Solution 31

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

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

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

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

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

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

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 .

Solution 32

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

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

Solution 33

(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.

Solution 34

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

Solution 35

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

m=50kg

M=120kg

Distance, d=10m

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

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

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

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

Solution 36

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

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

$F = 1472N$

Solution 37

Distance d=1.5 x 10^8 km= 1.5 x 10^{11} m
Mass of the sun, m=2 x10^{30} kg
Mass of the earth, M= 6 x 10^{24}kg

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

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

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

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

Solution 38
Initial velocity of the stone, u=?
Final velocity of stone, v=0
Acceleration due to gravity, g= -9.8m/s^2
Time, t=3 sec
Using relation, v=u + gt
0 = u -9.8 x 3
u =29.4m/s
Solution 39
Initial velocity,
u=0m/s
Acceleration due to
gravity, g=9.8m/s^2
Time taken to reach
the ground, t=2.5 sec
Height, h=?
Using relation,

Initial velocity, u=0m/s
Acceleration due to gravity, g=9.8m/s^2
Time taken to reach the ground, t=2.5 sec
Height, h=?
Using relation,

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

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

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

$$s = 30.625\ m$$

Solution 40
Height, s=20m
Initial velocity, u=0
Acceleration due to gravity, g=10m/s^2
Final velocity, v=?
Time taken, t=?
(i) Using relation,
(ii) For a freely falling body:
$v^2 = u^2 + 2gh$

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

(i) Using relation,

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

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

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

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

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

(ii) For a freely falling body:
$v^2 = u^2 + 2gh$
$= (0)^2 + 2 \times (10) \times (20)$
So, $v^2 = 400$

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

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

Solution 41
Initial velocity, u=20m/s
Final velocity, v=0
Acceleration due to gravity, g=-9.8m/s^2
Height, h=?
Using relation, for a freely falling body:
$v^2 = u^2 + 2gh$
$(0)^2 = (20)^2 + 2 \times (-9.8) \times h$

0-400 = -19.6 h
h= 400/19.6 = 20.4 m
Solution 42
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
Solution 43

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

Solution 44
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.
Page 102
Solution 45
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
Solution 46
Weight of the stone = Gravitational force acting on it = 20 N
Weight, W= m x g
20=m x 10
m=2 kg
Solution 47
(i) Its mass will be 20 kg as mass is a constant quantity.
(ii)Weight, W= m x g =20 x 1.6=32N
Solution 48
The mass of a body is more fundamental because mass of a body is constant and does not change from place to place.
Solution 49
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.
Solution 50
(a) The mass of a body is the quantity of matter contained in it. The SI unit of mass is kilogram (kg).
(b) The weight of a body is the force with which it is attracted towards the centre of the earth. The SI unit of weight is newton (N).
(c) Weight, W =m x g, i.e. the weight of a body is directly

proportional to its mass.

Solution 51

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

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

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

Sir Isaac Newton gave this law.

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

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

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

Sir Isaac Newton gave this law.

Solution 52

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

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

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

Solution 53

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

(b) Acceleration due to gravity,

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

Mass, M= 7.4×10^{22}kg

Radius, R = 1.74×10^6m

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

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

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

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

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

Solution 54

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.

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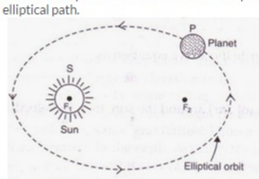
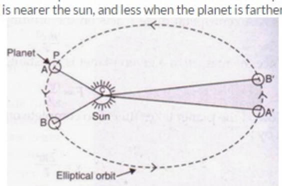


Kepler's Second law states that: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time. This means that a planet does not move with constant speed around the sun. The speed is greater when the planet is nearer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

$r^3 \alpha T^2$

Solution 55

Acceleration due to gravity,

Acceleration due to gravity,

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

Mass, M = 6x 10^{24}kg

Diameter = 12.8 x 10^3 km = 12.8 x 10^6 m

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

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

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

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

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

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

*********** END **********