Gravitation

Question 1:

What is the value of gravitational constant G (i) on the earth, and (ii) on the moon ?

Solution :

Value of gravitational constant G on the earth and the moon is = 6.67×10^{-11} Nm^2/kg^2

Note that the value of G always remains constant irrespective of the location.

Question 2:

Which force is responsible for the moon revolving round the earth ?

Solution :

Gravitational force is responsible for the moon revolving round the earth.

Question 3:

Does the acceleration produced in a freely falling body depend on the mass of the body ?

Solution :

No, the acceleration produced in a freely falling body is independent of the mass of the body.

Question 4:

Name the scientist who gave the three laws of planetary motion.

Solution :

Johannes Kepler gave the three laws of planetary motion.

Question 5:

Name the scientist who explained the motion of planets on the basis of gravitational force between the sun and planets.

Solution :

Newton explained the motion of planets on the basis of gravitational force between the sun and planets.

Question 6:

State the Kepler's law which is represented by the relation $r^3 \propto T^2$.

Solution :

Kepler's law of periods states that: The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

Question 7:

Which of the Kepler's laws of planetary motion led Newton to establish the inverse-square rule for gravitational force between two bodies ?

Solution :

Kepler's third law of planetary motion led Newton to establish the inverse-square rule for gravitational force between two bodies.

Question 8:

Name the property of earth which is responsible for extremely small acceleration being produced in it as a result of attraction by other small objects.

Solution :

Extremely large mass of the earth.

Question 9:

What is the acceleration produced in a freely falling body of mass 10 kg ? (Neglect air resistance)

Solution :

Acceleration produced in a freely falling body, irrespective of its mass, is $9.8 m/s^2$

Question 10:

When an object is dropped from a height, it accelerates and falls down. Name the force which accelerates the object.

Solution :

Gravitational force of the earth.

Question 11:

Give the formula for the gravitational force F between two bodies of masses M and m kept at a distance d from each other.

Solution :

The gravitational force F between two bodies of masses M and m kept at a distance d from each other is :

The gravitational force F between two bodies of masses M and m kept at a distance d from each other is :

$$F = G \times \frac{m \times M}{d^2}$$

Here, Gravitational constant, $G = 6.7 \times 10^{-11} Nm^2 kg^{-2}$

Question 12:

What force is responsible for the earth revolving round the sun ?

Solution :

Gravitational force is responsible for the earth revolving round the sun.

Question 13:

What name has been given to the force with which two objects lying apart attract each other ?

Solution :

Gravitational force causes two objects lying apart attract each other.

Question 14:

What type of force is involved in the formation of tides in the sea ?

Solution :

Gravitational force (exerted mainly by the moon and to some extent by the sun) is involved in the formation of tides in the sea.

Question 15:

Which force is responsible for holding the solar system together ?

Solution :

Gravitational force of the sun holds the solar system together.

Question 16:

What is the weight of a 1 kilogram mass on the earth ? (g = 9.8 m/s^2).

Solution :

Weight, W = m x g

= 1 kg x 9.8m/s^2=9.8 N

Question 17:

On what factor/factors does the weight of a body depend ?

Solution :

The weight of a body is directly proportional to its mass. It also depends on the acceleration due to gravity which varies from place to place.

Question 18:

As the altitude of a body increases, do the weight and mass both vary ?

Solution :

Weight of the body varies with altitude; mass of an object is constant.

Question 19:

If the same body is taken to places having different gravitational field strength, then what will vary: its weight or mass ?

Solution :

Its weight varies; mass of an object is constant.

Question 20:

If the mass of an object be 10 kg, what is its weight ? (g = 9.8 m/s^2).

Solution :

Weight, W = m x g = 10 x 9.8 =98 N

Question 21:

The weight of a body is 50 N. What is its mass ? (g = 9.8 m/s^2).

Solution :

Weight, W = m x g

Question 22:

A body has a weight of 10 kg on the surface of earth. What will be its weight when taken to the centre of the earth ?

Solution :

Its weight will be zero as value of g is zero at the centre of the earth.

Question 23:

Write down the weight of a 50 kg mass on the earth, (g = 9.8 m/s^2).

Solution :

Weight, W= m x g =50 x 9.8=490N

Question 24:

If the weight of a body on the earth is 6 N, what will it be on the moon ?

Solution :

Weight of the body on the surface of moon will be 1N approx. as the value of g on the surface of moon is one-sixth that of the earth

Question 25:

State whether the following statements are true or false :

(a) A falling stone also attracts the earth.

(b) The force of gravitation between two objects depends on the nature of medium between them.

(c) The value of G on the moon is about one-sixth $\left(\frac{1}{6}\right)$ of the value of G on the earth.

(d) The acceleration due to gravity acting on a freely falling body is directly proportional to the mass of the body.

(e) Tire weight of an object on the earth is about one-sixth of its weight on the moon.

Solution :

(a)True

(b)False

(c)False

(d)False

(e) False

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Question 26:

Fill in the following blanks with suitable words :

(a) The acceleration due to gravity on the moon is about..... of that on the earth.

(b) In order that the force of gravitation between two bodies may become noticeable and cause motion, one of the bodies must have an extremely large.....

(c) The weight of an object on the earth is about..... of its weight on the moon.

(d) The weight of an object on the moon is about ..... of its weight on the earth.

(e) The value of g on the earth is about..... of that on the moon.

(f) If the weight of a body is 6 N on the moon, it will be about..... on the earth.

Solution :

(a) One-sixth

(b) Mass

(c) Six times

(d) One-sixth

(e) Six times

(f) 36N

Question 27:

Explain what is meant by the equation :

$$g = G \times \frac{M}{R^2}$$

where the symbols have their usual meanings.

Solution :

This is the acceleration produced by the earth. It is also called acceleration due to gravity.

This is the acceleration produced by the earth. It is also called acceleration due to gravity.

$$g = G \times \frac{M}{R^2}$$

where, G= gravitational constant

M= mass of the earth.

R=radius of the earth

where, G= gravitational constant

M= mass of the earth.

R=radius of the earth

Question 28:

(a) What do you mean by the term 'free fall' ?

(b) During a free fall, will heavier objects accelerate more than lighter ones ?

Solution :

(a) The falling of a body from a height towards the earth under the gravitational force of the earth (with no other forces acting on it) is called free fall.

(b) No, acceleration is independent of the mass of the body during free fall.

Question 29:

Can we apply Newton's third law to the gravitational force ? Explain your answer.

Solution :

Yes, Newton's third law of motion holds good for the force of gravitation. This means that when earth exerts a force of attraction on an object, then the object also exerts an equal force on the earth, in the opposite direction.

Question 30:

Give reason for the following :

The force of gravitation between two cricket balls is extremely small but that between a cricket ball and the earth is extremely large.

Solution :

The force of gravitation between two bodies is directly proportional to the product of their masses.

The force of gravitation between two bodies is directly proportional to the product of their masses.

