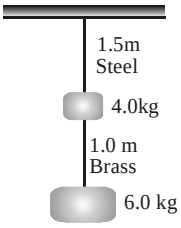
SUBJECTIVE UNSOLVED (C.B.S.E.) LEVEL – I

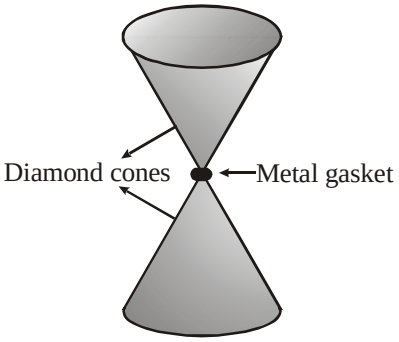
(REVIEW YOUR CONCEPTS)

1. A steel wire of length 4.7 m and cross-section $3.0\times10^{-5}\,m^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-section $4.0\times10^{-5}\,m^2$ under a given load. What is the ratio of the Young's modulus of steel to that of copper?

2. Two wires of diameter 0.25 cm, one made of steel and other made of brass are loaded as shown in figure. The unloaded length of steel wire is 1.5 m and that of brass wire is 1.0 m. Young's modulus of steel is 2.0×10^{11} Pa and that the brass is 0.91×10^{11} pa. Compute the elongations of steel and brass wires. (1 Pa = 1 N m^{-2})



3. Anvils made of single crystals of diamond, with the shape as shown in figure, are used to investigate behaviour of materials under very high pressures. Flat faces at the narrow end of the anvil have a diameter of 0.5 mm, and the wide ends are subjected to a compressional force of 50,000 N. What is the pressure at the tip of the anvil?



4. A composite wire of uniform diameter 3.0 mm consists of a copper wire of length 2.2 m and a steel wire of length 1.6 m stretches under a load by 0.7 mm . Calculate the load, given that the Young's modulus for copper is 1.1×10^{11} Pa and that for steel is 2.0×10^{11} Pa (1 Pa = 1 Nm^{-2})

5. A hydraulic automobile lift is designed to lift cars with a maximum mass of 3000 kg. The area of cross-section of the piston carrying the load is 425 cm^2. What maximum pressure would the smaller piston have to bear?

6. A U-shaped wire is dipped in a soap solution, and removed. The thin soap film formed between the wire and the light slider supports a weight of 1.5×10^{-2} N (which includes the small weight of the slider). The length of the slider is 30 cm. What is the surface tension of the film?

7. What is the pressure inside the drop of mercury of radius 3.00 mm at room temperature? Surface tension of mercury at that temperature (20° C) is $4.65\times10^{-1}\,Nm^{-1}$. The atmospheric pressure is 1.01×10^5 Pa. Also give the excess pressure inside the drop.

8. In Millikan's oil drop experiment, what is the terminal speed of an uncharged drop of radius 2.0×10^{-5} m and density 1.2×10^3 kg m^{-3}. Take the viscosity of air at the temperature of the experiment to be 1.8×10^{-5} Pa s. How much is the viscous force on the drop at that speed? Neglect buoyancy of the drop due to air.

9. A tank with a square base of area 1.0 m^2 is divided by a vertical partition in the middle. The bottom of the partition has a small-hinged door of area 20 cm^2. The tank is filled with water in one compartment, and an acid (of relative density 1.7) in the other, both to a height of 4.0 m. compute the force necessary to keep the door close.

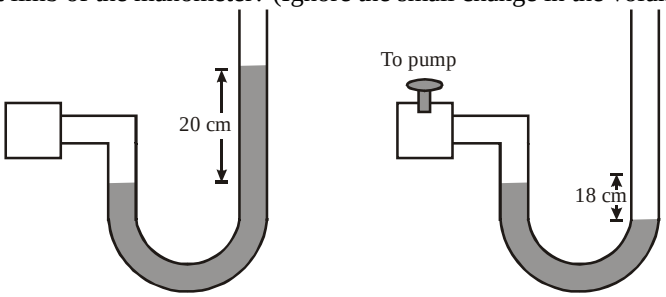
10. A U-tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are in level with 10.0 cm of water in one arm and 12.5 cm of spirit in the other. What is the specific gravity of spirit?

11. In the previous problem, if 15.0 cm of water and spirit each are further poured into the respective arms of the tube, what is the difference in the levels of mercury in the two arms? (Specific gravity of mercury = 13.6).

12. A manometer reads the pressure of a gas in an enclosure as shown in figure. (a) When a pump removes some of the gas, the manometer reads as in figure (b). The liquid used in the manometers in mercury and the atmospheric pressure is 76 cm of mercury.

(a) Give the absolute and gauge pressure of the gas in the enclosure for cases (a) and (b), in units of cm of mercury.

(b) How would the levels change in case (b) if 13.6 cm of water (immiscible with mercury) are poured into the right limb of the manometer? (Ignore the small change in the volume of the gas).



(a) (b)

13. A spring balance reads 10 kg when a bucket of water is suspended from it. What is the reading of the spring balance when

(a) an ice cube of mass 1.5 kg is put into the bucket?

(b) an iron piece of mass 7.8 kg suspended by another string is immersed with half its volume inside the water in the bucket? (Relative density of iron = 7.8).

14. Mercury has an angle of contact equal to 140º with soda lime glass. A narrow tube of radius 1.00 mm made of this glass is dipped in a trough containing mercury. By what amount does the mercury dip down in the tube relative to the liquid surface outside? Surface tension of mercury at the temperature of the experiment is 0.465 Nm^{-1}. Density of mercury 13.6×10^{3} kgm^{-3}.

15. Two narrow bores of diameters 3.0 mm and 6.0 mm are joined together to form a U-tube open at both ends. If the U-tube contains water, what is the difference in its levels in the two limbs of the tube? Surface tension of water at the temperature of the experiment is 7.3×10^{-2} Nm^{-1}. Take the angle of contact to be zero and density of water to be 1.0×10^{3} kgm^{-3} ($g = 9.8$ ms^{-2}).