NCERT Solutions Class 9 Science Chapter 9: NCERT Solutions Class 9 Science Chapter 9, "Gravitation," gives you an essential understanding of the ideas covered. Our comprehensive solutions and explanations in NCERT Solutions will aid in your clear comprehension of the ideas.

The intriguing subject of gravity explains a lot of phenomena, including why objects fall to the ground and how our planet maintains its orbit. Learn all there is to know about gravity by exploring NCERT Solutions Class 9 Science Chapter 9. Highly skilled educators and working professionals with decades of relevant experience provide the content. Additionally, these NCERT Solutions Class 9 Science Chapter 9 have been revised to incorporate the most recent information that the CBSE board has mandated.

NCERT Solutions Class 9 Science Chapter 9 Overview

NCERT Solutions Class 9 Science Chapter 9, "Gravitation," explores the fundamental principles of gravity that govern the motion of objects in the universe.

It begins by introducing the concept of gravitational force, explaining how every object with mass attracts every other object with a force that depends on their masses and the distance between them. The chapter covers Kepler's laws of planetary motion, which describe how planets move around the Sun in elliptical orbits.

NCERT Solutions Class 9 Science Chapter 9

Below we have provided NCERT Solutions Class 9 Science Chapter 9 for the ease of the students -

1. State the universal law of gravitation.

Solution:

According to the universal law of gravitation, all objects in the universe are drawn to all other objects by a force known as the gravitational force. The force between two objects is inversely proportional to the square of the distance between their centres and directly related to the product of their masses.

2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.

Solution:

Consider F as the force of attraction between an object on the surface of earth and the earth

Also, consider ‘m’ as the mass of the object on the surface of earth and ‘M’ as the mass of earth

The distance between the earth’s centre and object = Radius of the earth = R

Therefore, the formula for the magnitude of the gravitational force between the earth and an object on the surface is given as

$F = G Mm/R^2$

NCERT Solutions Class 9 Science Chapter 9 Exercise 10.2

1. What do you mean by free fall?

Solution:

Every item on Earth is drawn towards its centre by gravity. An object will start to descend to the Earth's surface when it is dropped from a specific height due to gravity. We refer to this type of item movement as free fall.

2. What do you mean by acceleration due to gravity?

Solution:

An object's velocity varies as it descends freely from a given height towards the surface of the earth. Acceleration caused by gravity, or "g," is the result of this change in velocity in the object.

On Earth, the acceleration caused by gravity is equal to

$$g = \frac{9.8m}{s^2}$$

NCERT Solutions Class 9 Science Chapter 9 Exercise 10.3

1. What are the differences between the mass of an object and its weight?

Solution:

The differences between the mass of an object and its weight are tabulated below.

Mass	Weight

Mass is the quantity of matter contained in the body.	Weight is the force of gravity acting on the body.
It is the measure of inertia of the body.	It is the measure of gravity.
It only has magnitude.	It has magnitude as well as direction.
Mass is a constant quantity.	Weight is not a constant quantity. It is different at different places.
Its SI unit is kilogram (kg).	Its SI unit is the same as the SI unit of force, i.e., Newton (N).

2. Why is the weight of an object on the moon 1/6th its weight on the earth?

Solution:

The moon has a radius of 1/4 and a mass of 1/100 that of Earth. Because of this, the moon's gravitational pull is around one-sixth that of Earth's. The mass and diameter of the moon determine its gravitational pull. As a result, an object's weight on the moon is one-sixth that of its weight on Earth. The moon has a different radius (R) than the Earth and is significantly less substantial than the planet.

NCERT Solutions Class 9 Science Chapter 9 Exercise 10.4

1. Why is it difficult to hold a school bag having a strap made of a thin and strong string?

Solution:

Because of the strain on the shoulders, carrying a school bag with a thin strap can be difficult. The area that the force acts on is directly correlated with the pressure. Therefore, the pressure on the surface will increase with decreasing surface area. The contact area is relatively tiny when using a thin strap. As a result, the shoulder is under a great deal of pressure.

2. What do you mean by buoyancy?

Solution:

The upward force possessed by a liquid on an object that’s immersed in it is referred to as buoyancy.

3. Why does an object float or sink when placed on the surface of water?

Solution:

There are two reasons why an object on the water's surface floats or sinks.

(i) An object sinks in water if its density is higher than that of water.

(ii) An object floats in water if its density is lower than that of water.

NCERT Solutions Class 9 Science Chapter 9 Exercise 10.5

1. You find your mass to be 42 kg on a weighing machine. Is your mass more or less than 42 kg?

Solution:

A weighing machine is calibrated to show mass and measures human weight. When we stand on a weighing machine, the air pushes upward and the weight acts downward. As a result, we appear to weigh less than we actually do. The weighing machine measures this perceived weight, hence the mass displayed is lower than the real mass. Thus, we will actually weigh more than 42 kg.

