Lakhmir Singh Solutions Class 9 Physics Chapter 3 Gravitation

Question 1:

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

ANSWER:

i. Value of gravitational constant on the earth is 6.67×10^{-11} m^3 kg^{-1} s^{-2}
ii. Value of gravitational constant on the Moon is 6.67×10^{-11} m^3 kg^{-1} s^{-2}

Question 2:

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

ANSWER:

Gravitational force is responsible for the moon to revolve around the earth.

Question 3:

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

ANSWER:

No, acceleration produced in a freely falling body does not depend on the mass of the body.

Question 4:

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

ANSWER:

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.

ANSWER:

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

Question 6:

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

ANSWER:

Kepler's second law is represented by the given relation, which 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.

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?

ANSWER:

The third law of Kepler's planetary motion (i.e. The law of harmonies) 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.

ANSWER:

The earth's large mass is responsible for the extremely small acceleration produced in it as a result of attraction by other small objects.

Question 9:

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

ANSWER:

The acceleration produced in a freely falling body of mass 10 kg would be $9.8 m/s^2$.

Question 10:

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

ANSWER:

Gravitational force of the earth accelerates an object when it is dropped from a height.

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.

ANSWER:

$F=\frac{GMm}{d^2}$F=GMmd2
where,
F − gravitational force
G − gravitational constant
M − mass of the earth
m − mass of object
d − distance

Question 12:

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

ANSWER:

Gravitational force is responsible for the earth's revolution around the sun.

Question 13:

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

ANSWER:

Gravitational force is responsible for the attraction between two objects lying apart from each other.

Question 14:

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

ANSWER:

Gravitational force exerted by the moon is responsible for the formation of tides in the sea.

Question 15:

Which force is responsible for holding the solar system together?

ANSWER:

Gravitational force of the sun is responsible for holding the solar system together.

Question 16:

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

ANSWER:

W (weight of the body) =?
m (mass of the body) = 1 kg
g (acceleration due to gravity) = 9.8 m/s^2
W= mg
= 1 × 9.8

= 9.8 N
Answer: Weight = 9.8 N

Question 17:

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

ANSWER:

Since, weight, W= mg. so weight of a body depends on:
• Mass of a body.
• Acceleration due to gravity (g) at a given place.

Question 18:

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

ANSWER:

As the altitude increases, the mass (m) of the body remains constant but the weight (W = mg) of the body, because of decreasing acceleration due to gravity (g), decreases with an increase in altitude.

Question 19:

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

ANSWER:

Only weight will vary because acceleration due to gravity (g) varies from place to place and mass remains constant.

Question 20:

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

ANSWER:

W (weight of the body) =?
m (mass of the body) = 10 kg
g (acceleration due to gravity) = 9.8 m/s^2
W= mg
= 10 × 9.8
= 98 N
Answer : Weight = 98N

Question 21:

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

ANSWER:

W (weight of the body) = 50N
m (mass of the body) = ?
g (acceleration due to gravity) = 9.8 m/s^2
W= mg
50 = m × 9.8
50 × 9.8 = m
m = 5.102kg
Answer: Mass = 5.102kg

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?

ANSWER:

As we go deep into the center of the earth, the acceleration due to gravity (g) there is zero. Hence, the weight of the body will become zero.

Question 23:

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

ANSWER:

W (weight of the body) =?
m (mass of the body) = 50 kg
g (acceleration due to gravity) = 9.8 m/s^2
W= mg
= 50 × 9.8
= 490 N
Answer: Weight = 490 N

Question 24:

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

ANSWER:

If the weight of a body on the earth is 6N, then its weight on the moon would be about 1N. This is because acceleration due to gravity on the surface of the moon is 1/6th the acceleration due to gravity on the earth's surface.

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 (16)16 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) The weight of an object on the earth is about one-sixth of its weight on the moon.
ANSWER:

a) True
b) False, force of gravitation between two objects depends on their masses
c) False, the value of g on the moon is about 1/6 of its value on earth
d) False, the acceleration due to gravity acting on a freely falling body is directly proportional to the earth's mass
e) False, the weight of an object on the moon will be 1/6 of its weight on the earth

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 to the force of gravitation between two bodies to become noticeable and cause motion, one of the bodies must have an extremely large _____.
(c) The weight of an object on earth is about _____ 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 6N on the moon, it will be about _____ on the earth.

ANSWER:

(a) The acceleration due to gravity on the moon is about one-sixth of that on the earth.
(b) In order to the force of gravitation between two bodies to become noticeable and cause motion, one of the bodies must have an extremely large mass.
(c) The weight of an object on earth is about six times its weight on the moon.
(d) The weight of an object on the moon is about one-sixth of its weight on the earth.
(e) The value of g on the earth is about six times of that on the moon.
(f) If the weight of a body is 6N on the moon, it will be about 36N on the earth.

Question 27:

Explain what is meant by the equation :
$g=G\times MR^2$g=G×MR2
where the symbols have their usual meanings.
ANSWER:

$g = GM / R^2$
This is an equation , which expresses acceleration due to gravity. It states that acceleration due to gravity (*g*) can be calculated as a product of the Gravitational Constant (*G*), which is 6.673×10^{-11} Nm^2 kg^{-2} and mass of the planet (*M*) i.e., 5.98×10^{24} kg in case of the earth divided by square of radius of that planet (*R*), i.e., 6.4×10^6 m for earth. This is an equation, which expresses acceleration due to gravity. By putting the respective values for earth, g can be calculated as 9.8 m/s^2.

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?

ANSWER:

A falling body, on which only the earth's gravity acts, is known as a freely falling body and such a fall is known as free fall.
a) No, because acceleration due to gravity (g) does not depend on the body's mass. Thus, bodies of different mass accelerate towards the earth with same acceleration.

Question 29:

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

ANSWER:

Yes, according to Newton's third law of motion, "to every action, there is an equal and opposite reaction". Now, we apply this concept to the gravitational attraction between the sun and the earth. The sun exerts a gravitational force on the earth, and thus the earth also exerts a gravitational force on the sun. Thus, they are balanced in their orbits and the earth revolves around the sun.

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.

ANSWER:

The gravitational force between two cricket balls is extremely small but that between a cricket ball and the earth is large because force depends on mass of an object. Greater the mass, greater is the force of gravitation. This force of gravity is very week between the two cricket balls because of their mass, so it cannot be felt. But with the earth, it can be felt as the earth's mass is very large.

Question 31:

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

ANSWER:

Gravitational force is inversely proportional to the square of the distance between the masses. More the distance, less the gravitational force; less the distance, more is the gravitational force. This is how gravitational force between two objects is dependent on the distance.

Question 32:

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

(i) doubled?
(ii) halved?

ANSWER:

$F=\frac{GMm}{r^2}$F=GMmr2
where,
F − gravitational force
G − gravitational constant
M − mass of the earth
m − mass of object
r − distance

(i). r = doubled
$F=\frac{GMm}{r^2}$F=GMmr2 keeping everything constant i.e. G, M, m
$=\frac{GMm}{(2r)^2}$=GMm2r2
$=\frac{GMm}{4r^2}$=GMm4r2
F becomes one-fourth.

