**CBSE Class 9 Science**

**Important Questions**

**Chapter 10**

**Gravitaion**

## 1 Marks Questions

**1. What is the acceleration of free fall?**

**Ans.** The acceleration of free fall is g = 9.8 $m/s^2$(on earth).

**2. What do we call the gravitational force between the earth and an object?**

**Ans.** Weight.

**3. In what direction does the buoyant force on an object immersed in a liquid act?**

**Ans.** In the upward direction only.

**4. Even though stone also attracts earth towards itself, earth does not move**

**(a) Because of greater mass of earth**

**(b) Because of lesser mass of stone**

**(c) Force exerted by stone is less**

**(d) Force exerted earth is large**

**Ans. (a)** Because of greater mass of earth

**5. The weight of an object is:**

**(a) Greater on earth and lesser on Moon**

**(b) Lesser on earth and Greater on earth**

**(c) Equal on both earth and Moon**

**(d) None of these**

**Ans. (a)** Greater on earth and lesser on Moon

**6. Weight of an object has S.I, unit of:**

**(a) Newton**

**(b) kg**

**(c) N/Kg**

**(d) Kg/N**

**Ans. (a)** Newton

**7. Which of the statements is correct?**

**(a) Mass is constant and weight is variable**

**(b) Mass is variable and weight is constant.**

**(c) Both Mass and weight are variable**

**(d) Both Mass and weight are constant.**

**Ans. (a)** Mass is constant and weight is variable

**8. If cross – sectional area of an object is more than the pressure applied by the external force is:**

**(a) Less**

**(b) More**

**(c) Remains same**

**(d) None of the above.**

**Ans. (a)** Less

**9. If the acceleration due to gravity at a place is more, the weight of that object will:**

**(a) Decrease**

**(b) Increase**

**(c) Remains same**

**(d) None of the above**

**Ans. (b)** Increase

**10. Weight of the object is:**

**(a) More at the equator and less at poles**

**(b) More at poles and less at equator**

**(d) Same at poles and equator**

**(d) Depend on Mass of the object**

**Ans. (b)** More at poles and less at equator

**11. If the distance between the object increase, mass remaining same then the gravitational forces between the object will :-**

**(a) Increase**

**(b) Decrease**

**(c) Remain same**

**(d) None of the above.**

**Ans. (a)** Increase

**12. The S. I. units of mass, force and weight are respectively:**

**(a) Kg, N, N**

**(b) N, Kg, N**

**(c) N, N, Kg**

**(d) Kg, N, Kg**

**Ans. (a)** Kg, N, N

**13. Units of 'g' are:**

**(a)** $\mathbf{m/s^2}$

**(b) N/Kg**

**(c)** $\mathbf{Nm/s^2}$

**(d)** $\mathbf{Nms^2}$

**Ans. (a)** $m/s^2$

**14. The relation between the weight of an object on the moon (** $W_m$ **) and on the earth (** $W_e$ **) is:**

**(a)** $Wm = \frac{1}{6} We$

**(b) Wm = We**

**(c)** $We = \frac{1}{6} Wm$

**(d) Wm = 6We**

**Ans. (a)** $Wm = \frac{1}{6} We$

**15. S. I. unite of Pressure:**

**(a)** $\mathbf{Nm^2}$

**(b)** $\mathbf{N/m^2}$

**(c) Nm**

**(d) N/m**

**Ans. (b)** $N/m^2$

**16. Units of pressure are:**

**(a)** $\mathbf{Nm^2}$

**(b)** $\mathbf{N/m^2}$

**(c) Nm**

**(d) N/m**

**Ans. (b)** $N/m^2$

**17. Units of Relative Density are:**

**(a)** $\mathbf{Kg/m^3}$

**(c) Depends on the density of the substance**

**(b) Unit less**

**(d) Depend on the density of water**

**Ans. (b)** Unit less

**18. Pressure at a point in the liquid is**

**(a) Same in all directions**

**(b) Greater in the upward direction**

**(c) Grater in the downward direction**

**(d) None of the Above**

**Ans. (a)** Same in all directions

**19. If the area of an object is less than the pressure acting on that object will be**

**(a) Less**

**(b) More**

**(c) Independent of area**

**(d) None of the above**

**Ans. (b)** More

**CBSE Class 9 Science**
**Important Questions**
**Chapter 10**
**Gravitaion**

**2 Marks Questions**

**1. What do you mean by free fall?**

**Ans.** It is the object falling towards earth under the influence of attraction force of earth or gravity.

**2. What do you mean by acceleration due to gravity?**

**Ans.** During free fall any object that has mass experiences force towards centre of earth and hence an acceleration works as well. “acceleration experienced by an object in its freefall is called acceleration due to gravity.” It is denoted by g.

**3. Why is it difficult to hold a schoolbag having a strap made of a thin and strong string?**

**Ans.** It is difficult to hold a schoolbag having a strap made of a thin and strong string because a bag of that kind will make its weight fall over a small area of the shoulder and produce a greater pressure that makes holding the bag difficult and painful.