2. You have a bag of cotton and an iron bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than other. Can you say which one is heavier and why?

Solution:

The cotton bag weighs more than an iron bar, which is the right response. The cotton bag weighs more than the iron bar. The air thrust on the cotton bag is greater than that of the iron bar. As a result, the weighing machine gives the cotton bag a lower weight reading than it actually does. The explanation is

True weight = (apparent weight + up thrust)

Since the density of the cotton bag is lower than that of the iron bar, it has a larger volume than the latter. Because of the air, the cotton bag experiences greater upthrust.

As a result, the true weight of the cotton bag is greater than the true weight of the iron bar when air is present.

NCERT Solutions Class 9 Science Chapter 9 Exercise 10.6

1. How does the force of gravitation between two objects change when the distance between them is reduced to half?

Solution:

Consider the Universal law of gravitation,

According to that law, the force of attraction between two bodies is

$$F = \frac{(Gm_1m_2)}{r^2}$$

Where,

m_1 and m_2 are the masses of the two bodies.

G is the gravitational constant.

r is the distance between the two bodies.

Given that the distance is reduced to half then,

r = 1/2 r

Therefore,

$$F = \frac{(Gm_1m_2)}{r^2}$$

$$F = \frac{(Gm_1m_2)}{(r/2)^2}$$

$$F = \frac{(4Gm_1m_2)}{(r)^2}$$

F = 4F

Therefore, once the space between the objects is reduced to half, then the force of gravitation will increase by fourfold the first force.

2. Gravitational force acts on all objects in proportion to their masses. Why then does a heavy object not fall faster than a light object?

Solution:

Acceleration due to gravity (g) is the constant acceleration that all objects experience as they descend from the top. Since this is constant on Earth, the value of "g" is independent of an

object's mass. Therefore, if there is no air resistance, heavier items do not fall faster than lighter ones.

3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is 6×10^{24} kg and radius of the earth is 6.4×10^{6}m.)

Solution:

From Newton's law of gravitation, we know that the force of attraction between the bodies is given by

$$F = \frac{(Gm_1m_2)}{r^2}$$

Here

m_1 = mass of Earth = 6.0×10^{24}kg

m_2 = mass of the body = 1kg

r = distance between the two bodies

Radius of Earth = 6.4×10^{6}m

G = Universal gravitational constant = 6.67×10^{-11} Nm^2kg^{-2}

By substituting all the values in the equation

$$F = \frac{(Gm_1m_2)}{r^2}$$

$$F = \frac{6.67 \times 10^{-11} \quad (6.0 \times 10^{24} \times 1)}{(6.4 \times 10^{6})^2}$$

F = 9.8 N

This shows that Earth exerts a force of 9.8 N on a body of mass 1 kg. The body will exert an equal force of attraction of 9.8 N on the Earth.

4. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth? Why?

Solution:

The earth attracts the moon with a force same as the force with which the moon attracts the earth. However, these forces are in opposite directions. By universal law of gravitation, the force between moon and also the sun can be

$$F = \frac{(Gm_1m_2)}{d^2}$$

Where,

d = distance between the earth and moon.

m_1 and m_2 = masses of earth and moon respectively.

5. If the moon attracts the earth, why does the earth not move towards the moon?

Solution:

We all know that the force of attraction between two things is the same, but it is directed in the opposite direction, according to Newton's third law and the universal law of gravity. Thus, although in different directions, the earth and moon are attracted to each other by the same force. The earth accelerates towards the moon at a slower rate than the moon does because the earth is heavier than the moon. The earth does not move in the direction of the moon as a result.

6. What happens to the force between two objects, if

(i) The mass of one object is doubled?

(ii) The distance between the objects is doubled and tripled?

(iii) The masses of both objects are doubled?

Solution:

(i)

According to universal law of gravitation, the force between 2 objects (m_1 and m_2) is proportional to their plenty and reciprocally proportional to the sq. of the distance(R) between them.

$$F = \frac{(G2m_1m_2)}{R^2}$$

If the mass is doubled for one object.

F = 2F, so the force is also doubled.

(ii)

If the distance between the objects is doubled and tripled

If it’s doubled

Hence,

$F = (Gm_1m_2)/(2R)^2$

$F = 1/4\ (Gm_1m_2)/R^2$

$F = F/4$

Force thus becomes one-fourth of its initial force.

Now, if it's tripled

Hence,

$F = (Gm_1m_2)/(3R)^2$

$F = 1/9\ (Gm_1m_2)/R^2$

$F = F/9$

Force thus becomes one-ninth of its initial force.

