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 = 6.7×10^{-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 = 6.7×10^{-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 $= 1.5 \times 10^{11}$ 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

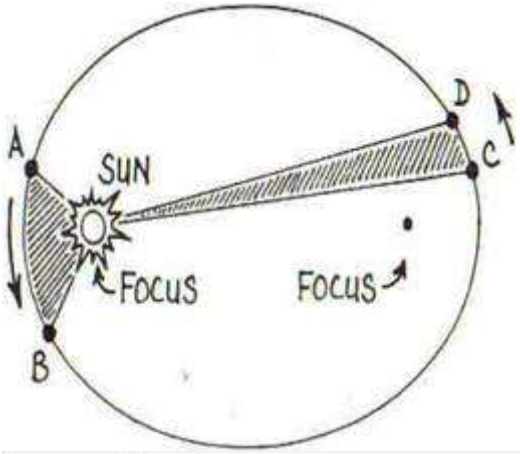
Kepler's first law: The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit. This law means that the orbit of a planet around the sun is an ellipse and not an exact circle. An elliptical path has two foci, and the sun is at one of the two foci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

$r^3 \alpha T^2$



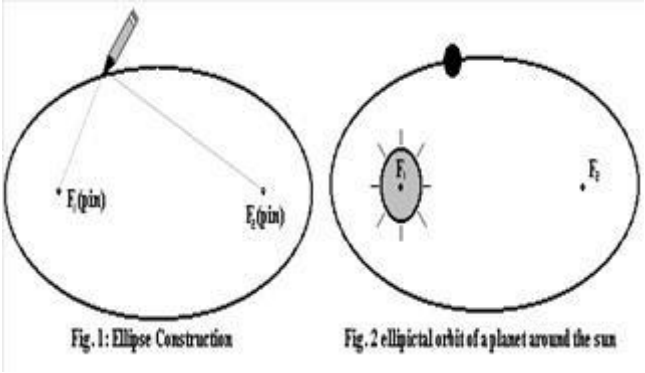


Fig. 1: Ellipse Construction

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.