**4. What do you mean by buoyancy?**

**Ans.** It is the upward force experienced by an object when it is immersed into a fluid.

**5. You find your mass to be 42 kg on a weighing machine. Is your mass more or less than 42 kg?**

**Ans.** Mass will be slightly more than 42 kg.

**6. You have a bag of cotton and anir on bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than other. Can you say which one is heavier and why?**

**Ans.** The bag of cotton is heavier since volume of cotton bag is greater than iron bar, so the up thrust is larger in case of cotton hence real mass of cotton bag is more and it is heavier.

**7. How does the force of gravitation between two objects change when the distance between them is reduced to half?**

**Ans.** The force of gravitation between two objects is inversely proportional to the square of the distance between them therefore the gravity will become four times if distance between them is reduced to half.

**8. Gravitational force acts on all objects in proportion to their masses. Why then, a heavy object does not fall faster than alight object?**

**Ans.** In free fall of objects the acceleration in velocity due to gravity is independent of mass of those objects hence a heavy object does not fall faster than alight object.

**9. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is $6\times1024\ \text{kg}$ and radius of the earth is $6.4\times106\ \text{m}$ .)**

**Ans.** $F = G\frac{Mm}{d^2}$

$= \frac{6.6\times10^{-11}\times6\times10^{24}\times1}{\left(6.4\times10^{6}\right)^{2}}$

$= \frac{6.7\times6\times10}{(6.4\times6.4)}$

= 9.81 N

**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.** The earth and the moon are attracted to each other by same gravitational force because for both of them formula to calculate force of attraction is the same

F = G $\frac{Me \times Mm}{d^2}$

d is also same for both.

**11. If the moon attracts the earth, why does the earth not move towards the moon?**

**Ans.** Earth does not move towards moon because mass of moon is very small as compared to that of earth.

**12. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [*Hint*: The value of *g* is greater at the poles than at the equator.]**

**Ans.** Since $W = m \times g$ and given in the question that value of g is greater at the poles than at the equator, hence weight of same amount of gold will be lesser at equator than it was on the poles. Therefore, the friend will not agree with the weight of gold bought.

**13. Why will a sheet of paper fall slower than one that is crumpled into a ball?**

**Ans.** A greater surface area offers greater resistance and buoyancy same is true in the case of a sheet of paper that has larger surface area as compared to paper crumpled into a ball. So sheet of paper falls slower.

**14. Gravitational force on the surface of the moon is only 1/6 as strong as gravitational force on the earth. What is the weight in newton's of a 10 kg object on the moon and on the earth?**

**Ans**. value of gravity on earth = $9.8\ m/s^2$

value of gravity on moon = 1/6$^{th}$ of earth = 9.8/6 = $1.63\ m/s^2$

weight of object on moon = $m \times 1.63 = 10 \times 1.63$ = 16.3 N

weight of object on earth = $m \times 9.8 = 10 \times 9.8$ = 98 N

**15. 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. (i)** v = u + gt

$0 = 49 + (-9.8) \times t$

9.8t = 49

t = 49/9.8 = 5 s

$h = ut + \frac{1}{2}gt^2$

$= 49 \times 5 + \frac{1}{2} \times 9.8 \times 25$ = 245 -122.5 = 122.5

**(ii)** total time taken to return = 5 + 5 = 10 s

**16. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity.**

**Ans.** $h = ut + ½gt^2$

$19.6 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$

$4.9t^2 = 19.6$

$t^2 = 19.6/4.9 = 4$

t = 2

since v= u + at $= \ 0 \ + \ 9.8 \times 2$

= 19.6 m/s

**17. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth $= 6 \times 10^{24}$ kg and of the Sun $= 2 \times 10^{30}$ kg. The average distance between the two is $1.5 \times 10^{11}$ m.**

**Ans.** $F = G\frac{Mm}{d^2}$

$F = 6.7 \times 10^{-11} \times 2 \times 10^{30} \times 6 \times 10^{24}$

$\left(1.5 \times 10^{11}\right)^2$

= $35.73 \times 10^{21} N$

**18. Why does a block of plastic released under water come up to the surface of water?**

**Ans.** Since of plastic has density very less as compared to water i.e. weight of plastic is less than the buoyant force experienced by it therefore a block of plastic released under water come up to the surface of water/floats.

**19. The volume of 50 g of a substance is $20 \text{ cm}^3$. If the density of water is $1 \text{ g cm}^{-3}$, will the substance float or sink?**

**Ans.** Density of that substance (d) = mass/volume = 50/20 = $2.5 \ g \ / cm^3$

since the density of substance (2.5) is greater than the density of water (1) therefore it will sink.

**20. State the Universal law of Gravitation?**

**Ans.** According to Universal law of Gravitation every particle in the universe attracts every other particle with a force which is directly proportional to the product of their masses and

inversely proportional to the square of the distance between them.

Let $M_1$, $M_2$ = Masses of two bodies

r = Distance of separation

f = force acting b/w them

So, $f \alpha M_1 M_2$

$f \alpha \frac{1}{r^2}$

$So, \ f \alpha \frac{M_1 M_2}{r^2}$ G = Universal Gravitational constant

$f = \frac{GM_1 M_2}{r^2}$

**21. If heavier bodies are attracted more strongly by the earth, why do they not fall faster to the ground?**

**Ans.** Heavier bodies do not fall fast on the ground even though they are attracted by the earth strongly because of their larger mass, the acceleration produced in them by the force of earth will be less as

F = m

$\frac{F}{m} = a$

m-mass, F=force, a = Acceleration

so if Mass is more, Acceleration will be less

**22. State Archimedes Principle?**

**Ans.** According to Archimedes Principle when a body is partially or completely immersed in a fluid, experiences an up thrust which is equal to the weight of fluid displaced.

