1) How does the force of gravitation between two objects change when the distance between them is reduced to half?

According to the law of gravitation, the force b/w any two objects of mass M & m is directly proportional their masses & inversely proportional to the square of distance between them.

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

If the distance is halved, i.e, now $r = \frac{r}{2}$

so, $F = G\dfrac{Mm}{\dfrac{r^2}{2^2}}$

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

∴ force of gravitation increases 4 times when distance is reduced to $\frac{1}{2}$.

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

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

$$\rightarrow F = mass \times acce^n$$

∴ 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 gravitational 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?

The earth attracts the moon with an equal force with which the moon attracts the Earth but these forces are in opposite direction. By universal law of gravitation the force b/w moon & the sun will be :

$$F = \frac{Gm_1 m_2}{r^2}$$

m_1 = mass of Earth
m_2 = mass of moon
r = distance b/w them.

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

i) According to universal law of gravitation,

$$F = \frac{Gm_1 m_2}{r^2}$$

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 distance b/w the objects is doubled & tripled then,

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

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

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

⇒ F = 9F, hence force become $\frac{1}{9}$th of the initial force.

iii) If the mass of both objs are doubled then,

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

⇒ F = 4F, hence force will be four times more than its initial velocity value.

5) (assertion) st-1⟩ when the distance b/w two bodies is doubled & also mass of the body is also doubled, gravitational force b/w them remains the same.

(Reason) st-2⟩ According to Newton's law of gravitation force is directly proportional to mass of bodies

Ans ⟩ st-1 & st-2 both are true & st2 is the correct explanation for st-2.

6) Define accl^n due to gravity.

→ Accl^n due to gravity is the accl^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 it is, why the earth does not move towards apple?

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?

> The gravitation force holds the solar system together.

> Holding the atmosphere near the surface of the earth.

> Occurance of tide.

> For rain & snowfall.

> The flow of water 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 $R = 6400 \, km$.

Half of $g : \frac{g}{2} (g^1)$

for height h

$\Rightarrow g^1 = g \left(\frac{R}{R+h}\right)^2$

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

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

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

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

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

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

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

$$\Rightarrow h = 0.414 \times 6400$$

$$\Rightarrow h = 2649.6 \text{ Km}$$

$$h = 2650 \text{ Km} \underline{\underline{Ans}}$$

10) The value of the universal gravitational constant :-
   b) does not change from place to place.

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

   d) 80 N.

12) St-1) The value of accl^n due to gravity does not depend
   upon mass of the body.
   St-2) accl^n due to gravity is a constant quantity
   Assertion is correct but reason is incorrect.