3. Gravitation

Very Short Answer Type Questions-Pg-100

1. Question

What is the value of gravitational constant G

(i) On the earth, and

(ii) On the moon?

Answer

The gravitational constant (also known as "universal gravitational constant", or as "Newton's constant"), denoted by the letter G, is an empirical physical constant involved in the calculation of gravitational effects in Sir Isaac Newton's law of universal gravitation and in Albert Einstein's general theory of relativity.

(i)The value of gravitational constant G on the earth is

$6.67\times10^{-11}Nm^2/kg^2$

(ii) The value of gravitational constant G on the moon?

$6.67\times10^{-11}\ Nm^2/kg^2$

2. Question

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

Answer

Gravitational force is the force which causes a centripetal force and causes moon to revolve around the earth.

3. Question

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

Answer

The acceleration of a freely falling body is equal to g, which is known as acceleration due to gravity.

The expression for acceleration due to gravity is

$g = G M / R^2$

Where,

'G' is universal gravitational constant,

'M' is mass of the earth,

And 'R' is radius of the Earth

From the above expression, it is clear that the acceleration of a freely falling body doesn't dependent of mass of the body, but depends on mass of the planet.

4. Question

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

Answer

The motion of planets on the basis of gravitational force between the planets and the sun is explained by Kepler's law which is discovered by the scientist Kepler.

5. Question

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

Answer

The motion of planets on the basis of gravitional force between the planets and the sun is explained by Kepler's law which is discovered by the scientist Kepler. Kepler's three laws of planetary motion can be stated as follows:

(1) All planets move about the Sun in elliptical orbits, having the Sun as one of the foci.

(2) A radius vector joining any planet to the Sun sweeps out equal areas in equal lengths of time.

(3) The squares of the sidereal periods (of revolution) of the planets are directly proportional to the cubes of their mean distances from the Sun.

6. Question

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

Answer

The third law of Kepler states that:

The square of the period of any planet is proportional to the cube of the semi major axis of its orbit. This is one of Kepler's laws .This law arises from the law of gravitation. Newton first formulated the law of gravitation from Kepler's 3rd law

7. Question

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

Answer

Kepler's third law of planetary motion (i.e., $r^3 \propto T^2$) led Newton to establish inverse square rule. It was coined from the law of gravitation.

8. Question

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

9. Question

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

Answer

Acceleration that will be exerted on the 10 kg body will be equal to 9.8 m/s^2 as acceleration do not depends on the mass of the object,

10. Question

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

Answer

While we drop an object it falls down with a constant acceleration, the force that accelerates the object is the gravitational force of the earth. The acceleration due to gravity is generally 10 m/s^2 or 9.8 m/s^2 on the earth.

11. Question

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

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

$F = G * m * M / d^2$

Here gravitational constant, G = $6.67 * 10^{-11}$ Nm^2kg^{-2}

12. Question

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

Answer

The reason for earth revolving around the sun is the gravitational force present.

13. Question

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

Answer

When two object lies at a certain distance from each other the possess a force of attraction towards each other. This happens due to the gravitational force present in them.

14. Question

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

Answer

The force involved in the formation of tides in the sea is the gravitational force exerted mainly by the moon and to some extent by the sun.

15. Question

Which force is responsible for holding the solar system together?

Answer

The force which is responsible for the holding the complete solar system together is the gravitational force of the earth. Due to the extremely huge mass sun attracts the planets and make them revolve around it.

16. Question

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

Answer

Mass, m = 1 kg

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

Weight, w = m * g

= 1 * 9.8 = 9.8 N

17. Question

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

Answer

The weight of the body depends on the following factors:

(i) It is directly proportional to its mass.

(ii) It also depends on the acceleration due to gravity which varies from place to place.

18. Question

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

Answer

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

19. Question

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

Answer

If the same body is taken to places having different gravitational field strength, then the weight of the mass would vary but the mass of the object would remain constant.

20. Question

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

Answer

Mass, m = 10 kg

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

We know,

Weight, W = m * g

= 10 * 9.8 = 98 N

21. Question

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

Answer

Let the mass be m,

Weight, W = 50 N

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

We know, W = m * g

$m = \frac{W}{g} = \frac{50}{9.8}$ = 5. 102 kg

22. Question

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

When the body is taking to the centre of the earth, its weight will be reduced to zero as the value of the g is zero at the centre of the earth.

