.....

(2)