

**CBSE Class 9 Science Notes Chapter 10:** In CBSE Class 9 Science, Chapter 10 is all about Gravitation. It's about how things with mass pull each other. Sir Isaac Newton's law of universal gravitation is a big part of this chapter.

It says that everything in the universe attracts everything else. The strength of this pull depends on the mass of the objects and the distance between them. We also learn about things like how gravity affects the movement of planets, moons, and satellites.

The chapter explains concepts like acceleration due to gravity, gravitational potential energy, and the difference between mass and weight. By studying this chapter, students get to understand how gravity works and how it affects things on Earth and in space.

## **CBSE Class 9 Science Notes Chapter 10 Gravitation Overview**

These notes about Chapter 10 Gravitation in CBSE Class 9 Science are made by subject experts at Physics Wallah. Gravitation is all about how things with mass attract each other. The notes explain Sir Isaac Newton's law of universal gravitation, which says that every object pulls on every other object. They cover basic ideas like what gravitational force is, how things accelerate due to gravity, and what gravitational potential energy is.

You'll also learn about the difference between mass and weight, and how gravity affects planets, moons, and satellites. These notes are made to help you understand gravity better and its role in the universe.

## **CBSE Class 9 Science Notes Chapter 10 PDF**

You can find the notes for Chapter 10 Gravitation in CBSE Class 9 Science by clicking on the provided link to the PDF. These notes explain the basics of gravity, which is how objects with mass attract each other.

**CBSE Class 9 Science Notes Chapter 10 PDF**

## **CBSE Class 9 Science Notes Chapter 10 Gravitation**

### **Introduction to Gravitation**

Gravitation, often referred to simply as gravity, is the fundamental force of attraction that exists between any two objects with mass. This chapter delves into the Universal Law of Gravitation, which provides insights into how this force operates in the universe. At its core, gravitation

governs the motion of celestial bodies, shapes the orbits of planets around the sun, and influences various phenomena observed on Earth.

## Understanding Gravitation

Gravitation is omnipresent, exerting its influence on every object in the universe. Despite its pervasive nature, the force of gravity is often imperceptible in everyday experiences due to the vast distances separating most objects and the relatively weak strength of the force. However, its effects become evident when considering significant celestial bodies like planets, moons, and stars.

## Key Concepts of Gravitation

The Universal Law of Gravitation, formulated by Sir Isaac Newton, serves as the cornerstone of our understanding of gravity. According to this law, every object in the universe attracts every other object with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. This law not only explains the gravitational interactions between celestial bodies but also sheds light on the behavior of objects on Earth under the influence of gravity.

## Type of Forces

In the vast expanse of the universe, there exist four fundamental forces, each playing a crucial role in shaping the dynamics of matter and energy. Understanding these forces provides profound insights into the workings of the cosmos and the interactions between particles at various scales.

**Gravitational Force:** Gravitational force, often regarded as the weakest among the four fundamental forces, exerts a pervasive influence on all objects with mass. This force, described by Sir Isaac Newton's law of universal gravitation, attracts every object to every other object with a strength that depends on their masses and the distance between them.

While gravity may seem weak in everyday experiences, its effects become significant when considering massive celestial bodies like stars, planets, and galaxies. On an atomic scale, gravitational force is relatively negligible compared to the other forces.

**Electromagnetic Force:** The electromagnetic force is a fundamental interaction that arises between electrically charged particles. It is a composite force, encompassing both electrical and magnetic components.

This force governs the interactions between charged particles, such as electrons and protons, and manifests as attractive or repulsive depending on the nature of the charges involved.

Electromagnetic force plays a pivotal role in phenomena ranging from the bonding of atoms in molecules to the propagation of light and the functioning of electronic devices.

**Strong Nuclear Force:** The strong nuclear force, aptly named for its immense strength, is responsible for binding quarks together to form particles like protons and neutrons, which constitute the atomic nucleus.

It acts to bind protons and neutrons within the nucleus, overcoming the repulsive electromagnetic forces between positively charged protons. Without the strong nuclear force, atomic nuclei would not be stable, and the universe as we know it would cease to exist.