(ii). r = halved

$F=\frac{GMm}{r^2}$F=GMmr2 keeping everything constant i.e. G, M, m
$=\frac{GMm}{(1/2r)^2}$=GMm1/2r2
$=\frac{GMm}{(1/4r)^2}$=GMm1/4r2
$=\frac{4GM\ m}{r^2}$=4GM mr2
F becomes four times the original.

Question 33:

State two applications of universal law of gravitation.

ANSWER:

Applications of universal law of gravitation,
i. Planets revolve round the sun due to gravitational force between the sun and the planets. The force required by the planets to move round in their orbit is the centripetal force, which is provided by the gravitational force of attraction between the planets and the Sun

ii. Tide is the periodic rise and fall of all ocean waters, including those of open sea, gulfs, and bays, resulting from the gravitational attraction of the Moon and the Sun upon the water and upon the Earth itself. The force that causes tides in the water of the world's oceans and seas is mostly due to the pull of the Moon's gravity. This pull causes the water in the oceans and seas nearest to the Moon to bulge slightly. The sea water furthest from the Moon is pulled less than elsewhere, producing another bulge here as well. There are high tides where the two bulges are, and low tides in between. As the Earth turns on its axis, places move in and out of these bulges and their sea level rises and falls.

Question 34:

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

ANSWER:

A stone, when released from the hand, falls towards the earth due to gravitational force. The gravitational force acts both on the stone and the earth. The stone attracts the earth with the same force by which the earth attracts the stone. Since, the stone's mass is very small as compared to the earth's mass, so acceleration produced in the stone is very large but that in the earth is negligible. Thus, the earth's motion is not noticed, whereas that of the stone is.

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

ANSWER:

F (gravitational force) = ?
G (gravitational constant) = 6.7×10^{-11} Nm^2 kg^{-2}
M (mass of body)= 120 kg
m (mass of body) = 50 kg
d (distance from each other) = 10 m
F=GMmd2 =6.7×10−11×120×50(10)2 =6.7×10−11×12×5×100100 =6.7×10F=GMmd2 =6.7×10-11×120×50102 =6.7×10-11×12×5×100100 =6.7×10-11×12×5 =402×10-11N =4.02×10-9N Answer: F=4.02×10-9N

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 = 6×10^{24} kg; Radius of earth = 6.4×10^6 m; G = 6.7×10^{-11} Nm^2/kg^2)

ANSWER:

F (gravitational force) = ?
G (gravitational constant) = 6.7×10^{-11} Nm^2 kg^{-2}
M (mass of earth)= 6×10^{24} kg
m (mass of body) = 150 kg
r (radius of earth) = 6.4×10^6 m
F=GMmr2F=GMmr2
=6.7×10−11×6×1024×150(6.4×106)2=6.7×10−11×6×1024×1506.4×6.4×1012 (1024−11=1013)=6.7×6×15×10146.4×6.4×1012 (1014−12=102)=14.72×10=6.7×10-11×6×1024×1506.4×1062=6.7×10-11×6×1024×1506.4×6.4×1012 1024-11=1013=6.7×6×15×10146.4×6.4×1012 1014-12=102=14.72×10² =1472N
Answer: Force of gravity = 1,472N

Question 37:

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

ANSWER:

F (gravitational force) = ?
G (gravitational constant) = 6.673×10^{-11} Nm^2 kg^{-2}

M (mass of sun) = 2×10^{30} kg
m (mass of earth)= 6×10^{24} kg
d (average distance between sun and earth) = 1.5×10^{8} km = $1.5\times10^{8}\times1000 = 1.5\times10^{11}$m
F=GMmd2F=GMmd2
$=6.673\times10^{-11}\times2\times10^{30}\times6\times10^{24}(1.5\times10^{11})^2=6.673\times10^{-11}\times2\times10^{30}\times6\times10^{24}1.5\times1.5\times10^{22}$ $(10^{24+30-11}=10^{43})=$
$6.673\times2\times6\times10^{43}1.5\times1.5\times10^{22}$ $(10^{43-22}=10^{21})=6.673\times2\times6\times10^{21}1.5\times1.5$
$(10^{43-22}=10^{21})=80.076\times10^{21}1.5\times1.5=35.59\times10$=6.673×10-
11×2×1030×6×10241.5×10112=6.673×10-
11×2×1030×6×10241.5×1.5×1022 1024+30-
11=1043=6.673×2×6×10431.5×1.5×1022 1043-
22=1021=6.673×2×6×10211.5×1.5 1043-
22=1021=80.076×10211.5×1.5=35.59×10^{21} N =3.57×10^{22} N
Answer: Force of gravity = 3.57×10^{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.

ANSWER:

v (final velocity) = 0 m/s
u (initial velocity) = ?
a (acceleration due to gravity i.e., g) = 9.8m/s^2
t (time) = 3 sec
v = u + gt
0 = u + 9.8 × 3
0 = u + 29.4
u = −29.4m/s
Note - Answer is in negative i.e. −29.4m/s, as it is directed opposite to the acceleration due to gravity and we have taken the motion along acceleration due to gravity as positive.
Answer: 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 = 9.8 m/s^2)

ANSWER:

s (distance) = ?
u (initial velocity) = 0 m/s
a (acceleration due to gravity i.e. g) = 9.8m/s^2
t (time) = 2.5 sec
S = ut +1/2 gt^2
= 0 ×2.5 + ½ × 9.8× 2.5× 2.5
= ½ ×9.8 ×2.5× 2.5
= 61.25×2
= 30.625 m
Answer: 30.625 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)

ANSWER:

(i) s (distance) = 20m
u (initial velocity) = 0 m/s
a (acceleration due to gravity i.e., g) = 10m/s^2
t (time) = ?
S = *ut* +1/2 gt^2
20 = 0×t + ½ ×10 ×t^2
20 = ½ ×10×t^2
20×2 = 10t^2
20×2 ×10 = t^2
t^2 = 4
t = 2
Answer: time = 2 sec

(ii). v (final velocity) = ?
u (initial velocity) = 0 m/s
a (acceleration due to gravity i.e., g) = 10m/s^2
t (time) = 2 sec
v = *u* + gt
= 0 + 10 × 2

= 20m/s
Answer: v = 20 m/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 = 9.8 m/s^2)

ANSWER:

s (distance) = ?
v (final velocity) = 0 m/s
u (initial velocity) = −20 m/s
a (acceleration due to gravity i.e., g) = 9.8m/s^2
$v^2 - u^2 = 2as$
$(0)^2 - (-20)^2 = 2 \times 9.8 \times S$
$-400 \times 2 \times 9.8 = S$
S = −20.4 m
The negative sign comes because the displacement is upward and we have considered the motion along the acceleration due to gravity (downward) as positive. Thus, the required distance is 20.4 m.
Answer: s = 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 m s^{-2})

ANSWER:

(a) v (final velocity) = 0 m/s
u (initial velocity) = ?
a (acceleration due to gravity i.e., g) = 10 m/s^2
S (distance) = 5 m
$v^2 - u^2 = 2aS$
$(0)^2 - (u)^2 = 2 \times 10 \times 5$
$-(u)^2 = 2 \times 10 \times 5$
$-(u)^2 = 100$
$u = -10$ m/s

Answer: $u = -10$ m/s

Note − The initial velocity was negative i.e. −10 m/s, as it was velocity against gravity because the ball was thrown upwards. This can be neglected.