$F \propto m \times M$

Since the mass of cricket balls is very small as compared to that of the earth, so the force of gravitation between two cricket balls is extremely small while that between a ball and the earth is extremely large.

Since the mass of cricket balls is very small as compared to that of the earth, so the force of gravitation between two cricket balls is extremely small while that between a ball and the earth is extremely large.

Question 31:

Describe how the gravitational force between two objects depends on the distance between them.

Solution :

The gravitational force F between two bodies of masses M and m kept at a distance d from each other is :

The gravitational force F between two bodies of masses M and m kept at a distance d from each other is :

$$F = G \times \frac{m \times M}{d^2}$$

The force between two bodies is inversely proportional to the square of the distance between them. That is,

$$F \propto \frac{1}{d^2}$$

Therefore , if we double the distance between two bodies, the gravitational force becomes one-fourth and if we halve the distance between two bodies, then the gravitational force becomes four times.

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Question 32:

What happens to the gravitational force between two objects when the distance between them is :

(i) doubled ?

(ii) halved ?

Solution :

(a)If we double the distance between two bodies, the gravitational force becomes one-fourth.

(b)If we halve the distance between two bodies, then the gravitational force becomes four times.

Question 33:

State two applications of universal law of gravitation.

Solution :

(i) Universal law of gravitation is used to determine the masses of the sun, the earth and the moon accurately.

(ii) Universal law of gravitation helps in discovering new stars and planets.

Question 34:

Explain why, if a stone held in our hand is released, it falls towards the earth.

Solution :

This is because the earth exerts a force of attraction (called gravity) on the stone and pulls it down.

Question 35:

Calculate the force of gravitation between two objects of masses 50 kg and 120 kg respectively kept at a distance of 10 m from one another. (Gravitational constant, G = 6.7 x 10^{-11} Nm^2 kg^{-2})

Solution :

$$F = G \times \frac{m \times M}{d^2}$$

m=50kg

M=120kg

Distance, d=10m

G=6.7 x 10^{-11} Nm^2/kg^2

$$F = 6.67 \times 10^{-11} \times \frac{50 \times 120}{10^2}$$

$$F = 6.67 \times 60 \times 10^{-11}$$

$$F = 4.02 \times 10^{-9} N$$

Question 36:

What is the force of gravity on a body of mass 150 kg lying on the surface of the earth? (Mass of earth = 6 x 10^{24} kg; Radius of earth = 6.4 x 10^6 m; G = 6.7 x 10^{-11} Nm^2/kg^2)

Solution :

Force due to gravity, $F = G \times \frac{m \times M}{d^2}$

$$F = 6.7 \times 10^{-11} \times \frac{6 \times 10^{24} \times 150}{(6.4 \times 10^6)^2}$$

$$F = 1472N$$

Question 37:

The mass of sun is 2 x 10^{30} kg and the mass of earth is 6 x 10^{24} If the average distance between the sun and the earth be 1.5 x 10^8 km, calculate the force of gravitation between them.

Solution :

Distance d=1.5 x 10^8km= 1.5 x 10^{11} m

Mass of the sun, m=2×10^{30}kg

Mass of the earth,

Distance d=1.5×10^{8} km= 1.5×10^{11} m

Mass of the sun, m=2×10^{30} kg

Mass of the earth, M= 6×10^{24}kg

Force of gravitation, $F = G \times \frac{m \times M}{d^2}$

$$F = 6.7 \times 10^{-11} \times \frac{2 \times 10^{30} \times 6 \times 10^{24}}{(1.5 \times 10^{11})^2}$$

$$F = \frac{6.7 \times 10^{-11} \times 12 \times 10^{54}}{1.5 \times 1.5 \times 10^{22}}$$

$$F = \frac{6.7 \times 12 \times 10^{21}}{1.5 \times 1.5} = 3.57 \times 10^{22} N$$

Question 38:

A piece of stone is thrown vertically upwards. It reaches the maximum height in 3 seconds. If the acceleration of the stone be 9.8 m/s^2 directed towards the ground, calculate the initial velocity of the stone with which it is thrown upwards

Solution :

Initial velocity of the stone, u=?

Final velocity of

stone, v=0

Acceleration due to gravity, g= -9.8m/s^2

Time, t=3 sec

Using relation, v=u + gt

0 = u -9.8 x 3

u =29.4m/s

Question 39:

A stone falls from a building and reaches the ground 2.5 seconds later. How high is the building ? (g =8 m/s^2)

Solution :

Initial velocity,

u=0m/s

Acceleration due to

gravity, g=9.8m/s^2

Time taken to reach

the ground, t=2.5 sec

Height, h=?

Using relation,

Initial velocity, u=0m/s

Acceleration due to gravity, g=9.8m/s^2

Time taken to reach the ground, t=2.5 sec

Height, h=?

Using relation,

$$s = u t + \frac{1}{2} g t^2$$

$$s = 0 \times 2.5 + \frac{1}{2} \times 9.8 \times 2.5 \times 2.5$$

$$s = 0 + 4.9 \times 2.5 \times 2.5$$

$$s = 30.625 \text{ m}$$

Question 40:

A stone is dropped from a height of 20 m.

(i) How long will it take to reach the ground ?

(ii) What will be its speed when it hits the ground ? (g =10 m/s^2)

Solution :

Height, s=20m

Initial velocity, u=0

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

Final velocity, v=?

Time taken, t=?

(i) Using relation,

(ii) For a freely falling body:

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

Height, s=20m
Initial velocity, u=0
Acceleration due to gravity, g=10m/s^2
Final velocity, v=?
Time taken, t=?

(i) Using relation,

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

$$20 = 0 \times t + \frac{1}{2} \times 10 \times t^2$$

$$20 = 0 + 5t^2$$

$$t^2 = \frac{20}{5} = 4$$

$$t = \sqrt{4} = 2s$$

(ii) For a freely falling body:

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

$= (0)^2 + 2 \times (10) \times (20)$

So, $v^2 = 400$

$v = \sqrt{400} = 20 m/s$

The speed of stone when it hits the ground will be 20m/s.

Question 41:

A stone is thrown vertically upwards with a speed of 20 m/s. How high will it go before it begins to fall ? (g =8 m/s^2)

Solution :

Initial velocity, u=20m/s

Final velocity, v=0

Acceleration due to gravity, g=-9.8m/s^2

Height, h=?

Using relation, for a freely falling body:

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

$(0)^2 = (20)^2 + 2 \times (-9.8) \times h$

0-400 = -19.6 h

h= 400/19.6 = 20.4 m

Question 42:

When a cricket ball is thrown vertically upwards, it reaches a maximum height of 5 metres.

(a) What was the initial speed of the ball ?

(b) How much time is taken by the ball to reach the highest point ? (g=10 ms^{-2})

Solution :

Initial velocity, u=?