**23. A stone is dropped from the edge of the roof. It passes a window 2m high is 0.1 s.**

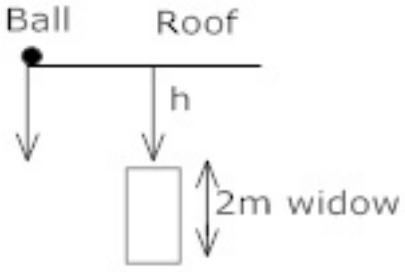
**How far is the roof above the window?**

**Ans.** S = h = height

u = Initial velocity

t = Time

g = Acceleration due to gravity




Let, the time taken to fall through height 'h' is 't' so,

$$h = ut + \frac{1}{2}gt^2$$

$$h = \frac{1}{2} \times (-10) \times t^2 (u = o)$$

$\Rightarrow -h = -5t^2$ equation – (1) (-h because fall is downward)

Let to fall (h = 2) m time taken is (t + 0.1) s.

$$-(h+2) = -5(t+0.1)^2 \text{ equation} \rightarrow (2)$$

Subtract equation (2) from (1)

$$-2 = -5\left[(t+0.1)^2 - t^2\right]$$

$$= -5\left[t^2 + 0.2t + 0.01 - t^2\right]$$

$$-2 = -5\left[0.2t + 0.01\right]$$

$$0.2t + 0.01 = 0.4$$

$0.2t = 0.39$

$t = 1.95s$

Substitute t in equation (1)

$-h = -5t^2$

$-h = -5 \times (1.95)^2$

$h = 19.0\ m$

The roof is 19.0 m above the window.

**24. How does acceleration due to gravity change with the shape of earth?**

**Ans.** Since earth is not a perfect sphere, it is flattened from the top and bulges at the centre and acceleration due to gravity (g) is inversely proportional to the radius of earth so, g is more at poles because of lesser radius and less at equator because of greater radius.

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


**25. What do you understand by the gravitational force of earth and weight?**

**Ans.** Gravitational force of earth is the force by which earth exerts on any object towards itself.

Weight is the force which the object exerts on the earth.

**26. A man of mass 60 Kg is standing on the floor holding a stone weighing 40 N. What is the force with which the floor is pushing him up?**

**Ans.** The gravitational pull on the man = Mg

$= 60 \times 10 = 600N$

The weight he is carrying = 40 N

The total downward force on the floor = 40 N + 600 N

= 640 N

The Gravitational force and upward force of the floor is an action – reaction pair.

The force with which the floor pushes the man = 640 N.

**27. What is acceleration due to gravity and how is it different from acceleration?**

**Ans.** Acceleration due to gravity is the acceleration produced in the object when it falls freely under the effect of gravitational force of earth only. Acceleration is produced when any external force applied on the body makes it to move.

**28. If the mass of one object is doubled and mass of other remains the same and if distance between them is halved then how does the gravitational force change?**

**Ans.** Let $M_1$ = Mass of first object

$M_2$ = Mass of second object

R = Distance between the two objects

G = Universal Gravitational constant

F = Gravitational force.

$$F1 = \frac{GM_1M_2}{R^2} \quad \rightarrow 1)$$

$$\text{Now, } M_1^1 = 2M_1$$

$M_1^1, M_2^1 \rightarrow$ New Masses

$R^1 \rightarrow$ New Distance

$M_2^1 = M_2$

$$R^1 = \frac{R}{2}$$

$So, F_2 = G \times 2$ $F_2$ = New force

$$F_2 = \frac{GM_1^1 M_2^1}{R^{12}}$$

$$F_2 = \frac{G2M_1M_2}{\left(\frac{R}{2}\right)^2}$$

$$F_2 = \frac{8GM_1M_2}{R^2}$$

Using equal 1)

$$F_2 = 8F_1$$

**29. Show that if mass of two bodies are equal their weights will be same in whichever part of universe it may be measured?**

**Ans.** Consider two bodies of masses $m_1$ and $m_2$. Let them be taken to a planet whose mass is $m_p$ and the radius to be $r_p$. The gravitational force of attraction exerted by the planet on the mass will be:

Force between planet and $m_1$ = $\frac{Gm_pm_1}{(r_p)^2} = F_1$

Force between planet and $m_2$ = $\frac{Gm_pm_2}{(r_p)^2} = F_2$

If two bodies have the same mass, that is if $m_1 = m_2$ then $F_1 = F_2$

$F_1 and\ F_2$ are the weights of the bodies on that planet. Therefore, if the mass of two bodies are equal, their weights will be same.

