Question on Class IX » Science » Gravitation » The Universal Law Of Gravitation.

Q.1. When we move from the poles to the equator. Hence, the value of ' g ' decreases. Why

Ans: The shape of earth is an ellipse so when we move from the poles to the equator the radius of the earth R increases. Hence, the value of ' *g* ' decreases because value 'g' is inversely proportional to the radius of earth. $g = GM/R^2$

Q. 2. What is the diffrence between centrifugal force and centripetal force?

Ans: Centripetal Force

(i) It is the force that keeps a body in circular path.

(ii) It acts toward the center.

Centrifugal Force

(i) It is the pseudo force that tries to make a body fly off the circular path.

(ii) It acts outward the center.

Q.3. Explain :Centrifugal force and Centripetal force?

Ans: A force which is required to move a body uniformly in a circle is known as centripetal force. This force acts along the radius and towards the center of the circle,

Centrifugal force arises when a body is moving actually along a circular path, by virtue of tendency of the body to regain its natural straight line path. This force acts along the radius and away from the center of the circle.

Q.4 an astronaut has 80 kg mass on earth (a)what is his weight on earth? (b) what will be his mass and weight on mars where $g=3.7\ m/s^2$

Ans: Mass of astronaut = 80 kg

Weight on earth = mg = (80)(9.8) N = 784 N Weight on mars = mg' = (80)(3.7) N = 296 N

Q.5. A certain particle has a weight of 30N at a place where the acceleration due to gravity is 9.8 m/s^2

(a) What are its mass and weight at a place where acceleration due to gravity is 3.5 m/s square

(b) What are its mass and weight at a place where acceleration due to gravity is 0

Ans (a) Weight of the body, W = 30 N =mg Mass of the body, m = W/g =30 /9.8= 3.06 kg

New weight of the body, W' = mg' = (3.06) (3.5) N = 10.71 N

(b) . Mass remains the same but weight becomes zero.

Q.6. Derive the inverse square of Newton.

Ans: Let a planet of mass m revolves around the sun of mass M in nearly circular orbit of radius r, with a constant angular velocity ω.

Let T be the time period of the revolution of the planet around the sun. then

$\omega = 2\pi/T$

The centripetal force acting on the planet, $F = mr\omega^2 = mr\,(2\pi/T)^2 = (4\pi^2 mr)/T^2$ ------(i)

According to Keller's third law

"The square of the time period of revolution of a planet around the sun is directly proportional to the cube of semi major axis of its elliptical orbit"

$T^2 \propto r^3$ $T^2 = K r^3$ ----------(ii)

Here, K is proportionality constant.

from (i)and (ii)

$F = (4\pi^2 mr)/ K r^3$

$F = (4\pi^2/ K)x \{m/ r^2\}$

$F \propto m/r^2$

According to Newton, the gravitational attraction between the sun and the planet is mutual. So if F depends upon the mass of the planet m then it should also be directly proportional to the mass of the sun, M.

Hence, $4\pi^2/ K \propto M$

$4\pi^2/ K = G M$

$F = G (Mm/r^2)$

This is Newton's law of gravitation.

Q,7. What is the difference between gravity and gravitation?

Ans: Gravity is defined as the ability of earth to attract another body by virtue of their masses. Gravitation is the phenomenon which explains the force of attraction between two masses separated by a certain distance. This force is known as Gravitational Force

Q.8.What are these :((i) Product Rule (ii) Inverse Square rule (iii) Universal gravitational constant iv) Universal law of gravitation:

Ans: (i) Product rule: Force between two mass separated by a distance is directly proportional to the product of the two masses.

(ii) Inverse square law means that the force is inversely proportional to the square of the distance between two objects. Gravitational force is an example of inverse square law. The relation between the force of gravitation and distance is F∝1/r2

(iii)Universal gravitational constant: The constant of proportionality is called the universal gravitational constant. Gravitational constant is defined as the force of attraction between two unit masses kept at unit distance. For example if we choose m 1, m 2 such that, m 1 = m 2 = 1 and keep them at a unit distance (r =1), gravitational constant is equal to gravitation force of attraction between them

Henry Cavendish measure the value for G.

(iv) Universal law of gravitation: a force of attraction between two masses separated by some distance. The gravitational force between two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Q.9. Determine the height h above the surface where the value of g falls to 1% of the value at the surface

The value of g at the surface of earth, $g = \frac{GM}{R^2} - - (i)$

At a height h above the surface of the earth, $g' = \frac{GM}{(R+h)^2} - - (ii)$

Now $\frac{g'}{g} = \frac{R^2}{(R+h)^2} \Rightarrow \frac{g - g/100}{g} = \frac{99}{100} = \frac{R^2}{(R+h)^2}$

$\frac{99}{100} = \frac{R^2}{(R+h)^2} \Rightarrow \sqrt{\frac{99}{100}} = \frac{R}{R+h}$

Putting $R = 6.4 \times 10^6 m$, *and solving we get* $h = 3.37 \times 10^5 m$

Q.9. If Earth And Moon attracts Each other then why Moon does not moves towards the Earth?

Ans: The earth is much larger than the moon so, the acceleration produced on the earth surface cannot be noticed.

Q.10. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth? Why?

Ans: According to the Newton's 3rd law of motion, the moon also attracts the earth with a force equal to that with which the earth attracts the moon. Since the earth is much larger than the moon so, the acceleration produced on the earth surface (acceleration α 1/m) cannot be noticed.

Q.11. A ball is thrown vertically upwards with a velocity of 49 m/s. Calculate

(i) the maximum height to which it rises,

(ii) the total time it takes to return to the surface of the earth.

Ans: (a)$v^2 = u^2 + 2as \Rightarrow 0 = 49^2 + 2 \times 9.8 \times S$

$S = 49x49/2x9.8 = 122.5m$

(b) Let the time taken to reach maximum height = t sec

$V = u + at \Rightarrow 0 = 49 - 9.8\ t \Rightarrow t = 49/9.8 = 5ses$

the total time it takes to return to the surface of the earth=2t=5x2=10sec

Q.12. A stone is thrown vertically upwards with an initial velocity of 40 m/s. Taking g = 10 m/s2, find the maximum height reached by the stone. What is the net displacement and total distance covered by the stone?

Ans: Given that, u = 40 ms–1, g = –10 m/s^2

At the highest point (h) the velocity (v) will be zero.

using the equation, v2 - u2 = 2gh $\Rightarrow$ 0 – 402 = 2(–10)h $\Rightarrow$ or, h = 80 m

The total distance covered = 2h = 160 m

Net displacement = 0(Initial and final point is same)

Q.13. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet?

Let they meet after x m above ground

Distance travelled by stone allowed to fall from the top of a tower 100 m high

$S = (100 - x)$, $u = 0$ m/s, $g = 10 m/s^2$

$(100 - x) = 1/2 \times 10 \times t^2$

$X = 100 - 5t^2$ ------(i)

Distance travelled by stone projected vertically upwards from the ground with a u = 25 m/s, v=0m/s

$G = -10 m/s^2$

$X = 25t + ½ \times 10 \times t^2$

$100 - 5t^2 = 25t - 5t^2$

$t = 4$ sec

$x = 100 - 5 \times 4 \times 4 = 20$m

Hence, the two stones will meet after 4 sec at height of 20m above ground