Final velocity, v=0

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

Height, h=5 m

(a) For a freely falling body:

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

$(0)^2 = u^2 + 2 \times (-10) \times 5$

$0 = u^2 - 100$

$u^2 = 100$

So, u=10m/s

(b) Using relation, v=u + gt

0 = 10 + (-10) t

-10= -10 t

t=1sec

Question 43:

Write the differences between mass and weight of an object.

Solution :

Mass	Weight
1. The mass of an object is the quantity of matter contained in it.	1. The weight of an object is the force with which it is attracted towards the centre of the earth.
2. SI unit of mass is kilogram (kg).	2. SI unit of mass is newton (N).
3. The mass of an object is constant.	3. The weight of an object is not constant. It changes with the change in acceleration due to gravity.
4. The mass of an object can never be zero.	4. The weight of an object can be zero.

Question 44:

Can a body have mass but no weight ? Give reasons for your answer.

Solution :

Yes, weight of a body is not constant, it varies with the value of acceleration due to gravity, g. Weight of a body is zero, when it is taken to the centre of the earth or in the interplanetary space, where g=0.

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Question 45:

A force of 20 N acts upon a body whose weight is 9.8 N. What is the mass of the body and how much is its acceleration ? (g = 9.8 m s^{-2}).

Solution :

Weight= 9.8N

W= m x g

9.8 =m x 9.8

m= 1kg

Force, F= mass x acceleration

20 N = 1kg x a

Acceleration,

$a=20m/s^2$

Question 46:

A stone resting on the ground has a gravitational force of 20 N acting on it. What is the weight of the stone ? What is its mass ? (g = 10 m/s^2).

Solution :

Weight of the stone = Gravitational force acting on it = 20 N

Weight, W= m x g

20=m x 10

m=2 kg

Question 47:

An object has mass of 20 kg on earth. What will be its (i) mass, and (ii) weight, on the moon ?

(g on moon = 1.6 m/s^2).

Solution :

(i) Its mass will be 20 kg as mass is a constant quantity.

(ii)Weight, W= m x g =20 x 1.6=32N

Question 48:

Which is more fundamental, the mass of a body or its weight ? Why ?

Solution :

The mass of a body is more fundamental because mass of a body is constant and does not change from place to place.

Question 49:

How much is the weight of an object on the moon as compared to its weight on the earth ? Give reason for your answer

It is quite difficult to lift heavy weights on the earth but it becomes very easy to lift the same heavy weights on the moon. Why ?

Solution :

The weight of an object on the moon is about one-sixth of its weight on the earth. This is because the value of acceleration due to gravity on the moon is about one-sixth of that on the earth.

Question 50:

(a) Define mass of a body. What is the SI unit of mass ?

(b) Define weight of a body. What is the SI unit of weight ?

(c) What is the relation between mass and weight of a body ?

Solution :

(a) The mass of a body is the quantity of matter contained in it. The SI unit of mass is kilogram (kg).

(b) The weight of a body is the force with which it is attracted towards the centre of the earth. The SI unit of weight is newton (N).

(c) Weight, W =m x g, i.e. the weight of a body is directly proportional to its mass.

Question 51:

(a) State the universal law of gravitation. Name the scientist who gave this law.

(b) Define gravitational constant. What are the units of gravitational constant ?

Solution :

(a) According to universal law of gravitation: Every body in the universe attracts every other body with a force (F) which is directly proportional to the product of their masses (m and M) and inversely proportional to the square of the distance (d) between them.

(a) According to universal law of gravitation: Every body in the universe attracts every other body with a force (F) which is directly proportional to the product of their masses (m and M) and inversely proportional to the square of the distance (d) between them.

$$F = G \times \frac{m \times M}{d^2}$$

Sir Isaac Newton gave this law.

(b) The gravitational constant G is numerically equal to the force of gravitation which exists between two bodies of unit masses kept at a unit distance from each other.

$$G = F \times \frac{d^2}{m \times M}$$

Units of gravitational constant= Nm^2/kg^2

Sir Isaac Newton gave this law.

Question 52:

(a) What do you understand by the term 'acceleration due to gravity of earth' ?

(b) What is the usual value of the acceleration due to gravity of earth ?

(c) State the SI unit of acceleration due to gravity.

Solution :

(a) The uniform acceleration produced in a freely falling body due to the gravitational force of the earth is called acceleration due to gravity of earth.

(b) Usual value of acceleration due to gravity, $g=9.8\ m/s^2$.

(c) SI unit of acceleration due to gravity is m/s^2.

Question 53:

(a) Is the acceleration due to gravity of earth 'g' a constant ? Discuss.

(b) Calculate the acceleration due to gravity on the surface of a satellite having a mass of 7.4×10^{22} kg and a radius of 1.74×10^6 m ($G = 6.7 \times 10^{-11}\ Nm^2/kg^2$). Which satellite do you think it could be ?

Solution :

(a) No, the value of acceleration due to gravity (g) is not constant at all the places on the surface of the earth. Since the radius of the earth is minimum at the poles and maximum at the equator, the value of g is maximum at the poles and minimum at the equator. As we go up from the surface of the earth, the distance from the centre of the earth increases and hence the value of g decreases. The value of g also decreases as we go down inside the earth.

(b) Acceleration due to gravity,

$$g = G \times \frac{M}{R^2}$$

Mass, $M = 7.4 \times 10^{22}$kg

Radius, $R = 1.74 \times 10^6$m

Gravitational constant, $G = 6.7 \times 10^{-11} Nm^2/kg^2$

$$g = 6.7 \times 10^{-11} \times \frac{7.4 \times 10^{22}}{(1.74 \times 10^6)^2}$$

$$g = \frac{6.7 \times 7.4}{1.74 \times 1.74 \times 10}$$

$$g = 1.637 m/s^2$$

As the value of $g = 1.637 m/s^2$, which is one sixth the value of g on earth, the satellite could be moon.

Question 54:

State and explain Kepler's laws of planetary motion. Draw diagrams to illustrate these laws.

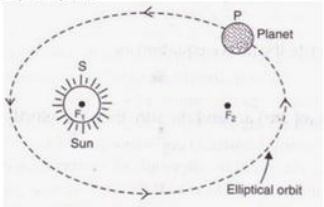
Solution :

Kepler's first law: The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit. This law means that the orbit of a planet around the sun is an ellipse and not an exact circle. An elliptical path has two foci, and the sun is at one of the two foci of the elliptical path.

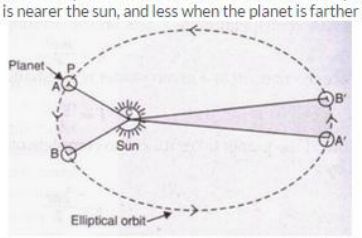
Kepler's Second law states that: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time. This means that a planet does not move with constant speed around the sun. The speed is greater when the planet is nearer the sun, and less when the planet is farther away from the sun.

