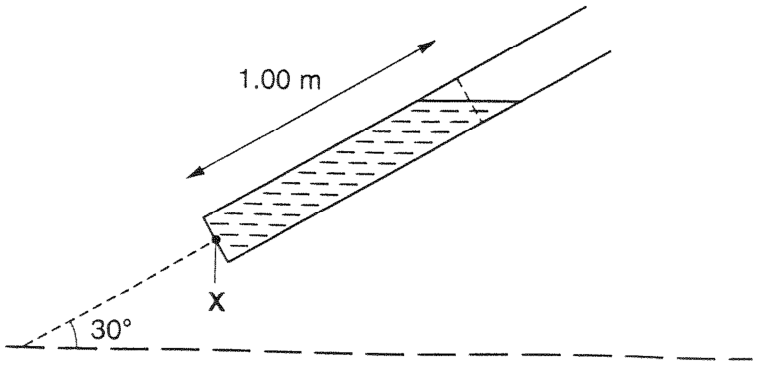
TUTORIAL QUESTIONS PHASES OF MATTER

Question 1

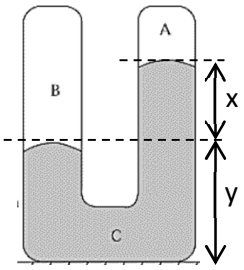
A long narrow tube contains salt water of density 1020 kg m^{-3} to a depth of 1.00 m. The tube is then inclined at 30° to the horizontal, as shown.



If atmospheric pressure is 100 kPa, what is the pressure at point **X** inside the tube?

A 5.00 kPa **B** 95.0 kPa **C** 105 kPa **D** 110 kPa

Question 2



A sealed U-tube contains gas B in one arm and gas A at pressure P in the other arm. The gases are separated by mercury of density ρ with dimensions as shown in the diagram. The acceleration of free fall is g. What is the pressure of gas B?

A. P **B. xρg** **C. P – xρg** **D. P + xρg** **E. P + (x + y) ρg**

Question 3

a.) State one of the similarity and difference between evaporation and boiling.

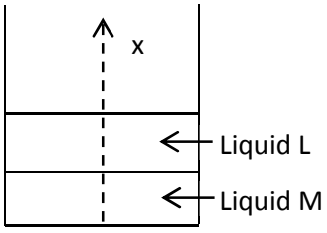
b.) Distinguish between the structure of a metal and of a polymer.

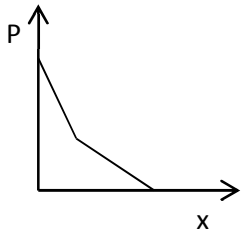
i metal:

ii polymer:

Question 4

A tall container which is open to the atmosphere contains a layer of liquid L, floating on liquid M. Liquid M has a density which is twice as great as that of liquid L. Which graph shows how the pressure, P, at a point varies with its height, x, above the base of the container?



A.


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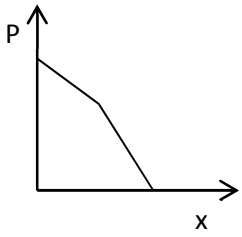

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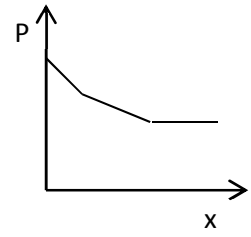

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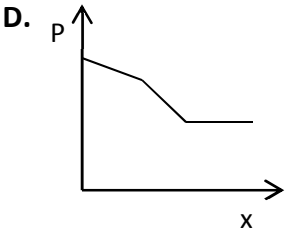


Question 5

a.)

Copper has density 8930 kg m^{-3} and zinc has density 7140 kg m^{-3}. Brass is an alloy consisting of 70% copper and 30% zinc by volume. Assume that the volume of the alloy is equal to the sum of the volume of the copper and zinc used. Consider one cubic metre of brass. Complete Fig. 5.1 in order to find the density of the brass.

metal	volume / m^3	mass / kg	density / kg m^{-3}
copper	0.70		8930
zinc	0.30		7140
brass			

Fig 5.1

b.) Measurement shows that the density of the brass in (b) is 8500 kgm^{-3}. Use your knowledge of the structure of solids to suggest why in practice, it is possible that the volume of brass might be different from the volume of copper plus the volume of zinc.

Question 6

Some smoke particles are viewed through a microscope, as illustrated in Fig. 5.1.

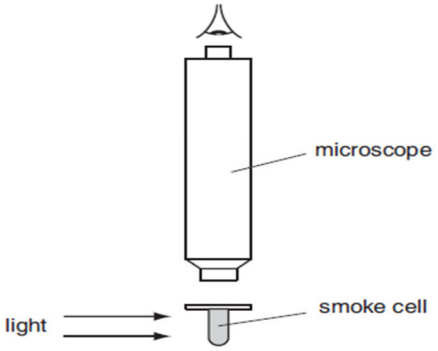


Fig. 5.1

Brownian motion is observed.

a.) Explain what is meant by *Brownian motion.*

b.) Suggest and explain why Brownian motion provides evidence for the movement of molecules as assumed in the kinetic theory of gases.

c.) Smoke from a poorly maintained engine contains large particles of soot.
Suggest why the Brownian motion of such large particles is undetectable.

Question 7

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.