23. Question

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

Answer

Mass, m = 50 kg

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

We know,

Weight, W = m * g

= 50 * 9.8 = 490 N

24. Question

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

Answer

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.

25. Question

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 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 (Since, it exerts acceleration due to gravity)

(b) False (Since, the force between the two objects depends only on their masses and the distance between them)

(c) False (Since, the gravitational constant does not vary on the location)

(d) False (Since, g does not depends on the mass of the object)

(e) False (Since, the weight of the object on the earth is six times the weight of the object on the moon)

26. Question

Fill in the following blanks with suitable words:

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

(b) In order that the force of gravitational 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.

Answer

(a) One-sixth

(b) Mass

(c) Six times

(d) One-sixth

(e) Six times

(f) 36N

Short Answer Type Questions-Pg-101

27. Question

Explain what is meant by the equation:

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

Where the symbols have their usual meanings?

Answer

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 object on the earth

R = radius of the earth

28 A. Question

What do you mean by the term 'free fall'?

Answer

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.

28 B. Question

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

Answer

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

29. Question

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

Answer

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.

30. Question

Give reason for the following:

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

Answer

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

$F \alpha m * M$

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.

31. Question

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

Answer

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

$F = G * m * M / d^2$

The force between two bodies is inversely proportional to the square of the distance between them. That is, $F \alpha 1/d^2$

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.

32. Question

What happens to the gravitational force between two objects when the distance between them is: (i) Doubled (ii) Halved

Answer

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

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

33. Question

State two applications of universal law of gravitation.

Answer

The two applications of universal law of gravitation are:

(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.

34. Question

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

Answer

When the stone held in our hand is released it falls down because the earth exerts a force of attraction which is also known as gravity, on the stone and pulls it down.

35. Question

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

Given,

Mass of first object, m = 50 kg

Mass of second object, M = 120 kg

Distance, d = 10m

Gravitation constant, $G = 6.7 * 10^{-11}\ Nm^2kg^{-2}$

We know, $F = G * m * M/d^2$

$= 6.67 * 10^{-11} * \frac{50*120}{10*10}$

$= 6.67 * 60 * 10^{-11}$

$= 4.02 * 10^{-9}\ N$

36. Question

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 = $6.7\times10^{-11}\ Nm^2/kg^2$)

Answer

Force due to gravity, $F = G * m * M/d^2$

$= 6.67 * 10^{-11} * 6 * 10^{24} * 150/ (6.4 * 10^{6})^2$

F = 1472 N

37. Question

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

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

Mass of the sun, $m=2 \times 10^{30}$ kg

Mass of the earth, $M = 6 * 10^{24}$ kg

Force of gravitation, $F = G * m * M/d^2$

$= 6.67 * 10^{-11} * 2 * 10^{30} * 6 * 10^{24}/ (1.5 * 10^{11})^2$

$= 6.7 * 12 * 10^{21}/ 1.5 * 1.5$

$F = 3.57 * 10^{22}$ N

38. Question

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

Initial velocity of the stone, u=?

Final velocity of stone, v=0

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

Time, t=3 sec

Using relation, v=u + gt

0 = u - 9.8 x 3

u = 29.4m/s

39. Question

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

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

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

$s = 0 + 4.9 * 2.5 * 2.5$

$s = 30.625m$

40. Question

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

Height, s=20m

Initial velocity, u=0

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

Final velocity, v=?

Time taken, t=?

(i) Using relation,

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

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

$20 = 0 + 5t^2$

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

$t = 2s$

(ii) For a freely falling body:

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

$= (0)^2 + 2 * (10) * (20)$

$= 400$

$v = 20m/s$

Thus, the speed of the stone when it hits the ground is 20m/s.

41. Question

A stone is thrown vertically upwards with a speed of 20 m/s. How high will go before it begins to fall? ($g = 9.8\ m/s^2$)

Answer

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 x (-9.8) x h

0-400 = -19.6 h

h= 400/19.6 = 20.4 m

42. Question

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

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

43. Question

Write the differences between mass and weight of an object.