(b) s (distance) = 5m

u (initial velocity) = 10 m/s

a (acceleration due to gravity i.e., g) = $10 m/s^2$

t (time) = ?

$S = ut + 1/2\ gt^2$

$\Rightarrow 5 = 10 \times t + ½ \times 10 \times t^2$

$\Rightarrow 5 = 10t + 5t^2$

$\Rightarrow t^2 + 2t - 1 = 0$

$\Rightarrow t = (2-\sqrt{2} - 1)$ s or $(-2-\sqrt{2} - 1)$ s

Since, time cannot be negative, so, the required answer is $(2-\sqrt{2} - 1)$ s.

Question 43:

Write the differences between mass and weight of an object.

ANSWER:

S.No	Mass	Weight
1.	The quantity of matter contained in a body is called mass.	The force with which the earth attracts a body towards its centre is called weight.
2.	Mass of a body remains constant.	Weight of a body changes from place to place.
3.	Mass of a body is never zero.	Weight of a body becomes zero wherever the net gravitational force due to earth is zero.
4.	Mass of a body is measured in kg.	Weight of a body is measured in kg-wt or N.
5.	Mass of a body is measured by beam balance.	Weight of a body is measured by weighing balance.

Question 44:

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

ANSWER:

Yes, a body can have mass but no weight at the centre of the earth. This is because acceleration due to gravity (g) decreases as we go deep into the earth and becomes zero at the centre.

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? ($g = 9.8\ m/s^{-2}$)

ANSWER:

W (weight of the body) = 9.8N
m (mass of the body) = ?
g (acceleration due to gravity) = 9.8 m/s^2
W= mg
9.8 = m × 9.8
9.8 /9.8 = m
1 = m
Answer: Mass = 1kg

F (force) = 20N
M (mass of body) = 1kg
F = m × a
20 = 1 × a
20/1 = a
a = 20m/s^2
Answer: Acceleration = 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).

ANSWER:

W (Weight of the stone) = 20N
m (mass of the stone) = ?

g (acceleration due to gravity) = 9.8 m/s^2
W= mg
20 = m × 9.8
20/9.8 = m
2.04 = m
Answer: Mass = 2.04 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)

ANSWER:

(i) Mass on moon = 20 kg (mass remains constant everywhere)
(ii) W (Weight of the object on moon) = ?
m (mass of the object) = 20kg
g (acceleration due to gravity on moon)= 1.6 m/s2
W= mg
= 20×1.6
= 32 N
Answer: Weight on moon = 32N

Question 48:

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

ANSWER:

Mass is more fundamental because it remains constant at all places, irrespective of a change in place. But weight depends on acceleration due to gravity (g), which varies with location.

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.

Figure

ANSWER:

The weight of an object on the moon is 1/6th of that on earth because the acceleration due to gravity on the moon is 1/6th of that on earth. Therefore, weight of an object decreases on the moon.

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?

ANSWER:

a) The quantity of matter contained in a body is called its mass. The SI unit of mass is kg.
b) The force with which the earth attracts a body towards its centre is called weight. The SI unit of weight is N.
c) The relation between mass and weight of a body is given by the following equation:
$W = mg$
Where,
m = mass of object
g = acceleration due to gravity
W = weight of a body

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?

ANSWER:

a) The force of attraction between two particles or bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. Isaac Newton proposed this law, which is also known as Newton's law of gravitation.

b) Gravitational constant is defined as the force of attraction between two bodies of unit mass separated by a unit distance. Unit of gravitational constant is $Nm^2 kg^{-2}$.

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.

ANSWER:

Uniform acceleration produced in a free falling body due to the earth's gravitational force is known as acceleration due to gravity on earth, and is denoted by 'g'.
(a) The usual value of acceleration due to gravity on earth is $9.8 m/s^2$.
(b) The 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?

ANSWER:

No, acceleration due to gravity of the earth, 'g', is not constant at all places. This is because the earth is not a perfect sphere, so its radius is not same at all the places on its surface. Since the radius of the earth is minimum at the poles, the value of 'g' is maximum at the poles. The value of 'g' is minimum at the equator, as the earth's radius is maximum.
a) $\mathbf{g = GM / R^2}$
g (acceleration due to gravity) = ?
G (Gravitational Constant) = $6.7 \times 10^{-11} Nm^2 kg^{-2}$
M (mass of satellite) = 7.4×10^{22} kg
R (radius of satellite) = 1.74×10^6 m
$\mathbf{g = GM / R^2}$
$g = 6.7 \times 10^{-11} \times 7.4 \times 10^{22} (1.74 \times 10^6)^2$ $= 6.7 \times 10^{-11} \times 7.4 \times 10^{22} (1.74 \times 10^6)^2$ $(10^{22-11} = 10^{11})$ $= 6.7 \times 7.4 \times 10^{11} 1.74 \times 1.74 \times 10^{12}$ $(10^{11-12} = 10^{-1})$ $= 16.376 \times 10$ g=6.7×10-11×7.4×10221.74×1062 =6.7×10-11×7.4×10221.74×1062 1022-11=1011 =6.7×7.4×10111.74×1.74×1012 1011-12=10-1 =16.376×10-1 $= 1.6 m/s^2$
Answer: $g = 1.6 m/s^2$
The satellite is Moon.

Question 54:

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

ANSWER:

Kepler's law of motion:
a) **Law of orbits** – Every planet moves around the sun in an elliptical orbit, with the sun at one of the 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 elliptical path.
b) **Law of areas** – The line joining the sun and every planet sweeps out equal areas in equal intervals of time.
This means that a planet moves faster when it is closer to the sun, and moves slowly when it is farther from the sun.
c) **Law of periods** – 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 55:

The mass of a planet is 6×10^{24} kg and its diameter is 12.8×10^{3} km. 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?

ANSWER:

$g = GM / R^2$
g (acceleration due to gravity) = ?
G (Gravitational Constant) = 6.7×10^{-11} $Nm^2 kg^{-2}$
M (mass of the planet) = 6×10^{24} kg
R (radius of planet) = 6.4×10^{6} m
(Diameter of the planet = $12.8 \times 10^{3} \times 2 \times 1000 = 6.4 \times 10^{6}$ m)
$g = GM / R^2$
g= 6.7 ×10−11×6×1024(6.4 ×106)2 =6.7×10−11×6×1024(6.4×106)2 (1024−11=1013) =6.7×6×10136.4×6.4×1012 (1013−12=10) =0.981×10 =9.8 m/sg= 6.7 ×10−11×6×1024(6.4 ×106)2 =6.7×10-11×6×10246.4×1062 1024-11=1013 =6.7×6×10136.4×6.4×1012 1013-12=10 =0.981×10 =9.8 m/s^2
Answer: g = 9.8 m/s^2
This planet is earth.