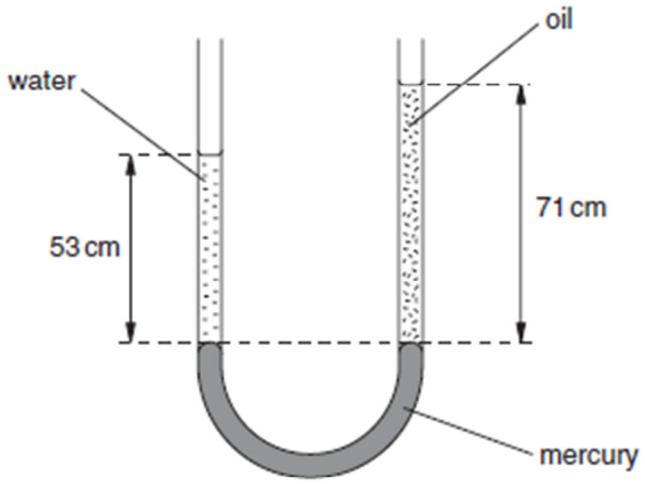


Fig. 4.1

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.

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

Calculate the density of the oil. Explain your working.

Question 8

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

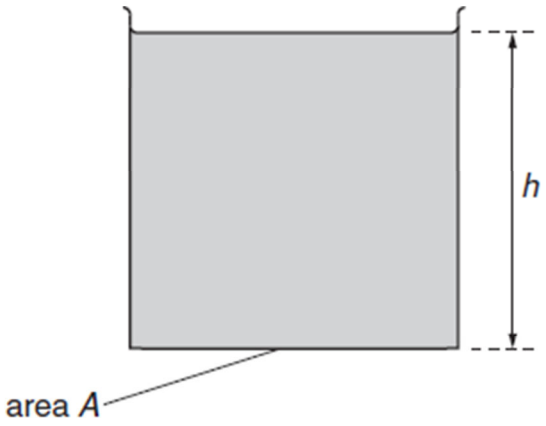


Fig. 3.1

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.

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

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

Determine the ratio

iii.) $$\frac{\text{volume of water vapour}}{\text{volume of equal mass of liquid water}},$$

iv.) $$\frac{\text{mean separation of molecules in water vapour}}{\text{mean separation of molecules in liquid water}}$$

State the evidence for

v.) the molecules in solids and liquids having approximately the same separation,

vi.) strong rigid forces between molecules in solids.

Question 9

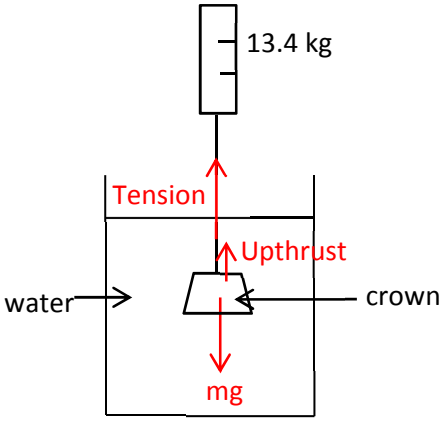
Consider two identical pails of water filled to the brim. One pail contains only water, while the other has a piece of wood floating in it. Which one has greater weight?

Question 10

A 70 kg ancient statue lies at the bottom of the sea. Its volume is 3.0×10^4 cm^3. How much force is needed to lift it? (Density of sea water = 1.025×10^3 kgm^{-3})

Question 11

When a crown of mass 14.7 kg is submerged in water, an accurate scale reads only 13.4 kg. (Density of water = 1000 kgm^{-3}, density of gold = 19.3×10^3 kgm^{-3})
a.) What is the density of the crown?
b.) Is the crown made of gold?



Question 12

A vessel, containing a liquid of density ρ, moves vertically upwards with an acceleration a.

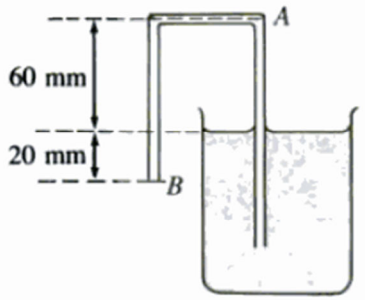
(a) Find the variation of the pressure p with depth h below the liquid surface.

(b) Find the variation of the pressure p with depth h if the vessel moves downwards with an acceleration a.

(c) Find the variation of the pressure p with depth h when the vessel is in free fall.

Question 13

A tube is arranged as a siphon in a beaker of liquid. The point A is 60 mm above the free surface of the liquid and B is 20 mm below it. The tube is first filled with liquid and the end B is closed with a finger.



Find the amounts by which the pressures at A and B are above or below atmospheric pressure. When the finger is removed from B, liquid runs out. Why is this? When will the flow stop? (Density of liquid = $0{\cdot}9 \times 10^3$ kg m^{-3}; take the acceleration of free fall, g as 10 m s^{-2}.)

Question 14

A copper block of mass 0.5 kg is hung from the end of a thread and completely immersed in water. IF the density of copper is 9 x 10^3 kgm^{-3} and the density of water is 1000 kgm^{-3}, calculate the tension on the thread.

Question 15

A thin plastic bag is found to have a mass m when empty and pressed flat. When the bag is filled with air at atmospheric pressure and re-weighed, the mass is again found to be m. Explain why the two results are the same.

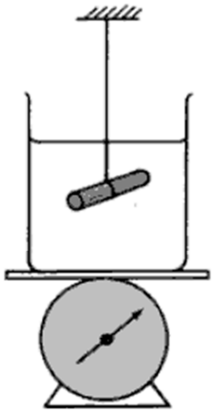
Question 16

An ice cube of sides 2·0 cm floats in a cup of tea. One of its faces is 0·20 cm above the surface of the tea in the cup. Calculate the density of the tea if the density of ice is 920 kg m^{-3}.

Question 17

The reading of a balance is X when a beaker filled with water is placed on it. A solid of weight Y in air displaced water of weight Z when immersed in the water.

What is the balance reading when the solid is hung in the beaker containing water as shown in the figure?



A.) X

B.) X + Z

C.) X + Y

D.)X + Y – Z

E.) X + Z - Y