Answer

Mass:

(i) The mass of an object is the quantity of the matter contained in it.

(ii) The SI unit of mass id kilo-gram (kg).

(iii) The mass of an object is constant.

(iv) The mass of an object can never be zero.

Weight:

(i) The weight of an object is the force with which it is attracted towards the centre of the earth.

(ii) The SI unit of weight is Newton (N).

(iii) The weight of an object is variable. It changes with the change in acceleration due to gravity.

(iv) The weight of an object can be zero.

44. Question

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

Answer

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.

45. Question

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

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

46. Question

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

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

Weight, W = m x g

20 = m x 10

m = 2 kg

47. Question

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

(ii)Weight, W = m x g

= 20 x 1.6

= 32N

48. Question

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

Answer

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

49. Question

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

Answer

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.

Long Answer Type Questions-Pg-102

50 A. Question

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

Answer

The mass of a body is the quantity of matter contained in it. The SI unit of mass is kilogram (kg). Mass remains constant and it can never be zero.

50 B. Question

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

Answer

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). Weight varies according to the acceleration due to gravity and it can be zero at times.

50 C. Question

What is the relational between mass and weight of a body?

Answer

Weight, W = m x g

i.e., the weight of a body is directly proportional to its mass.

51 A. Question

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

Answer

According to universal law of gravitation: Everybody 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.

$F = G * m * M / d^2$

Sir Issac Newton gave this law.

51 B. Question

Define gravitational constant. What are the units of gravitational constant?

Answer

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.

$G = F * d^2 / m * M$

Unit of gravitational constant = $Nm^2 kg^{-2}$

52 A. Question

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

Answer

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. Its value on the earth is generally $9.8 m/s^2$ or $10 m/s^2$.

52 B. Question

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

Answer

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

52 C. Question

State the SI unit of acceleration due to gravity?

Answer

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

53 A. Question

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

Answer

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.

53 B. Question

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 ($G = 6.7\times10^{-11}$ Nm^2/kg^2). Which satellite do you think it could be?

Answer

Acceleration due to gravity, $g = G * M/R^2$

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

Radius, $R = 1.74 * 10^{6}$m

Gravitational constant, $G = 6.67 * 10^{-11}$ Nm^2 kg^{-2}

$g = 6.67 * 10^{-11} * 7.4 * 10^{22} / (1.74 * 10^{6})^2$

$g = \frac{6.7*7.4}{1.74*1.74*10} = 1.637$ 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.

54. Question

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

Answer

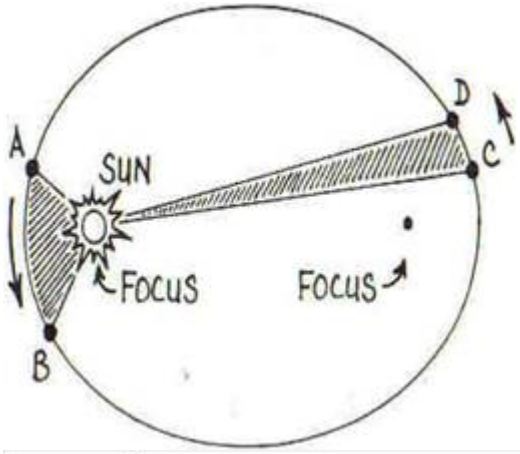
Kepler's first law: The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit. This law means that the orbit of a planet around the sun is an ellipse and not an exact circle. An elliptical path has two foci, and the sun is at one of the two foci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

