GRAVITATION

SUBJECT-PHYSICS
CHAPTER NUMBER-10

Students will be able

- Define mass and weight .

- Calculate weight of an object on moon.
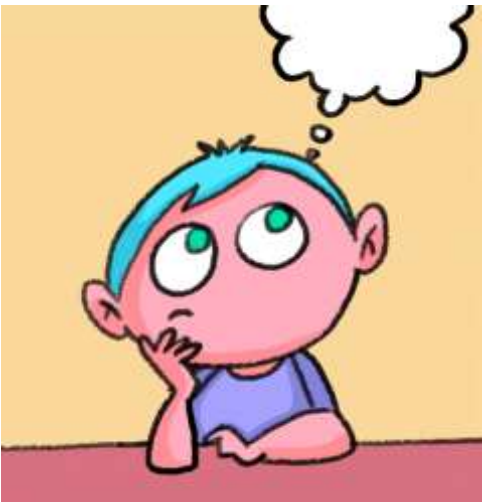
Recapitulation

➢ What is gravity ?

➢ What is gravitation force ?

➢ State the universal law of gravitation .

➢ What is the value of 'G '?

➢ What do you mean by free fall?

Mass (m)

➤ The mass of a body is the quantity of matter contained in it.

➤ Mass is a scalar quantity which has only magnitude but no direction.

➤ Mass of a body always remains constant and does not change from place to place.

➤ SI unit of mass is kilogram (kg).

➤ Mass of a body can never be zero

Weight (W)

- The force with which an object is attracted towards the centre of the earth, is called the weight of the object.
  Now, Force = $m \times a$
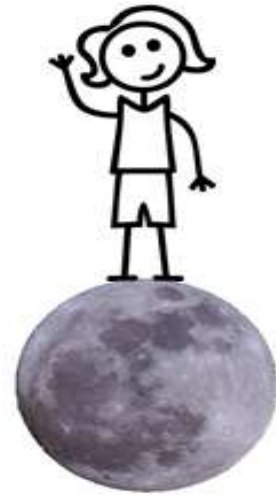 But in case of earth, $a = g$
  $\therefore F = m \times g$
  But the force of attraction of earth on an object is called its weight (W).
  $\therefore W = mg$

- As weight always acts vertically downwards, therefore, weight has both magnitude and direction and thus it is a vector quantity.

- The SI unit of weight is Newton.

Q. If the weight of a body on the earth is 6 N, what will it be on the moon? (Given that acceleration due to gravity on moon is one sixth of that on the earth.)

Q.A stone resting on the ground has a gravitational force of 20 N acting on it. What is the weight of the stone? Find its mass. (g=10 ms^{-2})

Weight of an object on moon

Just like the Earth, the Moon also exerts a force upon objects. Hence, objects on moon also have some weight. The weight will not be same as than on the earth. So, weight on the Moon can be calculated as –

$$W_M = \frac{GM_M m}{R_M^2}$$

Now,

$$\Rightarrow \frac{W_M}{W_E} = \frac{M_M R_E^2}{M_E R_M^2}$$

Where,
$M_E = 5.98 \times 10^{24}\ kg$
$M_M = 7.36 \times 10^{22}\ kg$
$R_E = 6.4 \times 10^6\ m$
$R_M = 1.74 \times 10^6\ m$

$$\Rightarrow \frac{W_M}{W_E} = \frac{7.36 \times 10^{22} \times (6.4 \times 10^6)^2}{5.98 \times 10^{24} \times (1.74 \times 10^6)^2} = 0.165 \approx \frac{1}{6}$$

Therefore, weight of an object on the moon is $\frac{1}{6}$ of its weight on the Earth.

HOME ASSIGNMENT

- Differentiate between mass and weight.

- It is said that the mass of an object remains constant at all places while weight may change. Why?

THANKING YOU
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