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1) $F \propto Mm$

$F \propto \frac{1}{r}$

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

A/Q r is halved which means $r = \frac{r}{2}$

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

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

∴ The Gravitational force becomes 4 times more when we reduce the distance to half

(2) Gravitational force acts on all objects in Proportion to their masses.

The acceleration of the body on which gravitational force acts = $9.8 m/s^2$ remain same for all bodies

$F = ma$

Let $F = 0$ then $m \propto \frac{1}{a}$ and $a \propto \frac{1}{m}$

Or $m \propto \frac{1}{a}$ & $a \propto \frac{1}{m}$

∴ heavy mass has less acceleration as compared to light mass

∴ A heavy object does not fall faster than a light object

3) Earth & the moon attract each other at equal gravitational force because the force of attraction is in different direction therefore they remain at their position

4) i) $F = \frac{GMm}{r^2}$

If mass of one body is doubled

$\rightarrow \frac{G2Mm}{r}$

$\rightarrow 2F \quad (\text{as } F = \frac{GMm}{r^2})$

$\therefore$ force become twice of original

ii) If d is doubled

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

$\Rightarrow \frac{GMm}{(2r)^2} \rightarrow \frac{GMm}{4r^2} \Rightarrow \frac{1}{4} \times \frac{GMm}{r^2}$

$\frac{1}{4} \times F \quad (\text{as } F = \frac{GMm}{r^2})$

$\therefore$ The force become $\frac{1}{4}$th of original force

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

If distance is tripled

$\rightarrow \frac{GMm}{(3r)^2} = \frac{GMm}{9r^2} = \frac{1}{9} \times \frac{GMm}{r^2}$

$\therefore$ force become $\frac{1}{9}$th of original force $\rightarrow \frac{1}{9} \times F$

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

If both r & m is doubled

$\Rightarrow G\frac{\times 2M \times 2m}{r^2}$

$\Rightarrow \frac{4GMm}{r^2}$

$\Rightarrow 4f$

∴ The force become 4 times of original force.

(Q) Assertion & Reasoning

(4) Statement 1 is False & Statement 2 is True.

5) Whenever an object falls towards earth an acceleration is involved. This is called the acceleration due to gravity

6) ~~Yes~~ the earth attracts the apple & the apple also attracts the earth in order to make action & reaction pair equal. The attraction of earth due to apple is very small or negligible

7) Universal law of gravitation:
This describes the gravitational force acting between any two body. Like the Earth & moon
Ex. It also describes that due to gravitational force of Sun & the planets, it binds the planet on its orbit.

8) acceleration due to gravity on surface of earth
Let- Radius of earth be- R_E $\quad g = \frac{GM_E}{R_E^2}$ -- (1)
Mass of earth M_E

Acceleration ~~due~~ due to gravity at a height h from Surface of earth

$$g' = \frac{GM_E}{(R_E+h)^2} \quad ---(11)$$

A/Q $g' = \frac{1}{2}g$

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

$$(R_E+h)^2 = 2R_E^2 \rightarrow (R_E+h) = \sqrt{2}R_E$$

$h = (\sqrt{2}-1)R_E \rightarrow \sqrt{2}-1 \times 6400. \Rightarrow 2650.97 km$

9) b) does not change from place to place
10) c) SON

Q) 3) Statement 1 is true & Statement 2 is false.