**30. The radius of the earth is about 6370 Km. An object of mass 30 Kg is taken to a height of 230 Km above the surface of earth.**

**(a) What is the mass of the body**

**(b) What is the acceleration to gravity at this height**

**(c) What is the weight of the body at this height.**

**Ans. a)** The mass of the body will be 30 Kg because mass is constant

**b)** The distance of the body form the centre of the earth = 6370 + 230 Km

= 6600 Km $= 6.6\times10^6 m$

Acceleration due to gravity = g = $\frac{Gme}{r^2}$

$$g = \frac{6.673\times10^{-11}\times5.98\times10^{24}}{\left(6.6\times10^6\right)^2}$$

$$g = 9.16 m/s^2$$

**c)** Weight at that height = mg

$= 30\times9.16$

= 274.8 N

**31. What is the importance of the universal law of Gravitation?**

**Ans.** The importance of universal law of gravitation:

**1)** The force that binds us to the earth.

**2)** The motion of the moon around the earth.

**3)** The motion of the planet around the sun

**4)** The tides due to the moon and the sun

**32. Define Pressure? How is thrust different from Pressure?**

**Ans.** The pressure due to a force is defined as the force acting or unit area.

Pressure (P) = $\frac{Force(F)}{Area(A)}$

A unit of Pressure is $N/m^2$.

Thrust is also the pressure but it is the force acting on a surface normal to its area.

**33. What are fluids? What are the factors on which the upward pressure at a point on a fluid depends?**

**Ans.** Fluids are that which flow and it includes both liquids and gases.

Factors on which the upward pressure at a point of the fluid depends are:

1) the depth of the point from the surface of the liquid.

2) the density of the liquid

3) the acceleration due to gravity.

**34. Define density and relative density?**

**Ans.** Density of a substance is defined as the mass of the unit volume of the substance. Its units are $\mathbf{Kg/m^3}$.

Relative Density of a substance is the ratio of the density of the substance to the density of

water.

Relative Density of substance = $\frac{\text{Density of substance}}{\text{Density of water}}$

It is unit less.

**35. Calculate the pressure at a depth of 50 m below the surface of sea. The density of sea water is $1024\ \text{Kg}/\text{m}^3$.**

**Ans.** Depth of the point where = 5 cm or 0.05 m pressure is to be calculated

Density of sea water = $1024 Kg/m^3$

Acceleration due to gravity = $g = 10 m/s^2$

Pressure = Depth × Density of water × Acceleration due of gravity

$$= \frac{0.05}{100} \times 1024 \times 10$$

$$= \frac{5120}{10}$$

Pressure = $512\ N/m^2$ or Pa

**CBSE Class 9 Science**
**Important Questions**
**Chapter 10**
**Gravitaion**

**3 Marks Questions**

**1. State the universal law of gravitation.**

**Ans.** According to Newton's universal law of gravitation:

*Every mass in this universe attracts every other mass with a force which is directly proportional to the product of two masses and inversely proportional to the square of the distance between them.*

**2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.**

**Ans.** The formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth is given below:

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

F = magnitude of gravitational force

G = Universal gravitation constant

M = mass of earth

m = mass of object

d = distance of object from the centre of earth

**3. What are the differences between the mass of an object and its weight?**

**Ans.**

| Mass of object | Weight of object |
|---|---|
| i)Mass is defined as quantity of matter contained in an object.<br>ii) It is denoted by 'm'.<br>iii) $F = m \times a$<br>iv) It remains constant at any place of the universe. | i) Weight is the force with which an object is attracted towards the earth's centre.<br>ii) It is denoted by 'W'.<br>iii) $W = m \times g$<br>iv) It is different at different places. |

**4. Why is the weight of an object on the moon 1/6th its weight on the earth?**

**Ans.** since we know $W = m \times g$ Mass of object remains the same whether on earth or moon but the value of acceleration on moon is $1/6^{th}$ of the value of acceleration on earth. Because of this weight of an object on moon is 1/6th its weight on the earth.

**5. Why does an object float or sink when placed on the surface of water?**

**Ans.** As an object comes in contact with the surface of a fluid it experiences two types of forces: gravitational force or gravity that pulls the object in downward direction and the second force is the force of buoyancy that pushes the object in upward direction.

It is these two forces that are responsible for an object to float or sink

i.e. if gravity >buoyancy then object sinks

if gravity<buoyancy then object floats.

**6. What happens to the force between two objects, if**

**(i) the mass of one object is doubled?**

**(ii) the distance between the objects is doubled and tripled?**

**(iii) the masses of both objects are doubled?**

**Ans. (i)** the force between two objects will be doubled.

**(ii)** the force between two objects will become $1/4^{th}$ and $1/9^{th}$ of the present force.

**(iii)** the force between two objects will become four times the present force.

**7. What is the importance of universal law of gravitation?**

**Ans.** The universal law of gravitation is important due to the following:

**i)** this law explains well the force that binds us to earth.

**ii)** this law describes the motion of planets around the sun.

**iii)** this law justifies the tide formation on earth due to moon and sun.

**iv)** this law gives reason for movement of moon around earth.

**8. A stone is thrown vertically upward with an initial velocity of40 m/s.**

**Taking $g = 10\ \mathrm{m/s^2}$, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?**

**Ans.** Initial velocity of stone (u) = 40 m/s

at maximum height stone will be at rest so v= 0

v = u + gt

$$0 = 40 + (-10) \times t$$

10t = 40

t = 40/10 = 4 s

distance covered /maximum height

$$h = ut + \tfrac{1}{2}gt^2$$

$$= 40 \times 4 + \frac{1}{2} \times (-10) \times 4 \times 4$$ = 160 - 80 = 80 m

net displacement of stone = 0(thrown upwards then falls back to same place)

total distance covered by the stone = 80 + 80 = 160 m

**9. The volume of a 500 g sealed packet is $350\ cm^3$. Will the packet float or sink in water if the density of water is $1\ g\ cm^{-3}$? What will be the mass of the water displaced by this packet?**