Kepler's Third Law states that: The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

Kepler's first law: The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit. This law means that the orbit of a planet around the sun is an ellipse and not an exact circle. An elliptical path has two foci, and the sun is at one of the two foci of the elliptical path.



Kepler's Second law states that: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time. This means that a planet does not move with constant speed around the sun. The speed is greater when the planet is nearer the sun, and less when the planet is farther away from the sun.



Kepler's Third Law states that: The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

$r^3 \alpha T^2$

Question 55:

The mass of a planet is 6×10^{24} kg and its diameter is 12.8×10^3 If the value of gravitational constant be 6.7×10^{-11} Nm^2/kg^2, calculate the value of acceleration due to gravity on the surface of the planet. What planet could this be ?

Solution :

Acceleration due to gravity,

Acceleration due to gravity,

$$g = G \times \frac{M}{R^2}$$

Mass, $M = 6 \times 10^{24}$kg

Diameter = 12.8×10^3 km = 12.8×10^6 m

Radius, $R = (12.8 \times 10^6)/2 = 6.4 \times 10^6$m

Gravitational constant, G= 6.7 x 10-11Nm^2/kg^2

$$g = 6.7 \times 10^{-11} \times \frac{6 \times 10^{24}}{(6.4 \times 10^6)^2}$$

$$g = \frac{6.7 \times 60}{6.4 \times 6.4}$$

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

As the value of $g=9.8m/s^2$, the planet could be Earth.

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Question 71:

If the distance between two masses is increased by a factor of 5, by what factor would the mass of one of them have to be altered to maintain the same gravitational force ? Would this be an increase or decrease in the mass ?

Solution :

Gravitational force is given by:

Gravitational force is given by:

$$F = G \times \frac{m \times M}{d^2}$$

Distance between two masses is increased s.t. new distance is D= 5 d
New gravitational force $F_1 = F$
Let on of the mass is changed to m_1 so as to maintain the same gravitational force.

$$F_1 = G \times \frac{m_1 \times M}{D^2}$$

$D = 5\,d$

$F = F_1$

$$G \times \frac{m \times M}{d^2} = G \times \frac{m_1 \times M}{D^2}$$

$$G \times \frac{m \times M}{d^2} = G \times \frac{m_1 \times M}{25d^2}$$

$$\frac{m_1}{m} = 25$$

$m_1 = 25m$

Hence one of the masses should be increased by 25 times in order to have the same gravitational force.

Hence one of the masses should be increased by 25 times in order to have the same gravitational force.

Question 72:

Universal law of gravitation states that every object exerts a gravitational force of attraction on every other object. If this is true, why don't we notice such forces ? Why don't the two objects in a room move towards each other due to this force ?

The universal law of gravitation states that every object exerts a gravitational force of attraction on every other object. If this is true, then why don't we see the various objects in a room moving towards one another ?

Solution :

In order to be able to notice the gravitational force of attraction between any two objects, at least one of the objects on the earth should have an extremely large mass. Since no object on the earth have an extremely large mass, we cannot notice such forces.

The two objects in a room do not move towards each other because due to their small masses, the gravitational force of attraction between them is very, very weak.

Question 73:

Suppose a planet exists whose mass and radius both are half those of the earth. Calculate the acceleration due to gravity on the surface of this planet.

Solution :

Acceleration due to gravity of earth,

Acceleration due to gravity of earth,

$$g = G \times \frac{M}{R^2} = 9.8 m/s^2$$

If mass of planet, m= M/2
And radius of planet, r= R/2
Acceleration due to gravity on the surface of planet will be:

$$g = G \times \frac{m}{r^2} \quad ---(i)$$

$$m = \frac{M}{2} \quad ----(ii)$$

$$r = \frac{R}{2} \quad -----(iii)$$

Put (ii) and (iii) in (i) eq. we get

$$g = G \times \frac{\frac{M}{2}}{(\frac{R}{2})^2} = \frac{4}{2} \times (G \times \frac{M}{R^2})$$

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

$$g = 19.6 m/s^2$$

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Question 74:

A coin and a piece of paper are dropped simultaneously from the same height. Which of the two will touch the ground first ? What will happen if the coin and the piece of paper are dropped in vacuum ? Give reasons for your answer.

Solution :

The coin reaches the ground first as compared to the piece of paper because it experiences lesser resistance from air than that felt by paper.

If the coin and the piece of paper are dropped in vacuum, both of them will touch the ground at the same time.

Question 75:

A stone and the earth attract each other with an equal and opposite force. Why then we see only the stone falling towards the earth but not the earth rising towards the stone ?

Solution :

The mass of a stone is very small, due to which the gravitational force produces a large acceleration in it. Due to large acceleration of stone, we see stone falling towards the earth. The mass of earth is, however, very, very large. Due to the very large mass of the earth, the same gravitational force produces very, very small acceleration in the earth, that it cannot be observed. And hence we do not see the earth rising up towards the stone.

Question 76:

What is the actual shape of the orbit of a planet around the sun ? What assumption was made by Newton regarding the shape of an orbit of a planet around the sun for deriving his inverse square rule from Kepler's third law of planetary motion ?

Solution :

The actual shape of the orbit of a planet around the sun is elliptical. The assumption made by the Newton regarding the shape of an orbit of a planet around the sun was that the orbit of a planet around the sun is 'circular'.

Question 77:

The values of g at six distances A, B, C, D, E and F from the surface of the earth are found to be 3.08 m/s^2, 9.2.3 m/s^2, 0.57 m/s^2, 7.34 m/s^2, 0.30 m/s^2 and 1.49 m/s^2, respectively.

(a) nArrange these values of g according to the increasing distances from the surface of the earth (keeping the value of g nearest to the surface of the earth first)

(b) If the value of distance F be 10000 km from the surface of the earth, state whether this

distance is deep . inside the earth or high up in the sky. Give reason for your answer.

Solution :

(a) 9.23 m/s^2 , 7.34 m/s^2 , 3.08 m/s^2 , 1.49 m/s^2 , 0.57 m/s^2 , 0.30 m/s^2

(b) This distance F of 10000 km is high up in the sky. The distance of 10000 km cannot be deep inside the earth because the radius of earth is only about 6400km and the value of g at the centre of earth becomes zero.

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Question 1:

Write the common unit of density.

Solution :

Grams per cubic centimtre (g/cm^3).

Question 2:

What is the density of water in SI units ?

Solution :

Density of water =1000kg/m^3.

Question 3:

What is the value of relative density of water ?

Solution :

Relative density of water is 1.

Question 4:

Name the quantity whose one of the units is pascal (Pa).

Solution :

Pressure has unit of Pascal (Pa).

Question 5:

State the units in which pressure is measured.

Solution :

Pressure is measured in newtons per square metre (N/m^2) i.e., pascal (Pa).

Question 6:

State whether the following statements are true or false :

(a) The buoyant force depends on the nature of object immersed in the liquid

(b) Archimedes' principle can also be applied to gases.