$r^3 \alpha T^2$



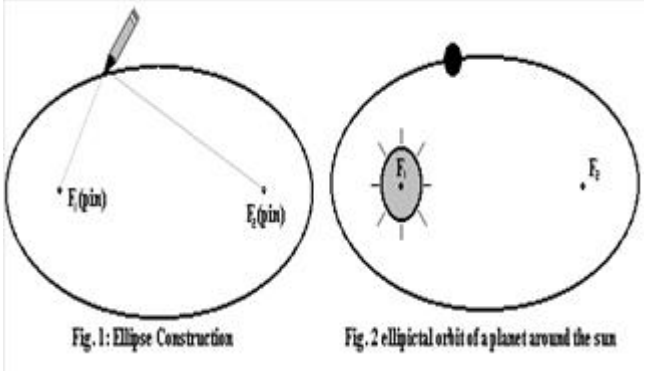


Fig. 1: Ellipse Construction

Fig. 2 elliptical orbit of a planet around the sun

55. Question

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

Acceleration due to gravity, $g = G * M / R^2$

Mass of the planet, $M = 6 * 10^{24}$ kg

Diameter = $12.8 * 10^3$ km = $12.8 * 10^6$ m

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

Gravitational constant, $G = 6.67 * 10^{11}$ Nm^2 kg^{-2}

$g = 6.67 * 10^{11} * 6 * 10^{24} / (6.4 * 10^6)^2$

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

$g = 9.8$ m/s^2

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

Multiple Choice Questions (MCQs)-Pg-102

56. Question

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

Since, The maximum height will be reached by the object when its v will be equal to zero.

We know:

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

$(0)^2 = u^2 - 2gh$

$u^2 = 2gh$

$h = u^2/ 2g$

57. Question

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

Since, the value of G remains constant (i.e. does not vary according to the location)

58. Question

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

Since, the mass of the moon is very less than that of the earth. So, the gravitational force on the moon will be less.

59. Question

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

Since, the gravity of the earth attracts every particle and object towards it.

60. Question

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

The gravitational constant is a universal constant. It remains constant independent of the location.

61. Question

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

Since, the weight of any object at the centre of the earth is always zero

62. Question

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

Because, the force of gravity acting on them will be equal.

63. Question

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

As, the distance of the equator from the centre of the earth is farthest.

64. Question

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

The expression for finding the gravitational force between two objects of mass M and m respectively separated by a distance d is equal to:

$F = G * M * m / d^2$

65. Question

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

Since, G is a universal constant. Hence, it remains constant independent of the mass and radius of the earth.

66. Question

Two particles are places 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

We know, $F = G * M * m/d^2$

Now after keeping the d same and doubling the masses as 2m and 2M respectively, we get:

$F' = G * 2M * 2m/d^2$

$F' = 4 (G * M * m/d^2)$

$F' = 4F$

67. Question

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

A. 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

Since, the G is the universal constant and remains constant independent masses of the object and their location.

68. Question

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. 2x D. 4x

Answer

We know, $F = G * M * m/d^2$

Now after keeping the masses of the object constant and decreasing the distance between them to half, than the previous, we get:

$F' = G * M * m/ (d/2)^2$

$F' = 4 (G * M * m/d^2)$

$F' = 4F$

69. Question

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 F1 and the magnitude of force exerted by the apple on the earth be F2 then:

A. F1 is very much greater than F2

B. F2 is very much greater then F1

C. F1 is only a little greater than F2

D. F1 and F2 are exactly equal

Answer

Since, the gravitational force exerted by both the object towards each other remains equal.

70. Question

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. $r^3 \propto \frac{1}{T^2}$

Answer

According to kepler's third law of planetary motion.

Questions Based on High Order Thinking Skills (HOTS)-Pg-103

71. Question

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

Answer

Gravitation force is given by:

$F = G * M * m / d^2$

Distance between the two masses is increased. So the new distance is D = 5d

New gravitational force, $F_1 = F$

Let one of the masses is changed to m_1 so as maintain the same gravitational force.

$F_1 = G * m_1 * M / D^2$

D = 5d

$F = F_1$

$G * m * M / d^2 = G * m_1 * M / D^2$

$G * m * M / d^2 = G * m_1 * M / 25d^2$

$\frac{m1}{m} = 25$

$m_1 = 25m$

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

72. Question

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? (Picture)

Answer

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 has 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.

73. Question

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

Acceleration due to gravity of earth,

$g = G * M / R^2 = 9.8\ m/s^2$

If mass of planet, $m = \frac{M}{2}$

And radius of planet, $r = \frac{R}{2}$

Acceleration due to gravity on the surface of the planet will be:

$g = G * m / r^2$ (i)

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

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

Put (ii) and (i) in equation (i), we get

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

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

$g = 19.6\ m/s^2$

74. Question

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.