(iii)

If masses of both the objects are doubled, then

$$F = \frac{(G2m_1 2m_2)}{R^2}$$

F = 4F, Force will therefore be four times greater than its actual value.

7. What is the importance of universal law of gravitation?

Solution:

A great deal of previously unrelated phenomena can be explained by the universal law of gravitation:

(i) The lunar orbit around the Earth

(ii) Gravity's responsibility for the body's weight, which holds us on the earth

(iii) The tides as a result of the Sun and moon

(iv) The planets' orbits around the Sun

8. What is the acceleration of free fall?

Solution:

The acceleration that an item experiences as a result of gravity is known as acceleration due to gravity. All bodies on Earth are subject to a downward gravitational force because of the mass of the planet. The acceleration of things falling freely is a measure of Earth's gravity. Gravity, represented by the letter "g," accelerates at a rate of 9.8 ms-2 at the surface of the Earth. Consequently, an object's speed rises by roughly 9.8 metres per second for every second it is in free fall.

9. What do we call the gravitational force between the earth and an object?

Solution:

The gravitation force between the earth and an object is called weight. Weight is equal to the product of acceleration due to the gravity and mass of the object.

10. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [Hint: The value of g is greater at the poles than at the equator.]

Solution:

The weight of a body on the earth's surface;

W = mg (where m = mass of the body and g = acceleration due to gravity)

The value of g is larger at poles when compared to the equator. So gold can weigh less at the equator as compared to the poles.

Therefore, Amit's friend won't believe the load of the gold bought.

11. Why will a sheet of paper fall slower than one that is crumpled into a ball?

Solution:

The surface area of a crumpled paper ball is smaller than that of a sheet of paper. There will be a lot of air resistance for a sheet of paper. A piece of paper falls slower than a ball that has crumpled as a result.

12. Gravitational force on the surface of the moon is only 1/6 as strong as gravitational force on the earth. What is the weight in newton's of a 10 kg object on the moon and on the earth?

Solution:

Given data:

Acceleration due to earth's gravity = g_e or g = 9.8 m/s^2

Object's mass, m = 10 kg

Acceleration due to moon gravity = g_m

Weight on the earth= W_e

Weight on the moon = W_m

Weight = mass x gravity

$g_m = (1/6)\ g_e$ (given)

So $W_m = m\ g_m = m \times (1/6)\ g_e$

$W_m = 10 \times (1/6) \times 9.8 = 16.34$ N

$W_e = m \times g_e = 10 \times 9.8$

$W_e = 98$N

13. A ball is thrown vertically upwards with a velocity of 49 m/s.

Calculate

(i) The maximum height to which it rises,

(ii) The total time it takes to return to the surface of the earth.

Solution:

Given data:

Initial velocity u = 49 m/s

Final speed v at maximum height = 0

Acceleration due to earth gravity g = -9.8 m/s^2 (thus negative as ball is thrown up).

By third equation of motion,

$2gH = v^2 - u^2$

$2 \times (-9.8) \times H = 0 - (49)^2$

$-19.6\ H = -2401$

$H = 122.5$ m

Total time T = Time to ascend (T_a) + Time to descend (T_d)

$v = u + gt$

$0 = 49 + (-9.8) \times T_a$

$Ta = (49/9.8) = 5$ s

Also, $T_d = 5$ s

Therefore $T = T_a + T_d$

$T = 5 + 5$

$T = 10$ s

14. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.

Solution:

Given data:

Initial velocity

$u = 0$

Tower height = total distance = 19.6m

$g = 9.8$ m/s^2

Consider third equation of motion

$v^2 = u^2 + 2gs$

$v^2 = 0 + 2 \times 9.8 \times 19.6$

$v^2 = 384.16$

$v = \sqrt{(384.16)}$

$v = 19.6$m/s

15. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?

Solution:

Given data:

Initial velocity u = 40m/s

g = 10 m/s^2

Max height final velocity = 0

Consider third equation of motion

$v^2 = u^2 – 2gs$ [negative as the object goes up]

$0 = (40)^2 – 2 \times 10 \times s$

s = (40 x 40) / 20

Maximum height s = 80m

Total Distance = s + s = 80 + 80

Total Distance = 160m

Total displacement = 0 (The first point is the same as the last point)

16. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6×10^{24} kg and of the Sun = 2×10^{30} kg. The average distance between the two is 1.5×10^{11} m.

Solution:

Given data:

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

Mass of the earth $m_e = 6 \times 10^{24}$ kg

Gravitation constant G = 6.67 x 10^{-11} N m^2/ kg^2

Average distance $r = 1.5 \times 10^{11}$ m

Consider Universal law of Gravitation

$$F = \frac{(Gm_1m_2)}{d^2}$$

$$F = \frac{(6.67 \times 10^{-11} \times 6 \times 10^{24} \times 2 \times 10^{30})}{(1.5 \times 10^{11})^2}$$

$F = 3.56 \times 10^{22}$ N

17. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.