Solution :

(a) False

(b) True

Question 7:

In which direction does the buoyant force on an object due to a liquid act ?

Solution :

Buoyant force on an object due to a liquid act s in the vertically upward direction.

Question 8:

What is the other name of buoyant force ?

Solution :

Upthrust is the other name of buoyant force.

Question 9:

Name the force which makes heavy objects appear light when immersed in a liquid.

Solution :

Buoyant force.

Question 10:

What is upthrust ?

Solution :

The upward force acting on an object immersed in a liquid is called upthrust.

Question 11:

Name the principle which gives the magnitude of buoyant force acting on an object immersed in a liquid.

Solution :

Archimedes' Principle.

Question 12:

lire relative density of mercury is 13.6. What does this statement mean ?

Solution :

The relative density of mercury is 13.6, this means that mercury is 13.6 times as heavy as an equal volume of water.

Question 13:

What name is given to 'thrust per unit area' ?

Solution :

Pressure is 'thrust per unit area'.

Question 14:

What is the ss ientific name of the 'upward force' acting on an object immersed in a liquid ?

Solution :

Buoyant force or upthrust.

Question 15:

What is meant by the term 'buoyancy' ?

Solution :

The tendency of a liquid to exert an upward force on an object placed in it, is called buoyancy.

Question 16:

What causes buoyant force (or upthrust) on a boat ?

Solution :

The buoyant force on a boat is caused by the pressure of water 'pushing up' on the bottom of the boat.

Question 17:

Why does ice float in water ?

Solution :

The density of ice is less than that of water, so ice floats in water.

Question 18:

What force acting on an area of 0.5 m^2 will produce a pressure of 500 Pa ?

Solution :

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Force} = \text{Area} \times \text{pressure}$$
$$= 0.5 \times 500$$
$$= 250N$$

Question 19:

An object of weight 200 N is floating in a liquid. What is the magnitude of buoyant force acting on it ?

Solution :

Since the object floats in the liquid, so the magnitude of the buoyant force exerted by the liquid is equal to the weight of the object.

Hence, buoyant force =200N

Question 20:

Name the scientist who gave he magnitude of buoyant force acting on a solid object immersed in a liquid.

Solution :

Archimedes gave the magnitude of buoyant force acting on a solid object immersed in a liquid

Question 21:

The density of gold is 19 g/cm^3. Find the volume of 95 g of gold.

Solution :

$$\text{Density of gold} = \frac{\text{mass of gold}}{\text{volume of gold}}$$

$$\text{Volume of gold} = \frac{\text{mass of gold}}{\text{density of gold}}$$
$$= \frac{95}{19} = 5cm^3$$

Question 22:

What is the mass of 5 m^3 of cement of density 3000 kg/m^3 ?

Solution :

Volume=5m^3

Density= 3000kg/m^3

Volume=5m^3

Density= 3000kg/m^3

$$\text{Density of cement} = \frac{\text{mass of cement}}{\text{volume of cement}}$$

$$\text{mass of cement} = \text{Density of cement} \times \text{volume of cement}$$
$$= 3000 \times 5 = 15000kg$$

Question 23:

What is the density of a substance of mass 100 g and volume 10 cm^3 ?

Solution :

Mass of the substance = 100g

Volume of the substance =10cm^3

Mass of the substance = 100g

Volume of the substance =10cm^3

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

$$\text{Density} = \frac{100}{10} = 10g/cm^3$$

Question 24:

Why does a block of wood held under water rise to the surface when released ?

Solution :

Because the weight of the block of wood is less than the weight of an equal volume of water. So when it is completely submerged in water, the upward buoyant force on it is greater than the downward gravitational force on it. Hence, the lock rises to the surface.

Question 25:

The density of a body is 800 kg/m3. Will it sink or float when dipped in a bucket of water ? (Density' of water = 1000 kg/m^3).

Solution :

The body will float when dipped in a bucket of water as its density is less than that of water.

Question 26:

Fill in the following blanks with suitable words :

(a) Force acting on a unit area is called……..

(b) It is the……. force which makes objects appear lighter in water.

(c) A heavy ship floats in water because its……. density is less than that of water.

(d) In fluids (liquids and gases), pressure acts in……. directions, and pressure…… as the depth increases.

(e) In order to sink in a fluid, the density of an object must be…… than the…… of the fluid.

(f) Snow shoes work by spreading out a person's…… over a much bigger……..

(g) If the area of a snow shoe is five times……. than the area of an ordinary shoe, then the pressure of a snow shoe on the snow is five times……

Solution :

(a) pressure

(b) buoyant

(c) average

(d) all; increases

(e) less; density

(f) weight; area

(g) bigger; smaller

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Question 27:

(a) What is the difference between the density and relative density of a substance ?

(b) If the relative density of a substance is 7.1, what will be its density in SI units ?

Solution :

(a) The **density** of a substance is defined as mass of the substance per unit volume.

(a) The **density** of a substance is defined as mass of the substance per unit volume.

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

SI unit of density is kg/m^3.

The **relative density** of a substance is the ratio of its density to that of water.

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

It has no units.

(b)

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

$$7.1 = \frac{\text{Density of substance}}{1000 kg/m^3}$$

$$\text{density of substance} = 7.1 \times 10^3 kg/m^3$$

Question 28:

Define thrust. What is its unit ?

Solution :

The force acting on a body perpendicular to its surface is called thrust. The SI unit of thrust is newton (N).

Question 29:

A mug full of water appears light as long as it is under water in the bucket than when it is outside water.

Why ?

Solution :

A mug full of water appears light as long as it is under water because buoyant force acts on it which reduces its effective weight and makes it appear lighter.

Question 30:

What happens to the buoyant force as more and more volume of a solid object is immersed in a liquid ? When does the buoyant force become maximum ?

Solution :

As more and more volume of the solid object is immersed in the liquid, the upward 'buoyant force' also keeps on increasing. When the object is completely immersed in the liquid, the buoyant force acting on the solid becomes maximum and remains constant thereafter.

Question 31:

Why do we feel light on our feet when standing in a swimming pool with water up to our armpits ?

Solution :

As more and more volume of our body is immersed in water, the apparent weight of the body goes on decreasing and the body seems to become lighter. This is due to the increase in upward buoyant force acting on the body.

Question 32:

Explain why, big boulders can be moved easily by flood.

Solution :

Big boulders weig much less while in water and as such are easily moved by the flood.

Question 33:

An iron nail sinks in water but it floats in mercury. Why ?

Solution :

An iron nail sinks in water but it floats in mercury because density of iron is more than that of water but less than that of mercury.

Question 34:

Explain why, a piece of glass sinks in water but it floats in mercury.

Solution :

A piece of glass sinks in water but it floats in mercury because density of glass is more than that of water but less than that of mercury.

Question 35:

Steel sinks in water but a steel boat floats. Why ?