Answer

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.

75. Question

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 rising towards the stone?

Answer

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.

76. Question

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?

Answer

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'.

77. Question

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, 9.23 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) 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.

Very Short Answer Type Questions-Pg-123

1. Question

Write the common unit of density.

Answer

The common unit of density is g/cm^3 (g/cm^3) represents gram per centimeter cube.

2. Question

What is the density of water in SI units?

Answer

The density of water in SI units is 1000km/cm^3. Hence, the SI unit of density is kilogram per centimeter cube and is represented as km/cm^3.

3. Question

What is the value of relative density of water?

Answer

Relative density, or specific gravity, is the ratio of the density (mass of a unit volume) of a substance to the density of a given reference material. Specific gravity usually means relative density with respect to water.

The value of relative density of water is 1.

4. Question

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

Answer

The quantity whose one of the units is Pascal (Pa) is pressure. Pressure is an expression of force exerted on a surface per unit area.

5. Question

State the units in which pressure is measured.

Answer

Pressure is an expression of force exerted on a surface per unit area. The standard unit of pressure is the Pascal (Pa), equivalent to one newton per meter squared (N/m^2)

6. Question

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 (Since, Buoyancy depends on the volume of the object and the density of the fluid)

(b) True (As that's the entire basis of convection. A balloon full of hot air floats in cold air)

7. Question

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

Answer

The buoyant force on an object submerged in a fluid is caused by the pressure difference between the top and bottom of the object. To overcome the gravitational force, the buoyant force acts in the upward direction. The larger pressure at greater depth pushes upward on the object.

8. Question

What is the other name of buoyant force?

Answer

Upthrust is the other name for buoyant force. Upthrust is the upward force that a liquid or gas exerts on a body floating in it.

9. Question

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

Answer

The force which makes heavy objects appear light when immersed in a liquid is the buoyant force. The buoyant force comes from the pressure exerted on the object by the fluid.

10. Question

What is upthrust?

Answer

The upward force Exerted on a body by the fluid in which it is emerged is called upthrust. It the other name of buoyant force.

11. Question

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

Answer

The principle which gives the magnitude of buoyant force acting on an object immersed in a liquid is called Archimedes principle. Archimedes' principle states that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces and acts in the upward direction at the centre of mass of the displaced fluid.

12. Question

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

Answer

The statement means that the Mercury is 13.6 times the density of water.

13. Question

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

Answer

The thrust per unit area is given by the pressure applied. Pressure is an expression of force exerted on a surface per unit area. The standard unit of pressure is the Pascal (Pa).

14. Question

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

Answer

The scientific name of the 'upward force' acting on an object immersed in a liquid is buoyant force. It is also known as the upthrust force. It is the upward force exerted on a body by the fluid in which it is emerged.

15. Question

What is meant by the term 'buoyant'?

Answer

The term Buoyancy represents the upthrust. It is an upward force exerted by a fluid that opposes the weight of an immersed object.

16. Question

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

Answer

The reason for the presence of buoyant force on a boat is the pressure difference between two fluids.

17. Question

Why does ice float in water?

Answer

Yes, ice floats on water due to the fact that ice has a lesser density than that of water.

18. Question

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

Answer

We know that pressure is the normal force acting per unit area. So,

P = F/A

So the force will be

F = P x A

Here,

P = pressure = 500 Pa

A = area = 0.5 m^2

Thus, we get

F = 500 x 0.5

So force is

F = 250 N

19. Question

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

Answer

As we know that the buoyant force acting on a floating body in a liquid is equal to the weight of the floating body,

Buoyant force acting on the body of weight 200N floating in liquid = 200N

20. Question

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. It was given by his famous principle commonly known as Archimedes principle which stated that

The upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces and acts in the upward direction at the centre of mass of the displaced.

