Numericals :

1. Convert 1 mm of Hg into pascal. Take density of Hg = $13{\cdot}6 \times 10^3$ kg m^{-3} and $g = 9{\cdot}8$ m s^{-2}.

   Ans. 133·28 Pa

2. At a given place, a mercury barometer records a pressure of 0·70 m of Hg. What would be the height of water column if mercury in barometer is replaced by water ? Take density of mercury to be $13{\cdot}6 \times 10^3$ kg m^{-3}. **Ans.** 9·52 m

3. At sea level, the atmospheric pressure is 76 cm of Hg. If air pressure falls by 10 mm of Hg per 120 m of ascent, what is the height of a hill where the barometer reads 70 cm Hg. State the assumption made by you.

   Ans. 720 m

   Assumption : Atmospheric pressure falls linearly with ascent.

4. At sea level, the atmospheric pressure is $1{\cdot}04 \times 10^5$ Pa. Assuming $g = 10$ m s^{-2} and density of air to be uniform and equal to 1·3 kg m^{-3}, find the height of the atmosphere. **Ans.** 8000 m

5. Assuming the density of air to be 1·295 kg m^{-3}, find the fall in barometric height in mm of Hg at a height of 107 m above the sea level. Take density of mercury $= 13{\cdot}6 \times 10^3$ kg m^{-3}. **Ans.** 10 mm of Hg

Solution 1N.

1. Density of Hg $= 13.6 \times 10^3$ kgm^{-3}

Acceleration due to gravity, $g = 9.8$ ms^{-2}

Height of mercury column = 1mm = 0.001 m

$\therefore$ Pressure, $P = h\rho g$

or, $P = (0.001)(13.6 \times 10^3)(9.8)$ pascal

or, $P = 133.28$ Pa

Solution 2N.

2. Relative Density of Hg $= 1.36 = 13.6 \times 10^3$ kgm^{-3}

Acceleration due to gravity, $g = 9.8$ ms^{-2}

Height of mercury column = 0.70 m

$\therefore$ Pressure, $P = h\rho g$

or, $P = (0.7)(1.36 \times 10^3)(9.8)$ pascal

or, $P = 93.3 \times 10^3$ Pa

Let h be the height of water column

Then, $P = h$ (density of water) g

or, $93.3 \times 10^3 = h \times 10^3 \times 9.8$

or, $h = 9.52$ m

Solution 3N.

3. Atmospheric pressure, P = 76 cm Hg

Rate at which pressure falls = 10 mm of Hg per 120 m of ascent = 1 cm of Hg per 120 m of ascent

Let h be the height of the hill.

Pressure at hill, P' = 70 cm Hg

Total fall in pressure = P - P' = (76-70) cm Hg = 6 cm Hg

Now, fall in pressure is 1 cm Hg for every 120m increase in height.

Thus, if the fall in pressure is 6 cm Hg, increase in height shall be (6×120) m = 720m

$\therefore$ Height of the hill = 720 m

Assumption: Atmospheric pressure falls linearly with ascent.

Solution 4N.

4. Atmospheric pressure, $P = 1.04 \times 10^5$ Pa

Acceleration due to gravity, $g = 10\ ms^{-2}$

Density, $\rho = 1.3\ kgm^{-3}$

Let h be the height of the atmosphere.

$P = h\rho g$

$$\therefore h = \frac{P}{\rho g} = \frac{1.04 \times 10^5}{1.3 \times 10} = 8000 \text{ m}$$

Solution 5N.

Let h = 107 m be the height above sea level

$$\therefore P_h - P_{sea} = \rho_{air} g h$$

$$\therefore \rho_m g h_f - \rho_m g h_i = \rho_{air} g h$$

$$\therefore \rho_m g \Delta h = \rho_{air} g h$$

$$\therefore \Delta h = \frac{\rho_{air} h}{\rho_m} = \frac{1.295 \times 107}{13.6 \times 10^3}$$

$$\therefore \Delta h = 0.010 \text{ m of Hg}$$

$$\therefore \Delta h = 10 \text{ mm of Hg}$$