Solution :

A piece of steel sinks in water because steel is denser than water. However, a steel ship is a hollow object made of steel and contains a lot of air in it. Due to presence of a lot of air in it, the average density of the ship becomes less than the density of water. Hence a ship floats in water.

Question 36:

Explain why, school bags are provided with wide straps to carry them.

Solution :

School bags have wide straps so that their weight may spread over a large area of shoulder producing less pressure on the shoulder.

Question 37:

Why does a sharp knife cut objects more effectively than a blunt knife ?

Solution :

A sharp knife cuts objects easily because due to its very thin edge, the force of our hand falls on a very small area of the object producing large pressure.

Question 38:

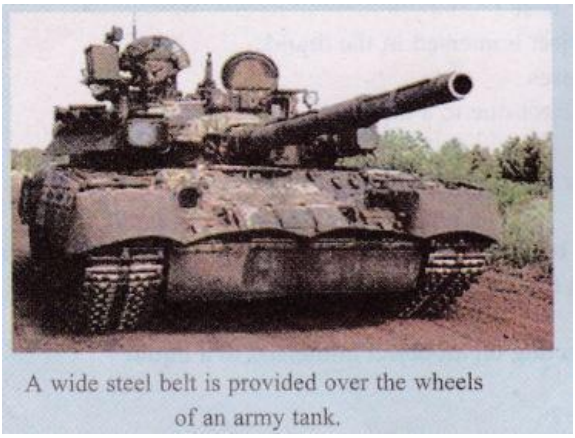
Explain why, wooden (or concrete) sleepers are kept below the railway line.

Solution :

Concrete or wooden
sleepers are kept below the railway line so that the weight of passing train
is spread over a large area of ground and the track may not sink into the
ground.

Question 39:

Explain why, a wide steel belt is provided over the wheels of an army tank.



A wide steel belt is provided over the wheels of an army tank.

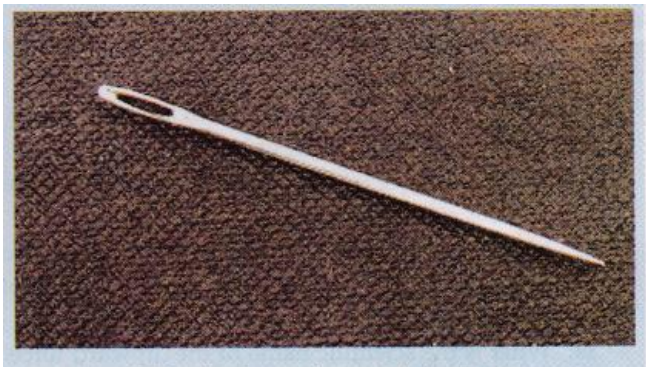
Solution :

A wide steel belt is

provided over the wheels of an army tank so that they exert less pressure on the ground and do not sink into it.

Question 40:

Explain why, the tip of a sewing needle is sharp.



The tip of a sewing needle is sharp.

Solution :

The tip of the sewing needle is sharp so that due to its sharp tip, the needle may put the force on a very small area of the cloth, producing a large pressure sufficient to pierce the cloth being stitched.

Question 41:

When is the pressure on the ground more—when a man is walking or when a man is standing ? Explain.

Solution :

When a man is walking, then at one time only one foot is on the ground. Due to this, the force of weight of man falls on a smaller area of the ground and produces more pressure on the ground. On the other hand, when the man is standing, then both his feet are on the ground. Due to this, the weight of the man falls on a larger area of the ground and produces lesser pressure on the ground.

Question 42:

Explain why, snow shoes stop you from sinking into soft snow.

Solution :

Snow shoes stop us from sinking into soft snow because due to large area of snow shoes, our weight is spread over a large area of the snow producing small pressure.

Question 43:

Explain why, when a person stands on a cushion, the depression is much more than when he lies down on it.

Solution :

When a person stands on a cushion then only his two feet (having small area) are in contact with the cushion. Due to this the weight of man falls on a small area of the cushion producing a large pressure causing a big depression in the cushion. On the other hand, when the same person lies down on the cushion, then his whole body (having large area) is in contact with the cushion. Here, his weight falls on a much larger area of the cushion producing much smaller pressure and very little depression in the cushion.

Question 44:

Use your ideas about pressure to explain why it is easier to walk on soft sand if you have flat shoes rather than shoes with sharp heels.

Solution :

Flat shoes have greater area in contact with the soft sand as compared to heels. Due to this,

there is less pressure on soft sand because of which they do not sink much in the sand and it is easy to walk on it.

Question 45:

Explain why, a nail has a pointed tip.

A nail has a pointed tip

Solution :

A nail has a pointed tip, so that when it is hammered, the force of hammer is transferred to a very small area of wood creating a large pressure which pushes the nail into the wood.

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Question 46:

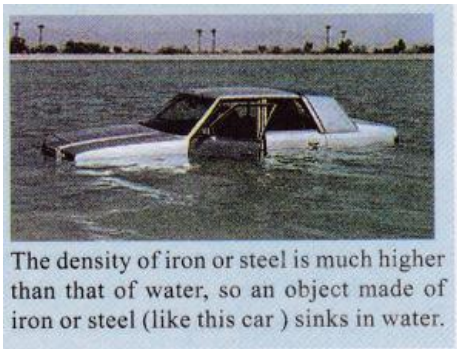
Explain why, buildings and dams have wide foundations.

Solution :

The foundations of buildings and dams are laid on a large area of ground so that the weight of the building or dam produces less pressure on the ground and they may not sink into the ground.

Question 47:

Why does a ship made of iron and steel float in water whereas a small piece of iron sinks in it ?



The density of iron or steel is much higher than that of water, so an object made of iron or steel (like this car) sinks in water.

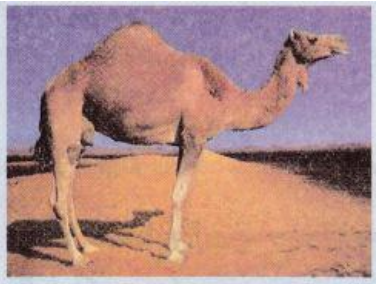
Solution :

A ship made of iron and steel is a hollow object which contains a lot of air in it. Due to the presence of a lot of air in it, the average density of the ship becomes less than the density of water. Hence a ship floats in water.

On the other hand, a piece of iron is denser than water, so it sinks in water.

Question 48:

Why do camels have large flat feet ?



A camel.

A large flat foot of camel.

Solution :

Camels have large flat feet so that there is a greater area in contact with the sand which produces less pressure on the sand and the camels can move easily on the sand.

Question 49:

Name these forces :

(a) the upward push of water on a submerged object

(b) the force which wears away two surfaces as they move over one another

(c) the force which pulled the apple off Isaac Newton's tree.

(d) the force which stops you falling through the floor.