21. Question

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

Answer

Density of gold = 19g/cm^3

Mass = 95g

Density = mass/volume

Therefore, volume = mass/density

Volume = 95/19 cm^3

Volume = 5cm^3

22. Question

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

Answer

Density = 3000 kg/m^3

Side of cube = 5 m

Volume = side^3

=5×5×5

= 125 m^3

Mass = density × volume

= 3000×125

= 375000kg

23. Question

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

Answer

Mass= 100g

Volume= 10cm^3

Density = mass/ volume

= 100/10

= 10g/cm^3

24. Question

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

Answer

A block of wood held under water rise to the surface when released. This happens because the upward force (buoyant force) is greater than the downward force i.e. weight.

25. Question

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

Answer

Since the density of water is greater than that of body, hence the body will float in the bucket of water.

26. Question

Fill in the 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, them the pressure of a snow shoe on the snow is five times ……..

Answer

(a) Pressure

(b) Buoyant

(c) Average

(d) All; Increases

(e) More; Density

(f) Weight; Area

(g) Bigger; Smaller;

Short Answer Type Questions-Pg-124

27 A. Question

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

Answer

Density:

The density of a substance is defined as mass of the substance per unit volume i.e Density = Mass / Volume

The SI unit of density is kg/m3

Relative Density:

The Relative Density of a substance is the ratio of its density to that of water. i.e

Relative Density = Density of substance / Density of water.

Relative Density is unit less.

27 B. Question

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

Answer

Relative density = density of object / density of water

Density of object = relative density × density of water

$d = 7.1 \times 1000 kg/m^3$

$d = 7100\ kg/m^3$

28. Question

Define thrust. What is its unit?

Answer

When a system expels mass in one direction with acceleration, the accelerated mass will cause an equal and opposite force to the system because of Newton's 3rd law of motion, this reaction force is called Thrust. E.g. Exhaust gases coming out of a rocket creates a thrust on the rocket to lift it up

However, thrust is also used in other sense also sometimes a force acting perpendicular to a body is also termed as thrust (like buoyant force). The SI unit of density is kg/m^3

29. Question

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

When the mug is under the water upward buoyant force acting on the mug reduces the weight of the mug. Due to that mug appears lighter when it is under the water. Or in other words can be explained as under the water it experiences upward buoyant force that cancels the gravitational force acting on the mug and it weighs lighter. When the mug is taken outside there is no other force to cancel or reduce gravitational force acting on the mug and it weighs much more.

30. Question

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

Answer

As more and more of the solid object is immersed in a liquid, more and more liquid is displaced. Since buoyant force is equal to the weight of liquid displaced, continuously displacing the liquid (by immersing the object) will lead to an increase in the force of buoyancy. Buoyant force is maximum when the entire object with its full volume is inside the liquid.

3. Question

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

Answer

We feel light on our feet when standing in a swimming pool with water up to our armpits because water of swimming pool exerts a buoyance force which reduces the net weight of the body.

32. Question

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

Answer

This is because the force with which the water flows in a typical flood is very large. It is more than enough to move large boulder and anything else in their path due to large buoyant force acting on it.

33. Question

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

Answer

An iron nail floats on mercury because the density of mercury is greater than the density of iron. But the density of water is less than that of iron so it sinks in water.

34. Question

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

Answer

This happens because the density of mercury is higher than that of glass, while the density of water is lower than that of water.

35. Question

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

Answer

When we put a piece of steel in water then it sinks because steel is denser than water whereas ship is not a block of iron and steel a ship is a hollow object made of iron and steel which contains a lot of air in it air has a very low density due to the presence of a lot of air in it the average density of the ship becomes less than the density of water and since the average density of ship is less than that of water therefore a ship floats in water thus a ship made of iron and steel floats in water because its average density is less than that of water due to the presence of a lot of air space in it.

36. Question

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

Answer

Larger the area smaller the pressure. School bags usually have broad straps so that the weight of the bag may fall over a large area on the shoulder producing less pressure and less pressure, it is comfortable to carry heavy bag.

37. Question

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

Answer

We know that Pressure is inversely proportional to area.

So, smaller area will exert more pressure, thus a sharp knife has small area that comes in contact with the object, so more pressure can be applied on the object. Whereas a blunt knife has more area than a sharp knife and the

pressure exerted by the blunt knife will be less as compared to that of a sharp knife.

Therefore it becomes easy to cut objects with a sharp knife than a blunt knife.

