CHAPTER EIGHT

GRAVITATION

Problem 1:

The gravitational force between two bodies is 6.66×10^{-7} N when the distance between them is 10m. If the mass of the first body is 800Kg, the find the mass of the second body.

Sol.

Given, $F = 6.67 \times 10^{-7}$ N

$r = 10$ m

$m_1 = 800$ Kg

$m_2 = ?$

Using newton's universal law of gravitation,

$$F = G\frac{m_1 m_2}{r^2}$$

$$6.66 \times 10^{-7} = \frac{6.67 \times 10^{-11} \times 800 \times m_2}{10^2}$$

$$\therefore m_2 = \frac{10^4}{8} = 1250 \text{ g}$$

Problem 2:

The time of revolution of planet A around sun is 8 times that if planets. The distance of planet A from sun is how many times greater than that of planet B from sun.

Sol.

Let $T_B = T$

$T_A = 8T$

$r_B = ?$

$r_A = r$

Using Kepler's III law,

$$T^2 \alpha R^3$$

$$\frac{T_A^2}{T_B^2} = \frac{R_A^3}{R_B^3}$$

$$\frac{64\,T^2}{T^2} = \frac{R_A^3}{r^3}$$

$$R_A^3 = 64\,r^3$$

$$\therefore R_A = 4r$$

Problem 3:

The radius and acceleration due to gravity of moon 1/4 and 1/5 that of earth. Find the ratio of the mass of earth to mass of the moon.

Sol.

$$r_m = \frac{1}{4} r_e \Rightarrow \frac{r_e}{r_m} = 4$$

$$g_m = \frac{1}{5} g_e \Rightarrow \frac{g_e}{g_m} = 5$$

We have the relation, $g = G\frac{M}{R^2}$

$$\therefore \quad \frac{g_m}{g_e} = \frac{\cancel{G}\frac{M_m}{R_m^2}}{\cancel{G}\frac{M_e}{R_e^2}}$$

$$\frac{M_e}{M_m} = \frac{g_e}{g_m} \times \frac{R_e^2}{R_m^2}$$

$$= 5 \times 4^2$$

$$= 80$$

$M_e : M_m = 80 : 1$