**Weak Nuclear Force:** The weak nuclear force operates at the subatomic level, mediating interactions between elementary particles with a low probability of occurrence.

While relatively weak compared to the other fundamental forces, the weak force plays a critical role in processes such as beta decay, where a neutron transforms into a proton, emitting an electron (beta particle) and a neutrino. This force contributes to the stability of atomic nuclei and governs certain fundamental processes in particle physics.

## The Universal Law of Gravitation

Proposed by Sir Isaac Newton in the 17th century, the Universal Law of Gravitation stands as one of the foundational principles in physics, offering profound insights into the gravitational interactions governing celestial bodies and everyday objects alike.

Newton's law succinctly articulates the nature of gravitational force between any two objects with mass. According to this law, every object in the universe attracts every other object with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. In mathematical terms, this can be expressed as:

$$F = G \cdot \frac{m_1 \cdot m_2}{r^2}$$

where:

- $F$  represents the gravitational force between the two objects,
- $m_1$  and  $m_2$  denote the masses of the two objects involved,
- $r$  signifies the distance between their centers of mass, and
- $G$  is the universal gravitational constant.

The Universal Gravitational Constant, denoted by  $G$ , serves as a fundamental constant in physics, representing the strength of the gravitational force between objects with mass. Its value is approximately  $6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$ . This constant encapsulates the inherent property of gravitational attraction that exists universally throughout the cosmos.

The implications of Newton's law are profound, extending from the motion of celestial bodies to the everyday experiences of objects on Earth's surface. It explains the gravitational pull that keeps planets in orbit around the sun, moons revolving around planets, and satellites circling the Earth. Additionally, it elucidates why objects fall toward the Earth's surface when released from a certain height, attributing this phenomenon to the gravitational attraction between the object and the Earth.

## Acceleration due to gravity

Acceleration due to gravity, denoted by  $g$ , represents the acceleration experienced by an object when it falls freely under the influence of Earth's gravitational pull. This fundamental quantity plays a crucial role in various physical phenomena, ranging from the motion of projectiles to the dynamics of celestial bodies.

Newton's Universal Law of Gravitation provides a framework for calculating the acceleration due to gravity. By applying this law to the gravitational interaction between an object and the Earth, we can derive an expression for the acceleration experienced by the object.

Using the formula for gravitational force  $F = G \cdot \frac{m \cdot M}{r^2}$ , where  $G$  is the universal gravitational constant,  $m$  is the mass of the object,  $M$  is the mass of the Earth, and  $r$  is the distance between the object and the center of the Earth, we can determine the acceleration due to gravity.

When the object is near the Earth's surface,  $r$  is approximately equal to the radius of the Earth, denoted by  $R$ . Hence, the formula for acceleration due to gravity becomes:

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

By substituting the given values of  $G$ ,  $M$ , and  $R$ , we can calculate the value of  $g$ . For instance, plugging in  $G = 6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$ ,  $M = 6 \times 10^{24} \text{ kg}$ , and  $R = 6 \times 10^6 \text{ m}$ , we find that  $g$  is approximately  $9.8 \text{ m/s}^2$ .

This value represents the standard acceleration due to gravity on the Earth's surface and is commonly used in physics calculations. It signifies the rate at which an object accelerates toward the Earth when falling freely under the influence of gravity.

It's important to note that the value of  $g$  may vary slightly depending on factors such as altitude and latitude due to variations in the Earth's radius and shape. However, for most practical purposes,  $g$  is considered to be approximately  $9.8 \text{ m/s}^2$  near the Earth's surface.

## The Moon's Falling – Moon's Revolution around Earth

The moon's orbit around the Earth is a result of the gravitational force between the two bodies. This force acts as a centripetal force, continually pulling the moon towards the Earth and preventing it from moving off in a straight line tangent to its orbit. If this gravitational force were to suddenly vanish, the moon would no longer experience the centripetal force and would follow a straight-line path tangential to its orbit, eventually drifting away from the Earth.