Question 56:

An object is thrown vertically upwards with a velocity *u*, the greatest height *h* to which it will rise before falling back is given by :

(a) u/g
(b) $u^2/2g$
(c) u^2/g
(d) $u/2g$

ANSWER:

(b) $u^2 / 2g$
At the maximum height 'h', the velocity becomes zero.
Using,
$v^2 = u^2 - 2gh$
$\Rightarrow 0 = u^2 - 2gh$
$\Rightarrow h = u^2/(2g)$

Question 57:

The mass of moon is about 0.012 times that of earth and its diameter is about 0.25 times that of earth. The value of G on the moon will be:

(a) less than that on the earth
(b) more than that on the earth
(c) same as that on the earth
(d) about one-sixth of that on the earth

ANSWER:

(c) Same as that of the earth
G is universal gravitational constant. So, it remains constant everywhere.

Question 58:

The value of *g* on the surface of the moon :

(a) is the same as on the earth
(b) is less than that on the earth
(c) is more than that on the earth
(d) keeps changing day by day

ANSWER:

(b) Is less than that of the earth
The value of g on moon is 1/6 times its value on the earth.

Question 59:

The atmosphere consisting of a large number of gases is held to the earth by :

(a) winds
(b) clouds
(c) earth's magnetic field
(d) gravity

ANSWER:

(d) Gravity
Gravity of the earth holds the atmosphere consisting of a large number of gases.

Question 60:

The force of attraction between two unit point masses separated by a unit distance is called :

(a) gravitational potential
(b) acceleration due to gravity
(c) gravitational field strength
(d) universal gravitational constant

ANSWER:

(d) universal gravitational constant

Question 61:

The weight of an object at the centre of the earth of radius R is :

(a) zero
(b) R times the weight at the surface of the earth
(c) infinite
(d) $1/R^2$ times the weight at the surface of the earth

ANSWER:

(a) zero, as g = 0

Question 62:

Two objects of different masses falling freely near the surface of moon would :

(a) have same velocities at any instant
(b) have different accelerations
(c) experience forces of same magnitude
(d) undergo a change in their inertia

ANSWER:

(a) have same velocity at any instance
We know,
$v = u + at$
$\Rightarrow v = 0 + gt$
[Here, g is acc. Due to gravity on moon]
Thus, the equation of velocity for a freely falling body is independent of the mass of the body.
So, different masses that are dropped simultaneously with the same or zero initial velocity will have same velocity at any instant.

Question 63:

The value of acceleration due to gravity of earth :

(a) is the same on equator and poles
(b) is the least on poles
(c) is the least on equator
(d) increases from pole to equator

ANSWER:

Is the least in equator
because its value decreases on moving near the equator.

Question 64:

The law of gravitation gives the gravitational force between :
(a) the earth and a point mass only
(b) the earth and the sun only
(c) any two bodies having some mass
(d) any two charged bodies only

ANSWER:

(c) any two bodies having the same mass.

Question 65:

The value of quantity G in the formula for gravitational force :

(a) depends on mass of the earth only
(b) depends on the radius of earth only
(c) depends on both mass and radius of earth
(d) depends neither on mass nor on radius of earth

ANSWER:

(d) depends neither on mass nor on the radius of earth, as it is a constant in the formula for gravitational force.

Question 66:

Two particles are placed at some distance from each other. If, keeping the distance between them unchanged, the mass of each of the two particles is doubled, the value of gravitational force between them will become :

(a) 1/4 times
(b) 1/2 times
(c) 4 times
(d) 2 times

ANSWER:

(c) 4 times
Here, m1 and m2 are doubled and r remains constant.
$F = G \times m1 \times m2/r^2$
$= G \times 2m1 \times 2m2/r^2$
$= 4 G \times m1 \times m2/r^2$

Question 67:

In the relation $F = G \times M \times m/d^2$, the quantity G:

(a) depends on the value of *g* at the place of observation
(b) is used only when the earth is one of the two masses
(c) is the greatest on the surface of the earth
(d) is of the same value irrespective of the place of observation

ANSWER:

(d) is of the same value irrespective of the place of observation
This is because G is constant in the given equation.

Question 68:

The gravitational force of attraction between two objects is *x*. Keeping the masses of the objects unchanged, if the distance between the objects is halved, then the magnitude of gravitational force between them will become :

(a) *x*/4
(b) *x*/2

(c) 2*x*
(d) 4*x*

ANSWER:

(d) 4x
G = x
m_1 and m_2 are constant
Since, r is reduced to half, let, r/ = r/2
Gravitation force, $F = G \times m_1 \times m_2/r^2 = x$
When r is reduced to half the force becomes, $F/ = G \times m_1 \times m_2/(r/)^2$
$= G \times m_1 \times m_2 /(r/2)^2$
= 4x

Question 69:

An apple of mass 100 g falls from a tree because of gravitational attraction between the earth and the apple. If the magnitude of force exerted by the earth on the apple be F_1 and the magnitude for force exerted by the apple on the earth be F_2, then :

(a) F_1 is very much greater than F_2
(b) F_2 is very much greater than F_1
(c) F_1 is only a little grater than F_2
(d) F_1 and F_2 are exactly equal

ANSWER:

(d) F_1 and F_2 are exactly equal in magnitude
According to Newton's third law of motion, if an object exerts a force on another object, then the second object exerts an equal and opposite force on the first object.

Question 70:

According to one of the Kepler's laws of planetary motion :

(a) $r^2 \propto T^3$
(b) $r \propto T^2$
(c) $r^3 \propto T^2$
(d) r3 ∝1T2r3 ∝1T2

ANSWER:

(c) $r^3 \propto T^2$
According to Kepler's third law of planetary motion, the cube of mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

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?

ANSWER:

F (gravitational force) = ?
G (gravitational constant) = G
M (mass of sun) = M
m (mass of the earth)= m
d (average distance between sun and earth) = increased by 5 times than
Rest all variables remain constant
F=GM md2F=GM m(5d)2F=GM m25 d2F=GM md2F=GM m5d2F=GM m25 d2
(NOTE – To maintain the same gravitational force, the mass should be increased by 25 times)
F=GM 25m25d2F=GM md2F=GM 25m25d2F=GM md2
There would be an increase in mass.

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?

