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Ch-3 GRAVITATION

H/w

1) How does the force of gravitation between two objects change when the d/s b/w them is reduced to half?

Ans) According to the law of gravitation, the force b/w any two objects of mass M & m is directly proportional to their masses & inversely proportional to the sq. of d/s b/w them

$$F = G\frac{Mm}{r^2}$$

If the d/s is halved, i.e. new $r = \frac{r}{2}$

So, $$F = \frac{G\frac{Mm}{r^2}}{\frac{r^2}{2^2}}$$

$$\Rightarrow F = 4G\frac{Mm}{r^2}$$

∴ So force of gravitation increases 4 times when d/s is reduced to 1/2.

2) Gravitation force acts on all objects in proportion to their masses. Why then, a heavy obj does not fall faster than a light obj?

Ans Accl^n = $\frac{\text{force}}{\text{mass}}$

F = mass × accl^n

∴ As force is directly proportional to mass, accl^n is constant of any mass.

3) The earth & the moon are attracted to each other by gravetational force. Does the earth attract the moon with a force that is greater / smaller / the same as the force with which the moon attracts the earth. Why?

Ans The earth attracts the moon with an equal force with which the moon attracts the earth but these forces are in opp. dir^{n}s.

By universal law of gravitation, the force b/w moon & the sun will be = $F = \frac{GM_1M_2}{r^2}$

M_1 = mass of earth
M_2 = mass of moon
r = dis b/w them

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4) What happens to the force b/w 2 objects, if
i) the mass of one obj is doubled?
ii) the dis b/w the obj is doubled ? tripled?
iii) the masses of both obj.s are doubled.

Ans) i) According to universal law of gravitation,

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

- If the mass is doubled.

Then $F = \frac{G \times 2m_1 \times m_2}{r^2}$

$\Rightarrow F = 2f$. (Force is doubled).

ii) If the dis b/w the obj.s is doubled & tripled,

Then; $F = \frac{G \times m_1 \times m_2}{2r^2}$

$\Rightarrow F = \frac{1}{4} f$, hence force becomes $\frac{1}{4}$th of the initial force.

$F = \frac{(G \times m_1 \times m_2)}{3r^2}$

$\Rightarrow F = \frac{1}{9} f$, hence force becomes $\frac{1}{9}$th of the initial force.

iii) If the masses of both objects are doubled:-

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

$\Rightarrow F = 4F$, hence force will be four times more than its actual value.

5) (A) st. 1) When the dis b/w 2 bodies is doubled & also mass of the body is also doubled, gravitational force b/w them remains the same.

(R) st. 2) According to Newton's law of gravitation, force is directly proportional to mass of bodies &

Ans) (a) St 1 & St 2 both are true & st 2 is the correct explanation for st 1. (✓)

b) Define acc^n due to gravity.

Ans) → Acc^n due to gravity is the acc^n gained by an obj due to the gravitational force.
→ Value is $9.8 m/s^2$ (at sea level).

7) The earth attracts the falling apple, but do you think, that the apple also attracts the earth? If its is, why the earth does not move towards apple?

Ans) The apple also attracts the earth, but the earth does not move towards the apple because there is not enough force to move an object that massive.

8) What is the importance of universal law of gravitation?

Ans) → ~~Note~~ The gravitation force holds the Solar System together.
→ Holding the atmosphere near the surface of the earth.
→ Occurrence of tide.
→ For rain & snowfall.
→ The flow of waters in the rivers.

9) At what height above the surface, the value of the gravity would be half of what it is on the surface of the earth. Take radius of the earth as R = 6400 km.

Sol) Half of $g = \frac{g}{2}$ (g').

For height h

$\Rightarrow g' = g\left(\frac{R}{R+h}\right)^2$

$\Rightarrow \frac{g}{2} = g\left(\frac{R}{R+h}\right)^2$

$\Rightarrow \frac{1}{\sqrt{2}} = \frac{R}{R+h}$

$\Rightarrow \frac{1}{\sqrt{2}} = \frac{R}{R+h}$

$\Rightarrow R+h = \sqrt{2}R$

$\Rightarrow h = \sqrt{2}R - R$

$\Rightarrow h = (\sqrt{2}-1) \times R$

$\Rightarrow h = (1.414-1) \times 6400$

$\Rightarrow h = 0.414 \times 6400$

$\Rightarrow h = 2649.6$ km

$h \approx 2650$ km (Ans)

10) The value of the universal gravitational constant :-

Ans (b) does not change from place to place. (✓)

11) The radius of earth is about 6400km & that of Mars is about 3200km. The mass of earth is about 10 times the mass of Mars. An obj weights 200N on earth's surface. Then its weight on the surface of Mars will be :-

Ans (d) 80N. (✓)

(A)

12) St. 1 :- The value of accl^n due to gravity does not depend upon mass of the body

(R) St. 2 :- Accl^n due to gravity is a constant quantity.

Ans Assertion is correct but reason is incorrect.