Solution :

(a) Buoyant force

(b) Force of friction

(c) Gravitational force

(d) Reaction force

Question 50:

A pressure of 10 Pa acts on an area of 3.0 m^2. What is the force acting on the area ? What force will be exerted by the application of same pressure if the area is made one-third ?

Solution :

If the area is made one-third i.e. $1m^2$, then the force would be:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{force} = \text{Area} \times \text{pressure}$$

$$= 3 \times 10$$

$$= 30N$$

If the area is made one-third i.e. $1m^2$, then the force would be:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{force} = \text{Area} \times \text{pressure}$$

$$= 1 \times 10$$

$$= 10N$$

Question 51:

A girl is wearing a pair of flat shoes. She weighs 550 N. The area of contact of one shoe with the ground is 160 cm^2. What pressure will be exerted by the girl on the ground :

(a) if she stands on two feet ?

(b) if she stands on one foot ?

Solution :

Force, F= 550N

Area of contact of one shoe =160 cm^2 =160 x $10^{-4}m^2$

Area of contact with two shoes =160 x 2 =320 cm^2=320 x $10^{-4}m^2$

Force, F= 550N

Area of contact of one shoe =160 cm^2 =160 x $10^{-4}m^2$

Area of contact with two shoes =160 x 2 =320 cm^2=320 x $10^{-4}m^2$

(a) If the girl stands on two feet,

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$= \frac{550}{320 \times 10^{-4}} = 17187.5 N/m^2$$

(b)

If she stands on one foot,

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$= \frac{550}{160 \times 10^{-4}} = 34375 N/m^2$$

Question 52:

Calculate the density of an object of volume 3 m^3 and mass 9 kg. State whether this object will float or sink in water. Give reason for your answer.

Solution :

Volume =$3m^3$
Mass = 9kg

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

$$\text{Density of substance} = \frac{9}{3} = 3kg/m^3$$

And density of water = 1000kg/m3
The object will float in the water as the density of the object is less than the density of water.

The object will float in the water as the density of the object is less than the density of water.

Question 53:

An object weighs 500 grams in air. This object is then fully immersed in water. State whether it will weigh less in water or more in water. Give reason for your answer.

Solution :

The object will weigh less in water because an upward force (buoyant force) equal to the weight of water displaced acts on the object when immersed in water which reduces its weight apparently.

Question 54:

(a) Write down an equation that defines density.
(b) 5 kg of material A occupy 20 cm^3 whereas 20 kg of materia! B occupy 90 cm^3. Which has the greater density : A or B ? Support your answer with calculations.

Solution :

(a)

(a)

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

(b)
For material A:
Mass= 5kg
Volume =$20\ cm^3 = 20 \times 10^{-6} m^3$

$$\text{Density of material A} = \frac{5}{20 \times 10^{-6}} = 0.25 \times 10^6 kg/m^3$$

For material B:
Mass =20kg
Volume =$90\ cm^3 = 90x\ 10^{-6} m^3$

$$\text{Density of material B} = \frac{20}{90 \times 10^{-6}} = 0.22 \times 10^6 kg/m^3$$

Density of material A is more than density of material B.

(b)

For material A:

Mass= 5kg

Volume =$20\ cm^3 = 20 \times 10^{-6} m^3$

For material B:

Mass =20kg

Volume =$90\ cm^3 = 90x\ 10^{-6} m^3$

Density of material A is more than density of material B.

Question 55:

(a) Define buoyant force. Name two factors on which buoyant force depends.
(b) What is the cause of buoyant force ?

(c) When a boat is partially immersed in water, it displaces 600 kg of water. How much is the buoyant force acting on the boat in newtons ? (g = 10 m s^{-2})

Solution :

(a) The upward force acting on an object immersed in a liquid is called buoyant force.

Factors affecting buoyant force:

(i) Volume of object immersed in the liquid,

(ii) Density of the liquid.

(b) The cause of buoyant force is the greater upward pressure exerted by water underneath the object..

(c) Mass of water displaced = 600kg

Weight of water displaced, W =m x g

=600 x 10 =6000N

Since, the weight of water displaced by the boat is 6000N, therefore the buoyant force acting on the boat will also be 6000N.

Question 56:

(a) State the principle of flotation.

(b) A floating boat displaces water weighing 6000 newtons.

(i) What is the buoyant force on the boat ?

(ii) What is the weight of the boat ?

Solution :

(a) According to the principle of floatation: An object will float in a liquid if the weight of object is equal to the weight of liquid displaced by it.

Weight of object = Weight of liquid displaced by it.

(b) Weight of water displaced by boat= 6000N

(i) Buoyant force =6000N, as the weight of water displaced is equal to buoyant force.

(ii) Weight of a floating object = Weight of water displaced by it = 6000N

Question 57:

(a) Define density. What is the SI unit of density ?

(b) Define relative density. What is the SI unit of relative density ?

(c) The density of turpentine is 840 kg/m^3. What will be its relative density ? (Density of water = 1000 kg/m^3)

Solution :

Question 58:

(a) Define pressure.

(b) What is the relation between pressure, force and area ? ,

(c) Calculate the pressure when a force of 200 N is exerted on an area of:

(i) 10 m^2

(ii) 5 m^2

Solution :

(a) Pressure is the force acting perpendicularly on a unit area of the object.

(a) Pressure is the force acting perpendicularly on a unit area of the object.

(b)

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

(c) (i) Pressure on an area of $10\ m^2$

Force =200N

$$\text{Pressure} = \frac{200}{10} = 20\text{Pa}$$

(ii) Pressure on an area of $5\ m^2$

Force =200N

$$\text{Pressure} = \frac{200}{5} = 40\text{Pa}$$

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Question 59:

(a) What are fluids ? Name two common fluids.

(b) State Archimedes' principle.

(c) When does an object float or sink when placed on the surface of a liquid ?

Solution :

(a) Those substances which can flow easily are called fluids. All the liquid and gases are fluids, like water, air etc.

(b) Archimedes' Principle :

When an object is wholly (or partially) immersed in a liquid, it experiences a buoyant force (or upthrust) which is equal to the weight of liquid displaced by the object.

Buoyant force on an object = weight of liquid displaced by that object

(c) If the buoyant force exerted by the liquid is less than the weight of the object, the object will sink in the liquid. If the buoyant force exerted by the liquid is equal to or greater than the weight of the object, the object will float in the liquid.

Question 60:

(a) How does a boat float in water ?

(b) A piece of steel has a volume of 12 cm^3, and a mass of 96 g. What is its density :

(i) in g/cm^3 ?

(ii) in kg/m^3 ?

Solution :

(a) A floating boat displaces water equal to its own weight. This displaced water exerts buoyant force to balance the weight of boat and keep it afloat.