## Centripetal force

The concept of centripetal force is crucial to understanding circular motion. When an object moves in a circular path, it experiences an inward force directed toward the center of the circle. This force, known as the centripetal force, keeps the object moving along its circular trajectory. Mathematically, the centripetal force is given by the equation:

$$F_c = mv^2/r$$

where  $F_c$  is the centripetal force,  $m$  is the mass of the object,  $v$  is its velocity, and  $r$  is the radius of the circular path.

## Free Fall and Motion

During free fall, objects experience a constant acceleration due to gravity, denoted by  $g$ , which is approximately  $9.8 \text{ m/s}^2$  near the Earth's surface. Importantly, this acceleration is independent of the object's mass. Thus, whether an object is large or small, it will experience the same acceleration due to gravity when falling freely.

## Weight and Mass

The concepts of weight and mass are fundamental to understanding the behavior of objects in the universe. While often used interchangeably in everyday language, they represent distinct properties of matter.

Mass refers to the measure of an object's inertia, representing the amount of matter contained within it. Importantly, the mass of an object remains constant regardless of its location in the universe. Whether on Earth, the moon, or in deep space, an object's mass remains the same.

Weight, on the other hand, is the force of gravity acting on an object. It varies depending on the strength of the gravitational field at the object's location. The weight of an object is given by the equation:

$$\text{Weight} = m \cdot g$$

where  $m$  is the mass of the object and  $g$  is the acceleration due to gravity. Since  $g$  varies depending on the celestial body and its distance from the center of mass, the weight of an

object can change accordingly. For example, the weight of an object on the moon is approximately one-sixth of its weight on Earth due to the moon's weaker gravitational pull.

## **Thrust and Pressure**

Thrust is the force exerted on an object perpendicular to its surface. It depends on both the magnitude and direction of the force applied. The effect of thrust is influenced by the area of contact between the object and the surface. Pressure, on the other hand, is defined as thrust per unit area. It quantifies the force applied over a specific area and is measured in pascals (Pa).

When a force acts on a smaller area, it applies more pressure compared to the same force acting on a larger area. This principle finds applications in various fields, including engineering, fluid mechanics, and aerodynamics.

## **Pressure in Fluids and Archimedes' Principle**

In fluids, pressure is exerted uniformly in all directions, transmitting force to the walls of the container. This principle holds true for both liquids and gases, with the pressure exerted depending on factors such as depth, density, and gravitational acceleration.

Archimedes' Principle elucidates the behavior of objects immersed in fluids. It states that when an object is submerged in a fluid, it experiences an upward force known as buoyant force or upthrust. The magnitude of this force is equal to the weight of the fluid displaced by the object. Consequently, objects with densities less than the fluid float, while those with densities greater than the fluid sink.

## **Relative Density**

Relative density, also known as specific gravity, compares the density of a substance to the density of water. It is calculated as the ratio of the density of the substance to the density of water. This concept finds applications in various fields, including materials science, chemistry, and geology, where it helps characterize and classify substances based on their densities relative to water.

## **The Story of Gravity – Introduction to Gravitation: Kepler's Laws**

In astronomy, Kepler's laws of planetary motion provide fundamental insights into the motion of planets around the sun. These laws describe the elliptical orbits of planets, the equal area law (which states that the line joining a planet and the sun sweeps equal areas in equal times), and the relationship between a planet's orbital period and its distance from the sun. Kepler's laws

laid the groundwork for our understanding of celestial mechanics and revolutionized our perception of the solar system.

## **Benefits of CBSE Class 9 Science Notes Chapter 10 Gravitation**

- **Conceptual Understanding:** The notes provide a detailed overview of the principles of gravitation, helping students grasp the fundamental concepts underlying this natural phenomenon.
- **Clarity of Concepts:** By breaking down complex topics into simpler explanations, the notes enhance clarity and facilitate better understanding among students, ensuring they comprehend the principles of gravitational force, acceleration due to gravity, and other related concepts.
- **Structured Learning:** The notes follow a structured format, organized according to the syllabus, making it easier for students to navigate and study systematically. This structured approach aids in effective revision and exam preparation.
- **Exam Preparation:** With concise summaries, key points, and practice questions, the notes assist students in preparing for examinations, enabling them to revise important concepts efficiently and effectively.