38. Question

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

Answer

this is because wooden sleepers increase the area on which pressure of train is to be exerted. Thus pressure is not concentrated on a single point densely. Therefore if there more area there would be less pressure and train will run smoothly. As we know, P = $\frac{1}{A}$

39. Question

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

Answer

We know that,

Pressure = Force / Area.

Area of the wide steel is large. So, the pressure acting on the surface is less and the tank moves on the surface easily

40. Question

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

Answer

In a sewing needle tip, as we know, the surface area is less. Hence the pressure exerted will be more. Greater the surface area, lesser the pressure and lesser the surface area, greater the pressure. So, as the surface area is very little, the pressure exerted will be more. Or we can say

The tip is sharp it can penetrate the fabric easily by applying more pressure on the fabric but if it is not pointed then more force is required to penetrate the fabric as the pressure on the fabric will be less.

41. Question

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

Answer

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

42. Question

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

Answer

Snow shoes have a large surface area in contact with snow therefore the pressure applied on snow is less thus the person does not sink.

43. Question

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 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.

44. Question

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

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.

45. Question

Explain why, a nail has a pointed tip.

Answer

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.

46. Question

Explain why, buildings and dams have wide foundations.

Answer

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.

47. Question

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

Answer

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.

48. Question

Why do camels have large flat feet?

Answer

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.

49. Question

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

50. Question

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

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

Force = Area * Pressure

= 3 * 10 = 30N

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

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

Force = Area * Pressure

= 1 * 10

= 10N

51. Question

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?

Answer

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 stand on two feet, Pressure = $\frac{Force}{Area}$

= 550/ 320 * 10^{-4}

= 17187.5 N/m^2

(b) If she stands on one foot, Pressure = $\frac{Force}{Area}$

= 550/ 160 * 10^{-4}

= 34375 N/m^2

52. Question

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

Volume = $3m^3$

Mass = 9kg

Density of substance = $\frac{Mass\ of\ substance}{Volume\ of\ substance}$

= $\frac{9}{3}$ = 3kg/ m^3

And density of water = 1000kg/ m^3

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

53. Question

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

Answer

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.

54 A. Question

Write down an equation that defines density.

Answer

Density of substance = $\frac{Mass\ of\ substance}{Volume\ of\ substance}$

54 B. Question

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

For material A: Mass= 5kg

Volume =20 cm^3

= 20 x 10^{-6} m^3

Density of material A = 5 / 20 * 10^{-6} = 0.25 * 10^6 kg/m^3

For material B:

Mass = 20kg

Volume = 90 cm^3

= 90 x 10^{-6} m^3

Density of material B = 20 / 90 * 10^{-6} = 0.22 * 10^6 kg/m^3

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

Long Answer Type Questions-Pg-125

54 A. Question

Define buoyant force. Name two factors on which buoyant force depends.

Answer

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.

54 B. Question

What is the cause of buoyant force?

Answer

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

55 C. Question

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

Answer

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.

56 A. Question

State the principle of flotation.

Answer

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.

56 B. Question

A floating boat displaces water weighing 6000 Newton.

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

(ii) What is the weight of the boat?

Answer

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

57 A. Question

Define density. What is the SI unit of density?

Answer

Density is defined as the mas per unit volume.

S.I Unit of density is kg/m^3

57 B. Question

Define relative density. What is the SI unit of relative density?

Answer

Relative density of a substance is the ratio of its density to that of water. Since, it's a ratio hence it do not contain any unit. It is a unit less quantity.

57 C. Question

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

Answer

Density of turpentine oil = 840kg/ m^3

Density of water = 1000kg/ m^3

Relative Density of turpentine oil = (Density of turpentine oil) / (Density of water)

= (840/ 1000) = 0.84

Hence, the relative density is 0.84

58 A. Question

Define Pressure.

Answer

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

58 B. Question

What is the relation between pressure, force and area?

Answer

The relation between pressure, force and area can be given by the expression:

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

58 C. Question

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

(i) 10 m^2 (ii) 5 m^2

Answer

(i) Force, f = 200 N

Pressure, p =?

Area, a =10

We know,

p = f/a

p = 200/10

p = 20 pa

(ii) Force, f = 200

Pressure, p =?

