GW
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# PHYSICS HOMEWORK

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1) Let the first object be Earth of mass M and radius R.

Let the second object be object A of mass m.

Let the distance between them = r

Now, force of gravity between two objects
$= F = \frac{GMm}{r^2}$

But, when distance between them is reduced to half :-

New distance between the Earth and the object A,
$= \frac{r}{2}$

So, force of gravity between two objects.

$= F' = \frac{GMm}{\left(\frac{r}{2}\right)^2}$

Now, $F = \frac{GMm}{r^2}$, and

$$F' = \frac{GMm}{\left(\frac{r^2}{2}\right)} = \frac{GMm}{\frac{r^2}{4}} = \frac{4GMm}{r^2}$$

$$\therefore \frac{F}{F'} = \frac{\frac{GMm}{r^2}}{\frac{4GMm}{r^2}}$$

Hence $\frac{F}{F'} = \frac{GMm}{4GMm} = \frac{1}{4}$

So, $F' = 4F$

Thus, we can say that the new force of gravity between two objects is four times the initial one.

2) A heavy object do not fall faster than a light object because during free fall every body irrespective of their masses falls with an acceleration g ( acceleration due to gravity) which is $9.8\ m/s^2$ and as value of g also do not depends upon the mass of the body, therefore though gravitational force being proportional to mass, heavy objects don't fall faster than light objects.

3) The force with which the Earth attracts the moon is equal to the force with which the moon attracts the Earth due to Newtons third law of motion that every action have a equal and opposit reaction.

4) Let the first object have mass $m_1$ and second object have mass $m_2$ and distance between them is $r$, then

$$F_1 = \frac{Gm_1m_2}{r^2}$$

i) When mass of one object is doubled,

Let New force be = $F_2$, and

Thus $F_2 = \frac{G \times 2m_1 \times m_2}{r^2}$

$$= \frac{2Gm_1m_2}{r^2}$$

Now, $\frac{F_2}{F_1} = \frac{\frac{2Gm_1m_2}{r^2}}{\frac{Gm_1m_2}{r^2}}$

$\therefore$ $\frac{F_2}{F_1} = 2$

So, $F_2 = 2F_1$

Hence, the force between two objects is doubled when mass of one of bodies is doubled.

iii) $F_1 = \frac{Gm_1m_2}{r^2}$

When distance between two bodies is doubled

Let the new force be $= F_3$, and

Distance between them $= 2r$

Now, $F_3 = \frac{Gm_1m_2}{(2r)^2}$

$= \frac{Gm_1m_2}{4r^2}$

Then $\frac{F_3}{F_1} = \frac{\frac{Gm_1m_2}{4r^2}}{\frac{Gm_1m_2}{r^2}}$

So, $\frac{F_3}{F_1} = \frac{r^2}{4r^2} = \frac{1}{4}$

$\therefore$ $4F_3 = F_1$

and $F_3 = \frac{F_1}{4}$

Hence, the force between two objects is reduced by 1/4 times.

Now, when distance between two bodies is tripled,

Distance = $3r$

Let force be = $F_4$, where

$$F_4 = \frac{Gm_1m_2}{(3r)^2}$$

$$= \frac{Gm_1m_2}{9r^2}$$

Now $$\frac{F_3}{F_1} = \frac{\frac{Gm_1m_2}{9r^2}}{\frac{Gm_1m_2}{r^2}}$$

So, $$\frac{F_3}{F_1} = \frac{r^2}{9r^2} = \frac{1}{9}$$

$\therefore$ $$F_3 = \frac{F_1}{9}$$

Hence the force between two objects is reduced by $1/9^{th}$ times. when distance between them is tripled.

(iii) $F_1 = \frac{Gm_1m_2}{r^2}$

When mass of both the objects is doubled, Let the new force be $= F_S$ where mass of first object $= 2m_1$ and, mass of second object $= 2m_2$

Now, $F_S = \frac{G2m_1 2m_2}{r^2}$

$= \frac{4Gm_1m_2}{r^2}$

So, $\frac{F_S}{F_1} = \frac{\frac{4Gm_1m_2}{r^2}}{\frac{Gm_1m_2}{r^2}}$

$\therefore \frac{F_S}{F_1} = \frac{4Gm_1m_2}{Gm_1m_2} = 4$

Thus $F_S = 4F_1$

Hence, the force between 2 objects is 4 times when the mass of both objects is doubled

# Home Assignment -2

1) Ans) Statement -1 :- When distance between two object is doubled and also mass of each body is doubled gravitation force remains same.

Statement -2 :- According to Newtons law of gravitation force is directly proportional to mass of body

Ans) (1) Statement 1 is true, Statement 2 is true and Statement -2 is correct explaination of statement -1.

## Home Assignment -3

1) The acceleration produced in a free falling body under gravitational pull of Earth is caued accelerration due to gravity.

2) When Earth attracts falling apple, the apple also attract the Earth but the Earth does not move towards apple because the apple is not capable

the apple because the acceleration produced by the apple in the Earth is very small (almost negligible) due to the massive mass of Earth. Therefore though apple attracts the Earth, but due its massive mass it have almost zero acceleration for which it does not move towards the apple.

4) The importance of universal Law of gravitation are :-

- The gravitational force is responsible for keeping us tightly bound with the Earth's surface
- It is responsible for holding the atmosphere around the Earth.
- It is responsible for snowfall and also rainfall
- The gravitional force is also responsible for planetary motion.

- It also helps in formation of tidal waves

4) Consider the Earth to be a sphere of mass M and radius R which is 6400 km.

Then gravity at any point on Earth's surface be

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

Let the height above the Earth's surface where acceleration due to gravity, say $g'$ will be half of $g$ be = $h$,

So, $$g' = \frac{GM}{(R+h)^2}$$

Now, $$\frac{g'}{g} = \frac{\frac{GM}{(R+h)^2}}{\frac{GM}{R^2}}$$

$$\therefore \frac{g'}{g} = \frac{GM \times R^2}{GM \times (R+h)^2} = \frac{R^2}{(R+h)^2}$$

Now, As $g' = \frac{1}{2}g$

$$\frac{g'}{g} = \frac{\frac{g}{2}}{g} = \frac{g}{2g} = \frac{1}{2}$$

$$\therefore \frac{g'}{g} = \frac{1}{2} = \frac{(R)^2}{(R+H)^2}$$

$$\frac{1}{2} = \frac{(R)^2}{(R+h)^2}$$

$$\text{So, } \frac{\sqrt{1}}{\sqrt{2}} = \frac{R}{R+h}$$

$$\therefore (R+H)\sqrt{1} = \sqrt{2}R$$

$$= (R+h)1 = \sqrt{2}R$$

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

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

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

Thus $h = 6400(\sqrt{2}-1)$

Hence at $6400(\sqrt{2}-1)$ m height above the Earth's surface, the acceleration due to gravity will be half of

acceleration due to gravity on Earth surface

## Home Assignment

1) b) Does not change from place to place

2) c) 40N

## Home Assignment

St. 1 The value of g does not depend on mass of body

St. 2 Acceleration due to gravity is a constant quantity

Ans) 3) Statement I is true but statement II is false.