

Gravitation Class 9 CBSE Notes - Chapter 10

Introduction to Gravitation

This chapter discusses gravitation and the universal law of gravitation. The motion of objects under the influence of gravitational force on Earth is also examined closely. Students will also understand how weight varies from place to place and the conditions required for objects to float on water.

What is Gravitation?

Gravitation or just gravity is the force of attraction between any two bodies. All the objects in the universe attract each other with a certain amount of force, but in most cases, the force is too weak to be observed due to the very large distance of separation. Besides, gravity's range is infinite but the effect becomes weaker as objects move away.

Type of forces

There are four fundamental forces in the universe and they are:

- Gravitational force
- Electromagnetic force
- Strong nuclear force
- Weak nuclear force

Gravitational Force

Gravitational force is the weakest force out of the four forces. When gravitational force is considered for massive objects, such as the sun, or giant planets, the gravitational force is considered to be strong as the masses of these objects are also large. On an atomic level, this force is considered weak.

Electromagnetic Force

The electromagnetic force is a type of physical interaction that occurs between electrically charged particles. It acts between charged particles and is the combination of magnetic and electrical forces. The electromagnetic force can be attractive or repulsive.

Strong Nuclear Force

The strong force holds together quarks, the fundamental particles that make up the protons and neutrons of the atomic nucleus, and further holds together protons and neutrons to form atomic nuclei.

Weak Nuclear Force

The weak force is the force existing between the elementary particles which are responsible for certain processes to take place at a low probability.

The Universal Law of Gravitation

Newton's Law of gravitation states that every object in the universe attracts every other object by a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Some examples of gravity are:

- The force that causes the ball to come down is known as gravity
- Gravity keeps the planets in orbit around the sun.
- Gravity is the force that causes a rock to roll downhill.

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$$\Rightarrow F \propto M * g$$

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

$$F = G \frac{Mm}{r^2}$$

where G is the universal gravitation constant.

Value of G = $6.673 \times 10^{-11} \text{Nm}^2\text{Kg}^{-2}$

To know more about the Universal Law of Gravitation, [visit here](#).

Acceleration due to Gravity

$$F = mg$$

and also,

$$F = G \frac{Mm}{R^2}$$

$$g = G \frac{Mm}{R^2}$$

Plug the values of G ($6.673 \times 10^{-11} \text{Nm}^2\text{Kg}^{-2}$)

M(mass of Earth) = $6 \times 10^{24} \text{kg}$ and R = $6 \times 10^6 \text{m}$, to get the value of gas $\approx 9.8 \text{ms}^{-2}$

This is the acceleration due to gravity and the acceleration felt by any freely falling body towards the Earth.

The value of g keeps changing due to the variation of Earth's radius.

To know more about Acceleration due to Gravity, [visit here](#).

The Moon's Falling – Moon's revolution around Earth

The moon revolves around the Earth due to centripetal force, which is the force of gravity of the Earth. If the force of attraction between the Earth and the moon ceases, then the moon will continue to travel in a straight line path tangential to its orbit around the Earth.

Centripetal force

When a body undergoes circular motion, it experiences a force that acts towards the centre of the circle. This centre-seeking force is called a centripetal force. Centripetal force is given by the following equation:

$$F = \frac{mv^2}{r}$$

To know more about Centripetal Force, [visit here](#).

Free Fall and Motion

When an object is under free fall, acceleration due to gravity is constant at $g = 9.8\text{ms}^{-2}$.

The value of g does not depend on mass i.e any object big or small experiences the same acceleration due to gravity under free fall. All three equations of motion are valid for freely falling objects as it is under uniform motion.

The sign of convention $\rightarrow$ towards earth g is +ve / away from earth g is -ve.

To know more about Free Fall, [visit here](#).

Weight and Mass

The mass of an object is the measure of its inertia and is constant throughout the universe. The weight of an object keeps changing as the value of g changes. Weight is nothing but a force of attraction of the Earth on an object and is given by the following equation:

$$W = mg$$

The weight of an object on the Moon is $1/6$ times the weight on Earth.

To know more about Weight and Mass, [visit here](#).

Thrust and Pressure

Force acting on an object perpendicular to the surface is called thrust. The effect of thrust depends on the area of contact. The pressure is thrust per unit area. SI unit is the pascal (Pa). Force acting on a smaller area applies more pressure than the same force acting on a larger area.

To know more about Thrust and Pressure, [visit here](#).

Pressure in fluids

The pressure exerted by a fluid in a container is transmitted undiminished in all directions on the walls of the container.

Archimedes' Principle – Why objects float or sink

The upward force exerted by a fluid on an object is known as upthrust or buoyant force.

The magnitude of buoyancy depends on the density of the fluid. If the density of an object is less than the fluid, it will float. If the density of the object is greater than the fluid, it will sink.

According to Archimedes' principle, when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

Relative Density

Relative density = Density of a substance/ Density of water

To know more about Relative Density, [visit here](#).

The Story of Gravity – Introduction to Gravitation: Kepler's laws

In astronomy, Kepler's laws of planetary motion are three scientific laws describing the motion of planets around the sun.

- Kepler's first law – The law of orbits
- Kepler's second law – The law of equal areas
- Kepler's third law – The law of periods

The orbit of a planet is an ellipse with the sun as its foci. The line joining the planets and the sun sweeps equal areas in equal intervals of time.

Cube of a mean distance of a planet from the sun $\propto$ Square of orbital time period T.

$$r^3 \propto T^2$$

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Frequently Asked Questions on CBSE Class 9 Science Notes Chapter 10: Gravitation

What is gravity?

Gravity is a natural phenomenon by which all masses and energy are attracted to one another and to Earth.

What is relative density?

The ratio of the density of a substance to the density of a standard substance under specified conditions.

What is meant by free fall?

When an object falls under the sole influence of gravity, the object is said to be under 'free fall'.