**Ans.** Density of the packet = mass/volume = 500/350 = $1.428\ g/cm^3$

Since the density of packet is more than density of water so it will sink. And packet will displace water equal to its volume:

volume of water displaced by packet $= 350cm^3$ (volume of packet)

mass of water displaced = volume of water displaced $\times$ density of water

$= 350 \times 1$ = 350 g

**10. The radius of earth is 6370 Km and of mars is 3400 Km. If an object weighs 200 N or earth, what will be its weight on mars. The mass of mars is 0.11 that of earth.**

**Ans.** Let m = Mass of the body

Me = Mass of earth

Mm = Mass of Mars

re = Radius of earth

$r_m$ = Radius of Mars

G = Universal gravitational constant

Weight of body on earth = $F_e = \frac{GMem}{(r_e)^2}$

Weight of body on Mars = $F_m = \frac{GMmm}{(r_e)^2}$

Divide one equal by another

$$\frac{Fm}{Fe}=\frac{GMmm\times(r_e)^2}{(r_m)^2\times GMem}$$

$$\frac{Fm}{Fe}=\frac{Mm(r_e)^2}{Me(r_m)^2}$$

As, M, = 0.11 Me

Fe = 200 N

$r_e$ = 6370 Km

$r_m$ = 3400 Km

$$\frac{Fm}{200}=\frac{0.11Me\times\left(6.37\times10^6\right)^2}{Me\times\left(3.4\times10^6\right)^2}$$

$$Fm=\frac{0.11\times\left(6.37\times10^6\right)^2\times200}{\left(3.4\times10^6\right)^2}$$

Fm = 77.22 N

Weight of the body on Mars = 77.22 N

**11. Determine the value and units of universal Gravitational constant, G?**

**Ans.** From Universal law of Gravitation,

$M_1$ = Mass of earth

$M_2$ = Mass of object

R = Radius of earth

F = Attractive force between earth and object

$$F \alpha M_1 M_2$$

$$F \alpha \frac{1}{R^2}$$

$$F \alpha \frac{M_1 M_2}{R^2}$$

$$F = \frac{G M_1 M_2}{R^2}$$

$$Let\ M_2 = 6 \times 10^{24} Kg$$

$$R = 6.4 \times 10^6 m$$

$$F = 1N$$

$$1N = \frac{G \times 6 \times 10^{24} \times 1}{\left(6.4 \times 10^6\right)^2}$$

$$\frac{1N \times \left(6.4 \times 10^6\right)^2}{6 \times 10^{24}} = G$$

Units of G

$$F = \frac{G M_1 M_2}{R^2}$$

$$N = \frac{G \times Kg \times Kg}{m^2}$$

$$\frac{N m^2}{(Kg)^2} = G$$

Units of $G = Nm^2 / Kg^2$

**12. What is the up thrust experienced by a cube of edge – length 5 cm made of iron when completely immersed in ethanol of density $0.8\ \mathbf{g/cm^3}$**

**Ans.** Volume of the cube $= (side)^3 = 5^3 cm^3 = 125 cm^3$

$= 125 \times 10^{-6} m^3$

Volume of ethanol displaced $= 1.25 \times 10^{-4} m^3$

Density of ethanol $= 0.8 g/cm^3$

$1 cm^3$ of ethanol has a mass of 0.8

$1 m^3$ (that is $106\ cm^3$) of ethanol will have a mass $= 0.8 \times 10^6 g$

$= 8 \times 10^5 g$ = 800 Kg

The Density of ethanol $= 800\ Kg/m^3$

Mass of ethanol $= 1.25 \times 10^{-4} \times 800$ = 0.1 Kg

Weight of ethanol displaced $= 0.1 \times 9.8$ = 0.98 N

By Archimedes's principles

Up thrust = weight of fluid displaced = 0.98 N

**13. A stone is dropped from a height of 50 m on earth. At the same time, another stone is thrown vertically upwards from the ground with a velocity up wards from the ground with a velocity of 50 m/s. At what height from the ground will the two stones meet $(\mathbf{g = -10\ m/s^2})$**

**Ans.** Volume of the cube = $(side)^3 = 5^3 cm^3 = 125 cm^3$

$= 125 \times 10^{-6} m^3$

Volume of ethanol displaced $= 1.25\times10^{-4} m^3$

Density of ethanol $= 0.8 g / cm^3$

$1 cm^3$ of ethanol has a mass of 0.8

$1 m^3$ (that is 106 $cm^3$) of ethanol will have a mass $= 0.8\times10^6 g$

$= 8\times10^5 g$ = 800 Kg

The Density of ethanol $= 800\ Kg / m^3$

Mass of ethanol $= 1.25\times10^{-4}\times800$ = 0.1 Kg

Weight of ethanol displaced = $0.1\times9.8$ = 0.98 N

By Archimedes's principles

Up thrust = weight of fluid displaced = 0.98 N

**14. What is acceleration due to gravity and calculate its value on earth?**

**Ans.** Acceleration due to gravity (g) is the acceleration produced is the object when it falls freely under the effect of gravitational force of earth.