ANSWER:

In order to notice the gravitational force of attraction that act between two objects, it is necessary that one of the objects should have extremely large mass as compared to the other. But none of the object has such large mass, so we cannot notice the forces.
The two objects in a room do not move towards each other because they have small mass and so the gravitational force of attraction between them is 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

ANSWER:

Mass and radius both are half of those of the earth
g (acceleration due to gravity) = ?
G (gravitational constant) = 6.673×10^{-11} Nm^2 kg^{-2}
M (mass of new planet)= $(5.98 \times 10^{24}$ kg)/2
R (radius of the earth) = $(6.4 \times 10^6$ m)/2
$g=GMR^2 = 6.673\times10^{-11}\times5.98\times10^{24}\times4(6.4\times10^6)^2\times2 = 6.673\times10^{-11}\times5.98\times10^{24}\times46.4\times6.4\times10^{12}\times2$ $(10^{24-11}=10^{13}) = 6.673\times5.98\times4\times10^{14}6.4\times6.4\times10^{12}\times2$ $(10^{13-12}=10) = 6.673\times5.98\times4\times106.4\times6.4\times2 = 159.61816\times106.4\times6.4\times2 = 1.9484\times10 = 19.5N$g=GMR2 =6.673×10-11×5.98×1024×46.4×1062×2 =6.673×10-11×5.98×1024×46.4×6.4×1012×2 1024-11=1013 =6.673×5.98×4×10146.4×6.4×1012×2 1013-12=10 =6.673×5.98×4×106.4×6.4×2 =159.61816×106.4×6.4×2 =1.9484×10 =19.5N

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 happed if the coin and the piece of paper are dropped in vacuum? Give reasons for your answer.

ANSWER:

The coin will touch the ground first, because the relative air resistance on the paper is greater than on the coin (because the coin and the paper do not have the same density, so the proportion of air resistance as compared to weight is the one relevant on paper than on coin).
In a vacuum, both the coin and the piece of paper will drop at the same rate due to the absence of air resistance (their acceleration being the same).

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?

ANSWER:

We see only the stone falling towards the earth but not the earth rising towards the stone because mass of the stone is negligible as compared to the earth's mass. Hence, acceleration in the earth is negligible as compared to acceleration in stone. So, the stone falls towards the earth, but not vice-versa.

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 of deriving his inverse square rule from Kepler's third law of planetary motion?

ANSWER:

The shape of a planet's orbit around the sun is elliptical.
The assumption made by Newton is that the orbit of the planet around the sun is circular.

Question 77:

The value 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, 9.23 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) Arrange 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.

ANSWER:

a) As $g \propto 1r2$g∝1r2, hence the value of g, according to the increasing distances from the earth, are as follows:
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) The place would be high up in the sky because the earth's radius is 6,400 km which is lesser than 10000 km.

Question 1:

Write the common unit of density.

ANSWER:

The common unit of density is g/cm^3.

Question 2:

What is the density of water in SI units?

ANSWER:

The SI unit of density of water is kg/m^3.

Question 3:

What is the value of relative density of water?

ANSWER:

The value of relative density of water is 1.

Question 4:

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

ANSWER:

Pascal (Pa) is one of the units of pressure.

Question 5:

State the units in which pressure is measured.

ANSWER:

The SI unit of pressure is N/m^2 or pascal.

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.

ANSWER:

a) False. The buoyant force depends on the volume of object immersed in the liquid and the density of the fluid.
b) True. Archimedes' principle can be applied to any fluid (liquid and gas).

Question 7:

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

ANSWER:

The buoyant force on an object due to a liquid acts in upward direction (i.e., *upthrust*).

Question 8:

What is the other name of buoyant force?

ANSWER:

Buoyant force is also known as *upthrust*.

Question 9:

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

ANSWER:

Buoyant force is the force that makes heavy objects appear light when immersed in a liquid.

Question 10:

What is upthrust?

ANSWER:

Upthrust (buoyant force) is the upward force exerted by a liquid when an object is immersed in it.

Question 11:

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

ANSWER:

Archimedes' principle gives us the magnitude of buoyant force acting on an object immersed in a liquid.

Question 12:

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

ANSWER:

According to the given statement, mercury is 13.6 times heavier than the equal volume of water.

Question 13:

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

ANSWER:

The thrust per unit area is called pressure.

Question 14:

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

ANSWER:

Buoyant force or *upthrust* is the scientific term for the upward force acting on an object immersed in a liquid.

Question 15:

What is meant by the term 'buoyancy'?

ANSWER:

Buoyancy is an upward force exerted by a fluid that opposes the weight of an immersed object.

Question 16:

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

ANSWER:

Water causes buoyant force or *upthrust* on a boat.

Question 17:

Why does ice float in water?

ANSWER:

The ice floats on the water because it is less dense than water. A substance floats if it is less dense than the liquid in which it is immersed.

Question 18:

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

ANSWER:

Area = 0.5 m^2
Pressure = 500 Pa
Thrust = ?
Pressure=ThrustAreaPressure=ThrustArea
Pressure × Area = Thrust
500 × 0.5 = Thrust
250 N = Thrust
Answer: Thrust = 250 N.

Question 19:

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

ANSWER:

According to Archimedes' principle, buoyant force equals the weight of the liquid displaced by the object. Therefore, the buoyant force on the object would be 200 N.

Question 20:

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

ANSWER:

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.

ANSWER:

ρ (density) = 19 g/cm^3
V (volume) = ?
m (mass) = 95 g
ρ=mVV=mρ =9519ρ=mVV=mρ =9519

V = 5 cm^3
Answer: Volume of gold = 5 cm^3.

Question 22:

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

ANSWER:

ρ (density) = 3,000 kg/m^3
V (volume) = 5 m^3
m (mass) = ?
ρ=mVρ=mV
$\rho \times V = m$
3,000 × 5 = m
15,000 = m
Answer: Mass of cement = 15,000 kg.

Question 23:

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

ANSWER:

ρ (density) = ?
V (volume) = 10 cm^3
m (mass) = 100 g
ρ=mV =10010ρ=mV =10010
ρ = 10
Answer: Density of the substance = 10g/cm^3.

Question 24:

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

ANSWER:

A wooden block held under water floats on the surface on release because it is less dense than water. A substance floats if it is less dense than the fluid in which it is immersed after the external force is withdrawn from it.

Question 25:

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

ANSWER:

It will float because its density is less than that of the water in the bucket.

Question 26:

Fill in the following blanks with suitable words :
(a) The amount of force acting perpendicularly per unit area is called _____.
(b) _____ force makes the object appear lighter in water.
(c) A heavy ship floats on water because its _____ density is less than that of water.
(d) In fluids (liquids and gases), pressure acts in _____ directions and _____ as the depth increases.
(e) In order to sink in a fluid, the density of an object must be _____ than the density of the fluid.
(f) Snowshoes work by distributing the person's _____ over a much bigger _____.
(g) If the area of a snowshoe is five times _____ than the area of an ordinary shoe, then the pressure exerted by it would be five times _____.

