SHIKSHA CLASSES

Subject : Science -I **ANSWERS PAPER** **Total Marks** : 20
Class : X **1. Gravitation**

Q. 1 A) Choose the correct alternatives. 2

1) Which of the following statement is correct?

Ans:a) Mass is constant and weight is variable.

2) Escape velocity for an object resting on earth is given by the formula.

Ans.: a) $\sqrt{\frac{2GM}{R}}$

Q. 1 B) Solve the following questions (Any One). 1

1) State whether the following statement is true or false.
The value of g increases with altitude.

Ans.: False

2) Define centripetal force.

Ans.: A force acting on any object moving along a circle & which is directed towards the centre of the circle is called as centripetal force.

3) Considering first correleation complete the second
Acceleration due to gravity : m/s^2 : : Gravitational constant : -----

Ans.: Considering first correleation complete the second
Acceleration due to gravity : m/s^2 : : Gravitational constant : $\underline{Nm^2}/\underline{kg^2}$

Q.2 : A) Give scientific reason (Any One). 2

1) The weight of a body is different on different planets.

Ans.: The weight of an object is the forec with which the earth attracts the object

$\therefore w = F = mg$

As the value of is not same on every planet the weight of an object changes on different planet. Therefore the weight of a body is different on different planets.

2) The value of g is zero at the centre of the earth.

Ans.: At the centre of Earth, the force due to upper half of the Earth will cancel the force due to lower half. In the similar manner, force due to any portion of the Earth at the centre will be cancelled due to the portion opposite to it. Thus, the gravitational force at the centre on any body will be 0. Since, from Newton's law, we know

$F = mg$

Since, mass m of an object can never be 0. Therefore, when F = 0, g has to be 0. Thus, the value of g is zero at the centre of Earth.

Q. 2 : B) Solve the following questions (Any 2) 4

1) Distinguish between mass and weight.

Ans.:

Mass	Weight
i) The quantity of matter contained in a body is mass.	i) Weight is a gravitational force acting on a body by celestial body.
ii) S.I. Unit of mass is Kilogram (Kg)	ii) S. I. Unit of weight is Newton (N)
iii) Mass is scalar quanity	iii) weight is vector quantity
iv) Mass is constant everywhere	iv) Weight changes from place to place.

2) Define : a) Freefall, b) Aceleration due to gravity.

Ans.: a) **Freefall :** The object falling towards earth under the influence of gravitational force of earth is called as freefall.

b) **Aceleration due to gravity :** Acceleration experienced by an object in its freefall is called acceleration due to gravity.

3) Why does low and high tides occur?

Ans.: The level of water in the sea changes because of the gravitational force exerted by the moon. Water directly under the moon gets pulled towards the moon & the level of water there goes up causing high tide at that place. At two place on the earth at 90^0 from the place of high tide the level of water is minimum and low tides occur there.

Q.3: Solve the following questions (Any 2) 6

1) Why does the feather and the stone do not reach the ground at the same time?

Ans.: The feather has larger surface area and experiences greater air resistance during free fall. The feather experiences a buoyant force and a frictional force due to air and therefore floats and reached the ground slowly later than heavy stone. The buyont and frictional forces on the stone are much less than the weight of the stone and does not affect the speed of the stone much. where as stone has smaller surface area & so experiences smaller air resistance during freefall. So it falls fast.

2) Write a short note on Gravitational waves.

Ans.: Gravitational waves are a very different type of waves. They have been called the waver on the fabric of space time. They are very weak & it is very difficult to detect them. Scientists have constructed extremely sensitive instruments to detect the gravitational waves.

3) State and explain Newton's law of Gravitation.

Ans.: Newton's law of gravitation states that the gravitational force (F) between two bodies of masses m_1 & m_2 whose centers are separated by distance (d) is :

a) directly proportional to product of masses.

b) inversely proportional to the square of distance between them i. e.

$$F \propto \frac{m_1 m_2}{d^2} \qquad F = \frac{G m_1 m_2}{d^2}$$

4) If a person weight 750N on earth, how much would be his weight on theMoon given that Moon's mass is 1/81 of that of the earth and its radius is 1/3.7 of that of the earth?

Ans.: Weight on earth = 750N

Ratio of mass of the earth (M_E) to Mass of the moons $(M_m) = \frac{M_E}{M_m} = 81$

Ratio of radius of earth (R_E) to radius of moon $(R_m) = \frac{R_E}{R_M} = 3.7$

Let the mass of the person be m kg.

Weight on the earth = mg = 750 = $\frac{mGM_E}{R_E^2}$

$\therefore m = \frac{750R_E^2}{(GM_E)}$ ..... (i)

$\therefore$ Weight on Moon = $\frac{mGM_m}{Rm^2}$ using. (i)

$= \frac{750R_E^2}{(GM_E)} \times \frac{GM_m}{R_{m^2}}$

$= \frac{750R_E^2}{R_{M^2}} \times \frac{M_m}{M_E}$

$= 75 \times (3.7)^2 \times \frac{1}{81}$

$= 126.8N$

Q. 4 : Solve the following question (Any one). 5

1) Write the three laws given by Kepler. How did they help Newton to derive the inverse square law gravity?

Ans.: Kepler derived 3 laws governing the planetary motion.

a) The orbit of a planet is an ellipse with the sun at one of the foci.

b) The line joining the planet & the sun sweeps equal areas in equal intervals of time.

c) The cube of mean distance of a planet from the sun is directly proportional to square of orbital period, i.e. $T^2 \propto r^3$

$\therefore \frac{r^3}{T^2} = \text{constant.}$

According to keplers third law, the gravitational force acting on planet provide it the centripetal force which is related to orbital velocity v & orbital radius r

$$F = \frac{mv^2}{r}$$

$$v = \frac{2\pi r}{T}$$

From kepler's third law of planetary motion

$$T^2 \propto r^3$$

$$\frac{T^2}{r^3} = k$$

$$F = \frac{4\pi^2 mr^2}{r^3} \cdot \frac{r^2}{r^2}$$

$$F = \frac{4\pi^2 m}{kr}$$

$$\left(\text{But } \frac{4\pi^2 m}{k} \text{ is cons tan t} \right)$$

$$\Rightarrow F \propto \frac{1}{r^2}$$

Or

Explain the variation in the value of 'g' in detail.

Ans: Variation in the value of g occurs with respect to change in the following. :

a) **Change along the surface of the earth :** The shape of the earth is not exactly spherical & so the distance of a point on the surface of the earth from its centre differs form place to place Its radius is largest at the equator & smallest at the poles. The value of g is highest at poles & lowest at the equator.

b) **Change with height :**

As we go above the earth's surface, the value of R increases and so the value of g decrease.

$$g = \frac{GM}{(r+h)} \longrightarrow \text{increase in R}$$

c) **Change with depth :**

The value of 'g' decreases as we go deep inside the earth. At centre it becomes zero.

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