Let M = Mass of earth

m = Mass of object

r = Radius of earth

g = Acceleration due to gravity

f = force.

By Newton's law of gravitation.

$$F = \frac{GMm}{R^2} \quad \rightarrow i)$$

Now, F = Ma (from Newton's $II^{nd}$ law)

F = mg → ii) (for free fall)

Equating i) & ii)

$$mg = \frac{GMm}{R^2}$$

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

$$Put\ \mathrm{G} = 6.67 \times 10^{-11} \mathrm{Nm}^2/\mathrm{Kg}^2$$

$$M = 6 \times 10^{24} Kg$$

$$R = 6400 Km$$

$$g = 9.8 m/s^2$$

**15. A ball is thrown vertically upwards. The speed of the ball was 10 m/s when it had reached one half of its maximum height.**

**(a) How high does the ball rise?**

**(b) Find the velocity and acceleration 1s after it is thrown.**

**Ans. a)** Let the initial velocity = u

Let the maximum height reached = h m

When it reached $\frac{h}{2}$, the velocity = 10 m/s

Now

$$v^2 = u^2 + 2gh$$

$$(10)^2 = (u)^2 + 2(-10) \times \frac{h}{2}$$

$$(u)^2 = 100 + h \times 10$$

When the ball reaches the highest point, v = o

$$v^2 - u^2 = 2gh$$

$$o^2 - u^2 = 2(-10)h$$

$$-u^2 = -2(10)h$$

$$\Rightarrow (100 + 10h) = 20h$$

100 = 20 h-10 h

100 = 10 h

10 m=h

Maximum height reached = 10 m

$$u^2 = 100 + 10h$$

$$u^2 = 100 + 10 \times 10$$

$$u^2 = 200$$

$$u = \sqrt{200} = 14.14 m/s$$

Initial velocity of the ball when it was thrown up = 14.14 m/s.

**b)** Velocity after 1s

$$v = u + at$$

$$v = 14.14 + (-10) \times 1$$

$$= 4.14 m/s$$

Acceleration after $1s = -10m/s^2$

**16. How does weight of a rocket change as it moves from earth to moon?**

**Ans.** The acceleration due to gravity on earth and on the moon is different and for a body of mass 'm' its weight on earth = mg earth and on Moon, weight = mg moon

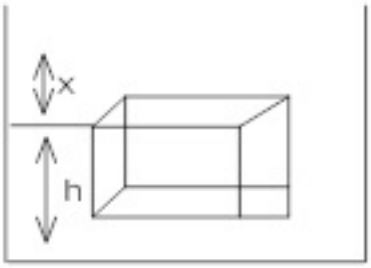
Now, $g_{earth} = \frac{GM\ earth}{R^2\ earth};\ g_{moon} = \frac{GM_{moon}}{R^2_{moon}}$

Putting the values of G, M, R for earth & Moon it is found that $W_{moon} = \frac{1}{6}W_{earth}$ i.e. the weight of the object will be less on the earth than on the moon.

**17. Give a mathematical proof of the Archimedes principle?**

**Ans.** According to Archimedes's Principle, for a fully or partially immersed object,

Up thrust = weight of fluid displaced




Let cross-section of solid = $Am^2$

Height of solid = hm

Density of liquid = $dKg/m^3$

Top surface of the solid by at depth = xm

Downward pressure acting on the top surface = xdg Pa

Downward force acting on the top surface = ndg xA = Axdg Newton

Bottom surface of the solid is at a depth (h + x)m from the surface of liquid.

Upward pressure acting on bottom surface =(h + n) dg

Upward force = (h + m) dg A

Excess upward force = (h + n) dg A – ndg A = A hdg → (1)

Volume of solid = $A\ hm^3$

Volume of fluid displaced = $A\ hm^3$

Mass of fluid displaced = A hd kg

Weight of fluid displaced = A hdg Newton → (2)

From equation (1) & (2)

Upward force = weight of fluid displaced y

**18. What is the magnitude of the gravitational force exerted by a 15 Kg mass on a 25 Kg mass separated by a distance of 25 cm. What is the acceleration produced on each mass?**

**Ans.** Mass of first Body = $m_1 = 15Kg$

Mass of second Body = $m_2 = 25Kg$

r = Distance between them = 25 cm = 0.25 m

F = Gravitational force = $\frac{Gm_1m_2}{r^2}$

$$= \frac{6.673\times10^{-11}\times15\times25}{(0.25)^2}$$

$$= 4.004\times10^{-7}N$$

Both the 15 Kg and 25 Kg mass attracts each other by a force equal to $4.004\times10^{-7}N$.