ANSWER:

(a) The amount of force acting perpendicularly per unit area is called <u>pressure</u>.
(b) <u>Buoyant</u> force makes the object appear lighter in water.
(c) A heavy ship floats on water because its <u>average</u> density is less than that of water.
(d) In fluids (liquids and gases), pressure acts in <u>all</u> directions and <u>increases</u> as the depth increases.
(e) In order to sink in a fluid, the density of an object must be <u>greater</u> than the density of the

fluid.
(f) Snowshoes work by distributing the person's weight over a much bigger area.
(g) If the area of a snowshoe is five times bigger than the area of an ordinary shoe, then the pressure exerted by it would be five times smaller.

Question 27:

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

ANSWER:

a)

Density	Relative density
The density of a material is its mass per unit volume.	Relative density of a substance is the ratio of density of a substance to the density of water.
$\rho = mV\rho = mV$	$RD = \rho_{substance}\rho_{water}RD = \rho substance\rho water$
SI unit of density is kg/m^3.	Relative density is a dimensionless quantity.

b) The density of the substance in SI unit would be 7.1 kg/m^3.

Question 28:

Define thrust. What is its unit?

ANSWER:

Thrust is the force exerted on a body perpendicular to the surface. It is the total force acting on the surface of a body.
The 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?

ANSWER:

In a bucket, a mug full of water appears lighter when it is under water than when it is outside the water because water exerts an upward force on the object immersed in it. Thus, the upward force acting on an object immersed in a liquid results in an apparent loss of weight, making the object to float on its surface. This upward force is called buoyant force or upthrust.

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?

ANSWER:

The buoyant force increases when there is an increase in volume of solid object immersed in a liquid. The buoyant force reaches the maximum when the object is completely immersed in a liquid.

Question 31:

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

ANSWER:

We feel light on our feet when standing in a swimming pool with water up to our armpits because of the buoyant force. It exerts an upward force on our body and makes us feel our apparent weight which is less than our actual weight.

Question 32:

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

ANSWER:

During the floods, the boulders are immersed in water. The apparent weights of the boulders are less and that helps the flowing water to push and move the boulders.

Question 33:

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

ANSWER:

An iron nail sinks in water because the density of iron (7,900 kg/m^3) is more than the density of water (1,000 kg/m^3). Whereas the density of mercury (13,600 kg/m^3) is more than the density of iron, so the iron nail floats in mercury.

Question 34:

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

ANSWER:

A piece of glass sinks in water because the density of glass (2,500 kg/m^3) is more than the density of water (1,000 kg/m^3). Whereas the density of mercury (13,600 kg/m^3) is more than the density of glass, so the glass piece floats in mercury.

Question 35:

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

ANSWER:

Steel sinks in water because the density of steel is higher than water. But when steel is converted into a steel boat, it traps a lot of air and thus the average density of the steel boat is less than water. Hence, steel boat floats on water.

Question 36:

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

ANSWER:

Schools bags are provided with wide straps. On carrying them on our shoulders, the area under these straps enlarges, exerting a small pressure. It is due to this small pressure we feel comfortable carrying our bags on our shoulders.

Question 37:

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

ANSWER:

The area under the sharp knife is less than the area under the blunt knife. Hence, the pressure exerted by the sharp knife is more than the pressure exerted by the blunt knife on an object. Therefore, when a same amount of force is applied on both the knives, the sharp knife penetrates deeper into the object than the blunt knife.

Question 38:

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

ANSWER:

Wooden or concrete sleepers are kept below the railway line because the weight of the train is spread over a large area of the sleepers. Therefore, the pressure acting on the ground under the sleepers is reduced. This prevents the shrinking of the ground under the weight of the train.

Question 39:

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

Figure

ANSWER:

An army tank is a very heavy vehicle. In order to make it travel faster over different kinds of ground surfaces, they are provided with wide steel belt. This wide steel belt spreads the weight of the tank over a larger surface area by exerting a smaller pressure on ground, as we know pressure is inversely proportional to the surface area of an object.

Question 40:

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

ANSWER:

The tip of a sewing needle is sharp because the area under the pointed end of the sharp needle is very small. Pressure exerted by a sharp needle is more on the cloth and can pierce easily through the cloth.

Question 41:

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

ANSWER:

We know surface area is inversely proportional to pressure. Therefore when we stand, our body pressure is transferred equally on both the legs. Hence, the surface area increases and the pressure decrease. But when we walk, our body pressure is transferred to single leg at a time. Hence, the surface area decreases and the pressure increase. Thus, pressure is more while we walk.

Question 42:

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

ANSWER:

Snowshoes do not sink in soft snow because they have wide and flat surfaces. Hence, the body weight is spread over a large surface area, thereby reducing the pressure on the shoes.

Question 43:

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

ANSWER:

When a person stands on a cushion, the entire weight of his body gets focused on a smaller area, thereby producing a larger pressure. But when a person lies on a cushion, the entire weight is distributed over a larger area, producing a smaller pressure. Thus, the depression in the cushion is more when a person stands than when he lies.

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.

ANSWER:

It is easier to walk on a soft sand by wearing a pair of flat shoes rather than a pair of high-heeled shoes because flat shoes have a larger surface area where the body weight of the person gets uniformly distributed and puts lesser pressure on sand, whereas heels have a smaller surface area where the weight of the body is focused on a smaller area and increases the pressure.

Question 45:

Explain why, a nail has a pointed tip.

Figure

ANSWER:

The tip of a nail is sharp and pointed because the area under the pointed end of the sharp nail is very small. Therefore, the pressure exerted by a sharp nail is more on the wall and it can pierce easily on the wall with less amount of work done.

Question 46:

Explain why, buildings and dams have wide foundations.

ANSWER:

The buildings and dams have wider foundations because wider the foundation, larger the surface area and smaller the pressure on the ground and thereby preventing the buildings and dams from sinking 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?

ANSWER:

Iron and steel pieces sink in water because iron and steel have higher density than water, but iron and steel ships float in water because they trap a lot of air and thereby reduce the average density of the ships (steel and iron) than water.

Question 48:

Why do camels have large flat feet?

Figure

ANSWER:

Camels have large flat feet and thus a larger surface area. Hence, the pressure exerted by the camel's large flat feet on the surface of the sand is small and the feet do not sink in sand. Therefore, they can walk easily on 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.

ANSWER:

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?

ANSWER:

Area = 3 m^2
Pressure = 10 Pa
Force = ?
Pressure=ForceAreaPressure=ForceArea
Pressure × Area = Force
10 × 3 = Force
30 N = Force
Answer: Force = 30 N.
If the area is made one-third, then
Area = 3 m^2 (1/3 of 3 m^2) = 1 m^2
Pressure = 10 Pa
Force = ?

Pressure=ForceAreaPressure=ForceArea
Pressure × Area = Force
10 × 1 = Force
10 N = Force
Answer: Force =10 N.

Question 51:

A girl is wearing a pair of flat shoes. She weighs 550 N. The area of contract 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?