Solution:

Given data:

(i) When the stone from the top of the tower is thrown,

Initial velocity u' = 0

Distance travelled = x

Time taken = t

Therefore,

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

$x = 0 + (1/2)\ gt^2$

$x = 5t^2$ ---------(a)

(ii) When the stone is thrown upwards,

Initial velocity u = 25 m/s

Distance travelled = (100 – x)

Time taken = t

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

$(100 - x) = 25t - (1/2) \times 10 \times t^2$

$x = 100 - 25t + 5t^2$ ------- (b)

From equations (a) and (b)

$5t^2 = 100 - 25t + 5t^2$

$t = (100/25) = 4sec.$

After 4sec, two stones will meet

From (a)

$x = 5t^2 = 5 \times 4 \times 4 = 80m.$

Putting the value of x in (100-x)

$= (100-80) = 20m.$

This means that after 4sec, 2 stones meet a distance of 20 m from the ground.

18. A ball thrown up vertically returns to the thrower after 6 s. Find

(a) The velocity with which it was thrown up,

(b) The maximum height it reaches, and

(c) Its position after 4s.

Solution:

Given data:

$g = 10m/s^2$

Total time T = 6sec

$T_a = T_d = 3sec$

(a) Final velocity at maximum height v = 0

From first equation of motion:-

$v = u - gt_a$

$u = v + gt_a$

$= 0 + 10 \times 3$

$= 30m/s$

The velocity with which stone was thrown up is 30m/s.

(b) From second equation of motion

$$s = ut_a - \frac{1}{2}g(t_a)^2$$
$$= 30 \text{ x } 3 - (1/2) \text{ x } 10 \text{ x } (3)^2$$
$$= 90\text{-}45 = 45\text{m}$$

The maximum height stone reaches is 45m.

(c) In 3sec, it reaches the maximum height.

Distance travelled in another 1sec = s'

$$s = ut_a - \frac{1}{2}g(t_a)^2$$
$$s = 0 + 10 \text{ x } 1 \text{ x } 1$$
$$s = 5\text{m}.$$

The distance travelled in another 1sec = 5m.

Therefore in 4sec, the position of point p (45 – 5)

= 40m from the ground.

19. In what direction does the buoyant force on an object immersed in a liquid act?

Solution:

The buoyant force on an object that is immersed in a liquid will be in a vertically upward direction.

20. Why a block of plastic when released under water come up to the surface of water?

Solution:

Water has a higher density than plastic does. Consequently, the buoyancy force exerted on the plastic block will surpass its weight. Therefore, the plastic block will accelerate in an upward direction. The plastic block therefore reaches the water's surface.

21. The volume of 50 g of a substance is 20 cm^3. If the density of water is 1 g cm^{-3}, will the substance float or sink?

Solution:

To find the Density of the substance the formula is

Density = (Mass/Volume)

Density = (50/20) = 2.5g/cm^3

Density of water = 1g/cm^3

Density of the substance is greater than density of water. So the substance will sink.

22. The volume of a 500 g sealed packet is 350 cm^3. Will the packet float or sink in water if the density of water is 1 g cm^{-3}? What will be the mass of the water displaced by this packet?

Solution:

Density of sealed packet = 500/350 = 1.42 g/cm^3

Density of sealed packet is greater than density of water

Therefore the packet will sink.

Considering Archimedes Principle,

Displaced water volume = Force exerted on the sealed packet.

Volume of water displaced = 350cm^3

Therefore displaced water mass = ρ x V

= 1 × 350

Mass of displaced water = 350g.

Benefits of NCERT Solutions Class 9 Science Chapter 9

NCERT Solutions for Class 9 Science Chapter 9 on Gravitation offer several benefits to students:

Conceptual Clarity: The NCERT Solutions Class 9 Science Chapter 9 provide clear explanations of fundamental concepts such as gravitational force, gravitational field, and Kepler's laws of planetary motion. This helps students develop a strong conceptual understanding of gravity and its effects.

Problem-Solving Skills: By solving the NCERT exercises and problems, students enhance their ability to apply theoretical knowledge to numerical problems involving gravitational force, gravitational potential, and orbital motion.

Exam Preparation: NCERT Solutions Class 9 Science Chapter 9 are aligned with the CBSE curriculum, making them highly relevant for exam preparation. Students can familiarize themselves with the types of questions likely to appear in exams and practice answering them effectively.

Comprehensive Coverage: The solutions cover all topics and subtopics of Chapter 9 comprehensively. This ensures that students don't miss any important concept or formula required for exams.