Since F = ma

a = Acceleration

Acceleration of the 15 Kg mass = $\frac{F}{m} = \frac{4.004 \times 10^{-7}}{15}$

$= 2.67 \times 10^{-8} m/s^2$

Acceleration of the 25 Kg mass = $\frac{4.004 \times 10^{-7}}{25}$

$= 1.60 \times 10^{-8} m/s^2$

**19. A stone is dropped from a height of 100 m on earth. At the same time, another stone is thrown vertically upwards from a ground with a velocity of 50 m/s. At what height from the ground will the stone meat?**

**Ans.** Let the two stones meet after t s. The distance travelled by a falling body is given by:

$$S = ut + \frac{1}{2}at^2$$

U =0

$$S = \frac{1}{2}(-10)t^2 = 5t^2 (Magnitude)$$

The height reached by the stone moving up in t s:

$$= ut + \frac{1}{2}gt^2$$

$$= 50t - 5t^2$$

Total distance travelled by two stones 100 m

$$5t^2 + 50 - 5t^2 = 100$$

t = 2 sec

The stone meet after 2s they are dropped

The height through which the stone makes up in 1

$S = 50t - 5t^2$

$= 50 \times 25 \times (2)^2$

= 100 – 20 = 80 m

They meet 80 m above the ground.

**20. What id the up thrust experienced by a balloon of volume 120 $m^3$ filled with hydrogen. The density of air $= 1.140\ \mathrm{Kg/m^3}$ and density of hydrogen $= 0.081\mathrm{Kg/m^3}$ at room temperature. What is the maximum weight this balloon can lift?**

**Ans.** The up thrust = weight of the air displaced

Mass of air displaced $= 120 \times 1.14$

= 136.8 Kg

Weight of air displaced $= 136.8 \times 9.8N$ = (Mg)

= 1340.6 N

Downward force = weight of the balloon + weight of $H_2$

Now, Mass of the balloon + Mass of $H_2$

= 75+120 (0.081)

= 84.72 Kg

Weight of the balloon and $H_2$ filling it $= 84.72 \times 9.8$

= 830.3 N

Net up thrust = 1340.6 – 830.3

= 510.3 N

Maximum weight the balloon can lift = 510.3 N

**21. A boy on a cliff 49 m high, drops a stone, one second later, he throws another stone vertically downwards. The two stones hit the ground at the same time. What was the velocity with which the second stone was thrown?**

**Ans.** For the first stone, Initial velocity u = o

Let the stone take t s to reach the ground

$$s = ut + \frac{1}{2}gt^2$$

$$-49 = \frac{1}{2}(-9.8)t^2$$

$$t^2 = 10$$

$$t = 3.162s$$

For the second stone, the initial velocity = $u_0$

Time of flight = 3.16 2-1s

= 2.162 s

$$s = ut + \frac{1}{2}gt^2$$

$$-49 = -u_0(2.162) + \frac{1}{2}(-9.8)\left(2.16^2\right)^2$$

$$-49 = -2.16u_0 - 22.9$$

$$u_0 = \frac{26.1}{2.162} = 12.1 m/s$$

The second stone was thrown downward with a velocity of 12.1 m/s

**22. What makes a body to float or sink in a liquid?**

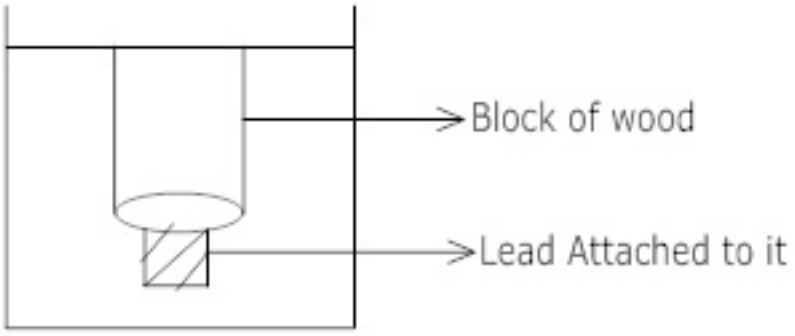
**Ans.** When an object is immersed in a liquid, it exerts a weight in the downward direction and the liquid exerts a force called up thrust in the upward direction on the object.

If the object sinks in the liquid, then the weight of the body is greater than the up thrust acting on the object by the liquid.

If the object floats in the liquid, then the weight of the body is less than the up thrust acting on the object by the liquid.

**23. A block of wood tied to the bottom of water tank as shown. The wooden block exerts tension, on the wire tied to it. The dimension of the block are $20\text{cm} \times 20\text{cm} \times 40\text{cm}$ .**

**The density of the wood is $600\text{Kg}/\text{m}^3$. What is the tension in the wire?**




**Ans.** The volume of the block $= (0.2 \times 0.2 \times 0.4) m^3$

$= 0.016 m^3$

Mass of the block = 0.016 × 600 = Density × Volume

= 9.6 Kg

Weight of the block $= M \times g$ (M = Mass, g = Acceleration due to gravity)

= 9.6 g

Up thrust on the block = Weight of water displaced

Mass of water displaced = volume of the block × Density of water

$= 0.016 \times 1000$

= 16 Kg

Weight of the water displaced = Mass × acceleration due to gravity

$= 16 \times g$ = 16 g

Up thrust = 16gN

Weight of the block = 9.6gN

Net up thrust = 16g – 9.6g

= 6.4gN

$= 6.4 \times 9.8N$

= 62.72N

The tension in the string = Net up thrust

= 62.72N

**24. The weight of balloon and gas inside it is 12 KN. The volume of the balloon is $1200m^3$. The density of air is $1.26\ Kg/m^3$. Calculate**