ANSWER:

Area of one foot = 160 cm^2 (160/10,000 = 0.016 m^2)
Area of two feet = 0.016 × 2 = 0.032m^2
Pressure = ?
Weight = 550 N
Pressure=ForceArea =5500.032Pressure=ForceArea =5500.032
Pressure = 17,187.5 Pa or N/m^2
Ans: Pressure = 17,187.5 Pa or N/m^2.

(b)
Area = 160 cm^2 (160/10,000 = 0.016 cm^2)
Pressure = ?
Weight = 550 N
Pressure=ForceArea =5500.016Pressure=ForceArea =5500.016

Pressure = 34,375 Pa
Answer: Pressure = 34,375 Pa or 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.

ANSWER:

ρ (density) = ?
V (volume) = 3 m^3
m (mass) = 9 kg
ρ=mV =93ρ=mV =93
ρ = 3 kg/m^3
Answer: Density = 3 kg/m^3.
It will float in water because the density of this object (3 kg/m^3) is less than the density of water (1,000 kg/m^3).

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.

ANSWER:

It will weigh less in water because an upward force (buoyant force) equals the weight of water displaced by it acts on the object when immersed in water which reduces its apparent weight.

Question 54:

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

ANSWER:

Density is defined by the following equation:
ρ=mVρ=mV,
where *ρ* = density,
V = volume, and
m = mass.

(b)
ρ (density of material A) = ?
V (volume of material A) = 20 cm^3
m (mass of material A) = 5 kg = 5 × 1,000 = 5,000 g
ρ=mV =5,00020ρ=mV =5,00020

ρ = 250 g/cm^3
Ans: Density of material A = 250 g/cm^3.

ρ (density of material B) = ?
V (volume of material B) = 90 cm^3
m (mass of material B) = 20 kg = 20 × 1,000 = 20,000 g
ρ=mV =20,00090ρ=mV =20,00090
ρ = 222.222 g/cm^3
Answer: Density of material B = 222.22 g/cm^3.
A has greater density.

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? ($g = 10\ m\ s^{-2}$)

ANSWER:

(a) The upward force exerted by a liquid on a body when immersed in a liquid is known as buoyant force. The buoyant force depends on the following factors:
(i) Size or volume of the body immersed in a liquid.
(ii) The density of the liquid in which the body is immersed.
Buoyant force is exerted by the pressure difference in the surrounding medium caused by gravity.

(b) F (force) = ?
m (mass)= 600 kg
a (acceleration due to gravity) = 10 m/s^2

$F = m \times a$
$= 600 \times 10$
$= 6{,}000$ N
Ans: Buoyant force acting on a boat = 6,000 N.

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?

ANSWER:

(a) Principle of flotation – It is the other name of Archimedes' Principle. the upthrust or the buoyant force is equal to the weight of the liquid displaced by the body. This is known as Archimedes' principle.
Archimedes principle states that when a body is immersed wholly or partially in a liquid, it experiences an upward buoyant force of magnitude equal to the weight of the liquid displaced by it.

Buoyant force = Weight of displaced liquid

(b) (i) Buoyant force = 6,000 N. (According to Archimedes' principle, buoyant force is equal to the weight of the liquid displaced by the body.)

(ii) Weight of the boat = 6,000 N. (According to Archimedes' principle, weight of the boat is equal to the amount of the water displaced by the body.)

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)

ANSWER:

(a) Density is defined as the mass per unit volume of a substance. The symbol for density is ρ. Mathematically, density is defined as
ρ=mVρ=mV
The SI unit of density is kg/m^3.

(b) Relative density of a substance is the ratio of density of the substance to the density of water. Relative density has no unit.

(c)
Relative density=Density of turpentineDensity of water =840 kg/m31,000 kg/m3 =0.84Relative density=Density of turpentineDensity of water =840 kg/m31, 000 kg/m3 =0.84

Ans: Relative density of turpentine = 0.84.

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

ANSWER:

(a) Pressure is defined as force per unit area applied in a direction perpendicular to the surface of an object.

(b) The relation between pressure, force, and area is given by following equation:
Pressure=ForceAreaPressure=ForceArea
(c) (i) Area = 10 m^2
Pressure = ?
Force = 200 N
Pressure=ForceArea =20010 =20 PaPressure=ForceArea =20010
=20 Pa
Ans: Pressure = 20 Pa.

(ii) Area = 5 m^2
Pressure = ?
Force = 200 N
Pressure=ForceArea =2005 =40 PaPressure=ForceArea =2005 =4
0 Pa
Ans: Pressure = 40 Pa.

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?

ANSWER:

(a) A substance which can flow is called fluid. The common fluids are juice, water, and soup.
(b) Archimedes' principle states that "when a body is immersed partially or completely in a fluid (liquid or gas), it experiences an upthrust or buoyant force that is equal to the weight of the fluid displaced by body."
(c) When an object is placed on the surface of water, two forces act on the object:
(i) The gravitational force that act in the downward direction.
(ii) The upthrust or the buoyant force that act in the upward direction.
An object floats on the surface of water if the upthrust of water on the object is greater than the weight of the object. An object sinks if the weight of the object is greater than the upthrust of water on the object.

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?

ANSWER:

(a) The boat floats in water because the upthrust of water on the boat is greater than the weight of the boat.

(b) (i) ρ (density of steel piece) = ?
V (volume of steel piece) = 12 cm^3
m (mass of steel piece) = 96 g
ρ=mV =9612ρ=mV =9612
ρ = 8 g/cm^3
Ans: Density of steel piece = 8 g/cm^3.

(ii) We know that 1 g/cm^3 = 1,000 kg/m^3
So, 8 g/cm^3 = 8 × 1,000 kg/m^3
= 8,000 kg/m^3
Ans: Density of steel piece = 8,000 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.

Figure

(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?

ANSWER:

a) Elephant has larger weight of 40,000 N, so elephant exerts larger force on the ground. Elephant exerts a large force on the ground by 40,000 N − 400 N= 39,600 N.
b) Area of elephant's one foot = 1,000 cm^2 (1,000/10,000= 0.1m^2)

Pressure = ?
Weight of the elephant = 40,000 N
Pressure=WeightArea =40,0000.1 =4×105PaPressure=WeightArea =40,00 00.1 =4×105Pa

Answer: Pressure exerted by one foot of elephant on the ground = 4×10^5 Pa.
c) Area of one stiletto foot = 1 cm^2 = 0.0001 m^2
Pressure = ?
Weight of the girl = 400 N
Pressure=WeightArea =4000.0001 =4×106PaPressure=WeightArea =4000. 0001 =4×106Pa
Answer: Pressure exerted by one foot of stiletto heel on the ground = 4×10^6 Pa.

d) The girl standing on stiletto heel would exert larger pressure on the ground because the surface area covered by the heel is small as pressure is inversely proportional to the surface area of the heel.
e) 40,00,000 : 4,00,000 = 10:1
The pressure exerted by the girl is 10 times greater than the elephant.