Area, a = 5

We know,

p = f/a

p = 200/5

p = 40 pa

59 A. Question

What are fluids? Name two common fluids.

Answer

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

59 B. Question

State Archimedes' principle.

Answer

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

59 C. Question

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

Answer

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.

60 A. Question

How does a boat float in water?

Answer

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.

60 B. Question

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

Volume, V= $12cm^3 = 12 \times 10^{-6}$

Mass, m = 96 g = 96 × 10^{-3}

We know,

Density, D = m/ V

(i) In g/cm^3

D = 96/12

= 8 g/cm^3

ii) In kg/m^3

D = 96 * 10^{-3} / 12 * 10^{-6}

= 8 * 10^3 kg/m^3

61. Question

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

(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

Weight of the elephant = 40000N

Area of 1 foot = 1000cm^2 = 0.1m^2

Weight of girl = 400N

Area of heel = 1cm^2 = 1 × 10^{-4} m^2

(a) Since, elephant has a larger weight therefore it exerts a larger force on the ground by 40000N - 400N = 39600N

(b) We know,

Pressure = Force/ Area

= 40000/ 0.1

= 400000N/m^2

(c) We know,

Pressure= Force/ Area

= 400/ 10^{-4}

=4000000N/m^2

(d) The girl exerts a larger pressure on the ground.

(e) Ratio = (Pressure exerted by the girl)/ (Pressure exerted by the elephant)

= 4000000/ 400000

= 10/1

Hence, the pressure exerted by the girl is 10 times the pressure exerted by the elephant.

Multiple Choice Questions (MCQs)-Pg-126

62. Question

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

Since, Archimedes' Principle states that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces and acts in the upward direction.

63. Question

A rectangular 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 from the base

B. The maximum pressure is exerted when length and height from 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

Since, the pressure exerted is inversely proportional to the area of the object.

64. Question

An object is put in three liquids having different densities, one by one. The object floats with $\frac{1}{9}, \frac{2}{11}$ and $\frac{3}{7}$ 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

According to the Archimedes' principle.

65. Question

A metal in which even iron can float is:

A. Sodium B. Magnesium

C. Mercury D. Manganese

Answer

Since, mercury is the only metal in liquid state and it has high density. In fact not only iron but many metals can float in it.

66. Question

For 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

According to Archimedes' principle.

67. Question

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

Since, lesser the density more the object will be submerged in the liquid.

68. Question

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 in kg/m^3 could be:

A. 850 B. 900

C. 950 D. 1050

Answer

According to the diagram.

69. Question

The density of water is 1000 kg/m^3 and the density of copper is 8900 kg/m^3. Which of the following statements is incorrect?

A. $\frac{\text{The density of a certain volume of copper}}{\text{The density of the same volume of water}} = 8.9$

B. $\frac{\text{The volume of a certain mass of copper}}{\text{The volume of the same mass of water}} = 8.9$

C. $\frac{\text{The weight of a certain volume of copper}}{\text{The weight of the same volume of water}} = 8.9$

D. $\frac{\text{The mass of a certain volume of copper}}{\text{The mass of the same volume of water}} = 8.9$

Answer

Since, the ration of volumes cannot be suspected.

70. Question

The diagram represents four measuring cylinders containing liquids. The mass and volume of the liquid in each cylinder are stated. Which two measuring cylinders could contain an identical liquid? (Picture)

A. W and X B. W and Y

C. X and Y D. X and Z

Answer

According to the diagram.

71. Question

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	8000	2	4000
B	2000	4	1000
C		4	2000
D			

Which object would float on water?

A. A

B. B

C. C

D. D

Answer

Since, D has a lesser density than the density of the water.

Questions Based on High Order Thinking Skills (HOTS)-Pg-127

72. Question

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 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.

73. Question

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 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.

74. Question

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. 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.

75. Question

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.

Answer

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.

76. Question

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 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.

77. Question

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.

Answer

(a) 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.

78. Question

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

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

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

79. Question

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, 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.

80. Question

A $\frac{1}{2}$ kg sheet of tin sinks in water but if the same sheet is converted into a box or boat, it floats. Why?

Answer

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.