**a) the weight it can lift**

**b) the acceleration as it rises.**

**Ans.** The up thrust = the weight of air displaced.

$=$ the weight of $1200\ m^3$ of air

$= 1200 \times 1.26 \times 9.8N$

$=$ volume $\times$ Density $\times$ Acceleration due to gravity

$= 1.482 \times 10^4 N$

Net upward force = the up thrust – the weight of the balloon

$= 1.482 \times 10^4 - 12000N$

$= 2820N$

The weight of the balloon can carry is 2820N

b) Mass of the balloon = $\frac{12000}{9.8} = 1224Kg$

Net up ward force = Mass × Acceleration

$2820 = 1224 \times a$

$a = \frac{2820}{1224}$

$= 2.3 m/s^2$

Up word Acceleration of the balloon $= 2.3m/s^2$

**25. A cylindrical block of wood of height 4.2m and mass 100Kg floats vertically in water. The relative density of wood is 0.8**

**1) What height of the block will be seen above the water ?**

**2) If block of lead of mass 10kg is placed, what height of the block will be seen above water?**

**Ans. a)** $\frac{\text{The Density of the floating body}}{\text{Density of fluid in which it floats}} = \frac{\text{Height immersed}}{\text{Total height}}$

$$\frac{0.8}{1.0} = \frac{h}{4.2}$$

$$h = 4.2 \times 0.8 = 3.36m$$

**b)** Mass of the block of wood = 100Kg

Mass of water displaced = 100Kg

Mass of lead placed on the block of wood = 10Kg

Total mass of the block of wood + weight placed on it = 110 Kg

Mass of water now displaced = 110Kg

When 100 Kg of water was displaced, 3.36m was submerged

When 110 Kg of water is to be displaced,

$\frac{110 \times 3.36}{100}$ m will be damaged.

= 3.696 m will be submerged.

Height seen above water = 4.2 - 3.696

= 0.504 m

**CBSE Class 9 Science**

**Important Questions**

**Chapter 10**

**Gravitaion**

**5 Marks Questions**

**1. 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.**

**Ans.** Suppose both the stones will meet after t seconds.

$$h = ut + \frac{1}{2}gt^2$$

$$= 0 \times t + \frac{1}{2} \times 10t^2$$

$$= 5t^2$$

$$h' = ut + \frac{1}{2} \times gt^2$$

$$= 25 \times t + \frac{1}{2} \times (-10) \times t^2$$

$= 25t - 5t^2$ h + h' = 100 m

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

25t = 100

t = 4 s

$h = 5t^2 = 5 \times 4 \times 4$ = 80 m

Therefore, the two stones will meet after 4 seconds when the falling stone would have covered a height of 80 m.

**2. A ball thrown up vertically returns to the thrower after 6 s. Find**

**(a) the velocity with which it was thrown up,**

**(b) the maximum height it reaches, and**

**(c) its position after 4 s.**

**Ans. (a)** time taken by ball to reach maximum height(t) = 6/2 = 3 s

v = u + gt

$0 = u + (-9.8) \times 3$

u = 29.4 m/s (the velocity with which it was thrown up)

**(b)** the maximum height it reaches: therefore $h = ut + \frac{1}{2}gt^2$

$= 29.4 \times 3 + \frac{1}{2} \times (-9.8) \times 3^2$

= 88.2 - 44.1

= 44.1 m

**(c)** its position after 4 s will be:

Since in first 3 s it will reach the maximum height and in next 1 s it will start a free fall so, u = 0, t =1

$h = ut + \frac{1}{2}gt^2 = 0 \times t + \frac{1}{2} \times 9.8 \times 1$ = 4.9 m

Therefore, after 4s the position of ball = 44.1 - 4.9 = 39.2 m.

**3.The Olympic high jump record is 2.45m held by Cuba let acceleration due to gravity on earth was $-1 m/s^2$ and not $-10 m/s^2$. Calculate the height to which the jumper would have jumped?**

**Ans.** Height = h = 2.45m

v = final velocity

u = Initial velocity

g = Acceleration due to gravity

**a)** $v^2 = u^2 + 2gh$

At the highest point v = o

The velocity with which he jumps is u

$o = u^2 + 2(-10) \times 2.45$

$u^2 = 49$

Now if g = -1m/s

$v^2 = u^2 + 2gh$

$o = 49 + 2(-1)s$

= 24.5 s

The height will be 24.5m

**4. State the factors on which acceleration due to gravity (g) depends?**

**Ans.** Acceleration due to gravity depends upon:

**1)** Height above at a height 'h' above the earth → The acceleration due to gravity on going above earth decreases as

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

so if R $\Rightarrow R + h$ (at a height h)

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

So, $g^1$ will be less

**2)** Rotation of earth → Since the earth rotates about it polar axis;

The radius of the circle decreases as we move from the equator to the poles, acceleration due to gravity increases as we move from equator to poles.

**3)** Shape of earth → The radius of the earth is more at the equator and less at poles so acceleration due to gravity increases as we move from equator to poles.