Question 62:

An object weighs 10 N in air. When immersed fully in a liquid, it weighs only 8 N. The weight of liquid displaced by the object will be :

(a) 2 N
(b) 8 N
(c) 10 N
(d) 12 N

ANSWER:

Ans: (a) 2N.
We know,
Buoyant force or weight of liquid displaced = Actual weight – Apparent weight
⇒ Weight of the liquid displaced = 10 – 8 = 2 N.

Question 63:

A rectangle wooden block has length, breadth and height of 50 cm, 25 cm and 10 cm, respectively. This wooden block is kept on ground in three different ways, turn by turn.

Which of the following is the correct statement about the pressure exerted by this block on the ground?

(a) the maximum pressure is exerted when the length and breadth form the base
(b) the maximum pressure is exerted when length and height form the base
(c) the maximum pressure is exerted when breadth and height form the base
(d) the minimum pressure is exerted when length and height form the base

ANSWER:

Ans: c The maximum pressure is exerted when breadth and height form the base.
This is because the pressure is inversely proportional to the surface area.

Question 64:

An object is put in three liquids having different densities, one by one. The object floats with 19,211and3719,211and37 parts of its volume outside the surface of liquids of densities d_1, d_2 and $d_3$respectively. Which of the following is the correct order of the densities of the three liquids?

(a) $d_1 > d_2 > d_3$
(b) $d_2 > d_3 > d_1$
(c) $d_1 < d_2 < d_3$
(d) $d_3 > d_2 > d_1$

ANSWER:

Ans: c $d_1<d_2<d_3$.
This is because if the density of the liquid is more than the object, then the object will float on the liquid. The more the object gets immersed in the liquid, lesser is the density of the liquid.

Question 65:

A metal in which even iron can float is :

(a) sodium
(b) magnesium
(c) mercury
(d) manganese

ANSWER:

Ans: c Mercury.
This is because the density of mercury is greater than the iron.

Question 66:

Four balls, A, B, C and D displace 10 mL, 24 mL, 15 mL and 12 mL of a liquid respectively, when immersed completely. The ball which will undergo the maximum apparent loss in weight will be :

(a) A
(b) B
(c) C
(d) D

ANSWER:

Ans: b B.
This is because B has displaced maximum amount of water.

Question 67:

The relative densities of four liquids P, Q, R and S are 1.26, 1.0, 0.84 and 13.6 respectively. An object is floated in all these liquids, one by one. In which liquid the object will float with its maximum volume submerged under the liquid?

(a) P
(b) Q
(c) R
(d) S

ANSWER:

Ans: c R.
This is because R has the lowest density among the four.

Question 68:

A solid of density 900 kg/m^3 floats in oil as shown in the given diagram. The oil floats on water of density 1000 kg/m^3 as shown. The density of oil kg/m^3 could be :

Figure

(a) 850
(b) 900
(c) 950
(d) 1050

ANSWER:

Ans: c 950.
The solid object floats in oil because the density of the solid object is less than the oil. The oil floats in water because the density of oil is less than water. Thus, the density of oil must be between density of solid and water.

Question 69:

The density of water is 1000 kg/m3 and the density of copper is 8900 kg/m3. Which of the following statements is incorrect?

(a) The density of a certain volume of copperThe density of the same volume of water=8.9The density of a certa in volume of copperThe density of the same volume of water=8.9
(b) The volume of a certain mass of copperThe volume of the same mass of water=8.9The volume of a certain mass of copperThe volume of the same mass of water=8.9
(c) The weight of a certain volume of copperThe weight of the same volume of water=8.9The weight of a certai n volume of copperThe weight of the same volume of water=8.9
(d) The mass of a certain volume of copperThe mass of the same volume of water=8.9The mass of a certain vol ume of copperThe mass of the same volume of water=8.9

ANSWER:

Ans: b.
Density=The volume of a certain mass of copperThe volume of the same mass of water=8.9Density=The volu me of a certain mass of copperThe volume of the same mass of water=8.9
This is because the density is defined as the ratio of the mass of the object to the volume of the object.

Question 70:

The diagrams represent four measuring cylinders containing liquids. The mass and volume of the liquid in each cylinder are stated. Which two measuring cylinder could contain an identical liquid?

Figure

(a) W and X
(b) W and Y
(c) X and Y
(d) X and Z

ANSWER:

Ans: d X and Z.
This is because the density of these two liquids is same.

Question 71:

Consider the following information in respect of four objects A, B, C and D :

Object	Density (kg/m^3)	Volume (m^3)	Mass (kg)
A		2	4000
B	8000	4	
C	2000		1000
D		4	2000

Which object would float on water?

(a) A
(b) B
(c) C
(d) D

ANSWER:

Ans: d D.
This is because among these four objects, only the density of object D is less than water.

Question 72:

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

ANSWER:

The two equal weights of unequal volumes will get unbalanced when they are completely immersed in water due to their unequal volumes; they will displace unequal volumes of water and will suffer unequal losses in weight when completely dipped in water.

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.

ANSWER:

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 amount of loss in weight on completely immersing them in water due to their equal volumes and not because of their 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.

ANSWER:

The body will sink less in water because the density of water (1,000 kg/m3) is more than the density of kerosene (800 kg/m^3).

Question 75:

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

ANSWER:

The reading on the spring balance will be zero. It is because the weight of floating block of wood is fully supported by the liquid in which it is floating. 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?

ANSWER:

When a large amount of salt is dissolved in water, the density of salt solution becomes higher than pure water. It is because of its higher density, the salt solution exerts a greater upward buoyant force on the egg, making it rise and then float.

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?

ANSWER:

(a) The beaker is suspended from a spring balance. If an object is added to the beaker, the net weight held by the spring balance increases. Thus, the reading of the spring balance will increase by the weight of the cork.

(b) The beaker is suspended from a spring balance. If an object is added to the beaker, the net weight held by the spring balance increases. Thus, the reading of the spring balance will increase by the weight of the heavy metal.

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.

ANSWER:

ρ (density of golf ball) = ?
V (volume of steel piece) = 30 cm^3
m (mass of steel piece) = 33 g
ρ=mV =3330ρ=mV =3330
ρ = 1.1 g/cm^3
Ans: Density of the golf ball = 1.1 g/cm^3.

Question 79:

A boy gets into a floating boat.

(a) What happens to the boat?
(b) What happens to the weight of water displaced?
(c) What happens to the buoyant force on the boat?

ANSWER:

(a) The boat sinks a little more in water so that the weight of new volume of water displaced by the boat equalizes the weight of the boat and the boy.
(b) The weight of the water displaced by submerged part of the boat increases. It is now equal to sum of weight of boy and weight of boat.
(c) The buoyant force acting on the boat increases. The new buoyant force is equal to sum of weight of boy and weight of boat.

Question 80:

A 12kg12kg sheet of tin sinks in water but if the same sheet is converted into a box or boat, it floats. Why?
ANSWER:

A tin sheet sinks in water because the density of tin is higher than water. But the tin box or boat floats on water because of the trapping of large amount of air, whereby the average density of tin box or boat becomes lower than water.