Gravitation
Worksheet -2

1. The gravitational force between two blocks is F what would happen if a mass of both the blocks as well as distance between them is doubled? 1

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

$m_1' = 2m_1, m_2' = 2m_2$

$r' = 2r$

$F' = G\frac{m_1' m_2'}{(r')^2} = G\frac{2m_1 \times 2m_2}{(2r)^2} = G\frac{4m_1 m_2}{4r^2} = G\frac{m_1 m_2}{r^2} = F$

2. A body is weightless at the centre of earth. Why? 1

Ans. At the centre of earth g = 0 so W = mg = 0

3. Where will a body weigh more at Delhi or at Shimla? Why? 1

Ans. Delhi because at higher altitudes the value of g decreases.

4. Find an expression for the weight of a body at the centre of the earth? 1

Ans. Value of g at a depth is $g' = g\left(1 - \frac{h}{R}\right)$

At the centre of earth h = R so $g' = g\left(1 - \frac{R}{R}\right) = 0$

So, weight of a body at the centre of earth is $W = mg' = 0$

5. Find an expression for gravitational intensity due to earth at a point on its free surface. 2

Ans. The gravitational force exerted on an object of mass 'm' on earth is $F = G\frac{Mm}{R^2}$

Gravitational intensity due to earth at a point on its free surface is

$I = \frac{F}{m} = \frac{\frac{GMm}{R^2}}{m} = \frac{GM}{R^2}$

6. The earth's mass is 80 times that of moon and their diameters are in the ratio 4:1 respectively. What is the value of g on moon? 2

Ans. $g_E = \frac{GM_E}{R_E^2}, \quad g_M = \frac{GM_M}{R_M^2}$

$\frac{g_M}{g_E} = \frac{\frac{GM_M}{R_M^2}}{\frac{GM_E}{R_E^2}} = \frac{M_M}{M_E} \times \frac{R_E^2}{R_M^2} = \frac{M_M}{80M_M} \times \frac{16R_M^2}{R_M^2}$

$\frac{g_M}{9.8} = \frac{1}{5}$

$g_M = 1.96 ms^{-2}$

7. Determine the value of g at the bottom of an ocean 7km deep Given that radius of earth is 6370 km and g = 9.8m|s^2. 1

Ans. $g' = g\left(1-\frac{h}{R}\right) = 9.8\left(1-\frac{7}{6370}\right) = \frac{9.8\times 6363}{6370} = 9.79 ms^{-2}$

8 Show that value of g at a height h is same as the value of acceleration due of gravity at a depth d = 2h 2

Ans. Value of g at a height is $g' = g\left(1-\frac{2h}{R}\right)$

Value of g at a depth is $g' = g\left(1-\frac{d}{R}\right)$

On comparing we get

$g\left(1-\frac{2h}{R}\right) = g\left(1-\frac{d}{R}\right)$

$d = 2h$

9. If T be the period of satellite revolving just above the surface of a planet whose average density is p, show that PT^2 is a universal constant. 2

Ans. $T = \sqrt{\frac{3\pi}{G\rho}}$

$T^2 = \frac{3\pi}{G\rho}$

$\rho T^2 = \frac{3\pi}{G}$

$\rho T^2 = const.$

10. Define Gravitational potential energy Hence deduces an expression for gravitational potential energy of a body placed at a point sear the surface of earth? 3

Ans.