(b) (i) Mass = 96 g

Volume = $12cm^3$

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

$$\text{Density of substance} = \frac{96}{12} = 8\text{g/cm}^3$$

(ii) Mass = 96×10^{-3}kg

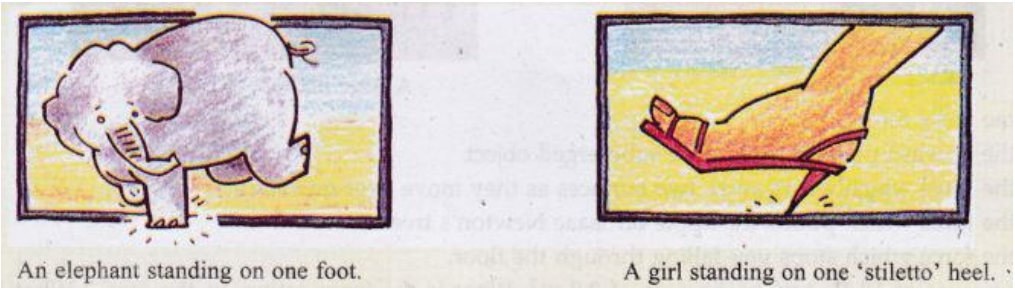
Volume = $12 \times 10^{-6} m^3$

$$\text{Density of substance} = \frac{\text{mass of substance}}{\text{volume of substance}}$$

$$\text{Density of substance} = \frac{96 \times 10^{-3}}{12 \times 10^{-6}} = 8 \times 10^3 \text{kg/m}^3$$

Question 61:

An elephant weighing 40,000 N stands on one foot of area 1000 cm^2 whereas a girl weighing 400 N is standing on one 'stiletto' heel of area 1 cm^2.



An elephant standing on one foot. A girl standing on one 'stiletto' heel.

(a) Which of the two, elephant or girl, exerts a larger force on the ground and by how much ?
(b) What pressure is exerted on the ground by the elephant standing on one foot ?
(c) What pressure is exerted on the ground by the girl standing on one heel ?
(d) Which of the two exerts larger pressure on the ground : elephant or girl ?
(e) What is the ratio of pressure exerted by the girl to the pressure exerted by the elephant ?

Solution :

Weight of elephant=40000N
Area of one foot =1000 cm^2= 1000 x $10^{-4}m^2$
Weight of girl=400N
Area of heel of girl =1 cm^2=1 x $10^{-4}m^2$
(a) Elephant has a larger weight of 40000N, therefore, elephant exerts a larger force on the ground. Elephant exerts a larger force on the ground by 40000N – 400 N=39600N.
(b)Weight of elephant = 40000N
Area of one foot =1000cm^2= 1000 x $10^{-4}m^2$

Weight of elephant=40000N
Area of one foot =1000 cm^2= 1000 x $10^{-4}m^2$
Weight of girl=400N
Area of heel of girl =1 cm^2=1 x $10^{-4}m^2$

(a) Elephant has a larger weight of 40000N, therefore, elephant exerts a larger force on the ground. Elephant exerts a larger force on the ground by 40000N - 400 N=39600N.
(b) Weight of elephant = 40000N
Area of one foot =1000cm^2= 1000 x $10^{-4}m^2$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Pressure} = \frac{40000}{1000 \times 10^{-4}} = 400000 N/m^2$$

(c) Weight of the girl = 400N
Area of heel of girl = 1 cm^2 = 1 x $10^{-4}m^2$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Pressure} = \frac{400}{1 \times 10^{-4}} = 4000000 N/m^2$$

(d) Girl exerts a larger pressure on the ground.

(e)

$$\text{Ratio} = \frac{\text{Pressure exerted by the girl}}{\text{Pressure exerted by the elephant}}$$

$$= \frac{4000000}{400000} = \frac{10}{1}$$

The pressure exerted by girl is 10 times greater than that exerted by the elephant.

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Question 72:

If two equal weights of unequal volumes are balanced in air, what will happen when they are completely dipped in water ? Why ?

Solution :

The two equal weights of unequal volumes which are balanced in air, will get imbalanced when they are completely dipped in water because due to their unequal volumes, they will displace unequal volumes of water and hence suffer unequal loss in weight.

Question 73:

Two different bodies are completely immersed in water and undergo the same loss in weight. Is it necessary that their weights in air should also be the same ? Explain.

Solution :

No, it is not necessary that their weights in air should also be the same. This is because the two bodies have undergone the same loss in weight on completely immersing in water due to their equal volumes and not because of their equal weights, so they may have different weights in air.

Question 74:

A body floats in kerosene of density 0.8×10^3 kg/m^3 up to a certain mark. If the same body is placed in water of density 1.0×10^3 kg/m^3, will it sink more or less ? Give reason for your answer.

Solution :

The body will sink less in water. This is because the density of water is more than that of kerosene due to which water will exert a greater upward buoyant force on the body.

Question 75:

Giving reasons state the reading on a spring balance when it is attached to a floating block of wood which weighs 50 g in air.

Solution :

The reading on spring balance will be zero. This is because the weight of floating block of wood is fully supported by the liquid in which it is floating and hence it does not exert any force on the spring balance.

Question 76:

If a fresh egg is put into a beaker filled with water, it sinks. On dissolving a lot of salt in the water, the egg begins to rise and then floats. Why ?

Solution :

When a lot of salt is dissolved in water, then the density of salt solution becomes much more than pure water. Due to its much higher density, the salt solution exerts a greater upward buoyant force on the egg making it rise and then float.

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Question 77:

A beaker full of water is suspended from a spring balance. Will the reading of the balance change :

(a) if a cork is placed in water ?

(b) if a piece of heavy metal is placed in it ?

Give reasons for your answer.

Solution :

The reading of spring balance will not change if a cork is placed in water because cork, being lighter than water, floats in water.

(b)The reading of spring balance will change if a piece of heavy metal is placed in water because heavy metal being denser than water, sinks in water.

Question 78:

When a golf ball is lowered into a measuring cylinder containing water, the water level rises by 30 cm^3 when the ball is completely submerged. If the mass of ball in air is 33 g, find its density.

Solution :

Volume of golf ball = rise in water level = 30 cm^3

Volume of golf ball = rise in water level = 30 cm^3

$$\text{Density of ball} = \frac{\text{Mass of ball}}{\text{Volume of ball}} = \frac{33}{30} = 1.1\,g/cm^3$$

Question 79:

72. A boy gets into a floating boat.

- What happens to the boat ?
- What happens to the weight of water displaced ?
- What happens to the buoyant force on the boat ?

Solution :

a) The boat sinks a little more in water, that is, the boat floats lower in water.

b) The weight of water displaced (by the submerged part of the boat) increases.

c) The buoyant force acting on the boat increases.

Question 80:

A y kg sheet of tin sinks in water but if the same sheet is converted into a box or boat, it floats. Why ?

Solution :

The sheet of tin sinks in water because the density of tin is higher than that of water. When the same sheet of tin is converted into a box or a boat, then due to the trapping of lot of 'light' air in the box or boat, the average density of the box or boat made of tin sheet becomes lower than that of water and hence it floats in water.