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SUBJECT TEACHER:- MR. NEEL NIRANJAN

CHAPTER 3. (GRAVITATION) (BASED ON NCERT PATTERN)(REVISION)

Q1. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?

Ans. u = 40 m, g = –10 m/s^2 (going against gravity)

h = s = ? , v = 0

$v^2 - u^2 = 2gs$

$(0)^2 - (40)^2 = 2\,(-10) \times s$

$$\therefore s = \frac{-(40 \times 40)}{2(-10)}$$

$\therefore$ **s = 80 m**

Net displacement of the stone = 0 (As the stone falls, back to the same point.)

Total distance covered by stone = 80 m (up) + 80 m (down)

= 160 m

Q2. Gravitational force acts on all objects in proportion to their masses. Why then, a heavy object does not fall faster than a light object?

Ans. The heavy object when falls, the acceleration due to gravity 'g' is acting which is independent of the mass of the body.

$$g = \frac{GM}{R^2}$$

Gravitation force is $F \propto \frac{Mm}{R^2}$

$\therefore$ F and g are different.

Q3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface?

[Mass of the earth is 6 x 10^{24} kg and radius of the earth is 6.4 x 10^6 m].

Ans. The magnitude of the gravitational force between earth and an object is given by the formula.

$$F = \frac{GMm}{R^2}$$

$m = 1\ kg,\ M = 6 \times 10^{24}\ kg.$

$R = 6.4 \times 10^{6}\ m,\ G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

$$\therefore F = \frac{6.67 \times 10^{-11} Nm^2/kg^2 \times 6 \times 10^{24} kg \times 1 kg}{(6.4 \times 10^6 m)^2}$$

$$\therefore F = 9.8\ N$$

Q4. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6 x 10^{24} kg and of the Sun = 2 x 10^{30} kg. The average distance between the two is 1.5 x 10^{11}m.

Ans. Me = 6 x 10^{24} kg G = 6.67 x 10^{-11} Nm^2/kg^2

Ms = 2 x 10^{30} kg

d = 1.5 x 10^{11} m

$$\therefore \text{Gravitational force } F = G\frac{M_e M_s}{d^2}$$

$$\therefore F = \frac{6.67 \times 10^{-11} Nm^2/kg^2 \times 6 \times 10^{24} kg \times 2 \times 10^{30} kg}{(1.5 \times 10^{11} m)^2}$$

$$= \frac{80.04 \times 10^{-11+24+30}}{2.25 \times 10^{22}} = 3.56 \times 10^{22}\ N.$$

Q5. What do you mean by free fall?

Ans. Whenever an object falls toward earth under the force of gravity one and no other force is present, the motion of object is said to be “free fall”.

Q6. What do you mean by acceleration due to gravity?

Ans. The acceleration of free fall is the acceleration due to gravity. We can also say the acceleration of an object due to gravitational force of earth acting on it is known as acceleration due to gravity.

Q7. State the universal law of gravitation.

Ans. Every object in the universe attracts every other object with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them. The force is along the line joining the centres of two objects

$$F \propto \frac{Mn}{d^2} \text{ or } F = \frac{GMm}{d^2}$$