

# CHAPTER EIGHT

## GRAVITATION

### Problem 1:

The gravitational force between two bodies is  $6.66 \times 10^{-7}$  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,

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

$$\cancel{6.66} \times 10^{-\cancel{7}} = \frac{6.67 \times 10^{-\cancel{7}} \times 8\cancel{0}\cancel{0} \times m_2}{10^{\cancel{2}}}$$

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

**Problem 2:**

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

**Sol.**

$$\text{Let } T_B = T$$

$$T_A = 8T$$

$$r_B = r$$

$$r_A = R$$

Using Kepler's III law,

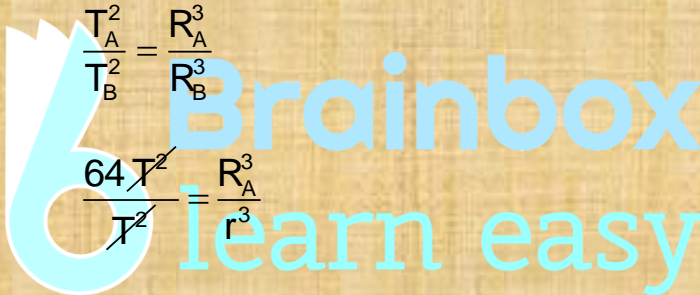
$$T^2 \propto R^3$$

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

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

$$R_A^3 = 64r^3$$

$$\therefore R_A = 4r$$



**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,  $g = G \frac{M}{R^2}$

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

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

$$= 5 \times 4^2$$

$$= 80$$

$$M_e : M_m = 80 : 1$$

