



Chapter 1: Gravitation

Science & Technology Part 1 / Maharashtra SSC Board

Complete Board Exam Notes – Easy Language



What's Inside These Notes?

1. What is Gravitation?
2. Circular Motion & Centripetal Force
3. Kepler's Three Laws of Planetary Motion
4. Newton's Universal Law of Gravitation
5. Derivation: Relation between g and G
6. Acceleration due to Gravity (g)
7. Variation of ' g ' (Height, Depth, Shape)
8. Mass vs Weight (with Table)
9. Free Fall (with Solved Numericals)
10. Gravitational Potential Energy
11. Escape Velocity
12. 🌟 Board Exam Cheat Sheet & Memory Tricks

💡 **Study Tip:** Read these notes like a story. Every concept is explained so simply that even a 6th class student can understand it. All formulas are highlighted in **orange boxes**. All important definitions are in **yellow boxes**.

🌟 Total Pages: 14 🌟

1. What is Gravitation? 🤔

Definition: The force of attraction between any two objects in the universe is called **gravitational force**. This phenomenon is called **gravitation**.

In Simple Words: Have you ever wondered why:

- 🍎 An apple falls DOWN when you drop it?
- 🌍 The Moon goes around the Earth instead of flying away?
- ☀️ The Earth goes around the Sun?

The answer is: Because of an **invisible pulling force** called **Gravitation**!

Every single thing in the universe – from a tiny ant to a giant star – pulls every other thing towards itself. You are pulling your chair, your chair is pulling you! But because you both are very light compared to the Earth, you don't feel it.

⚠️ **Remember:** Gravity and Gravitation are slightly different!

- **Gravitation** = Force between ANY two objects in the universe.
- **Gravity** = The special case when one of the objects is the **Earth**.

2. Circular Motion 🎡

Definition: When an object moves along a circular path with a **constant speed**, its motion is called **Uniform Circular Motion (UCM)**.

Simple Example: Think of a fan blade spinning, or a stone tied to a string whirled in a circle. The stone moves at the same speed, but its **direction keeps changing** at every point!

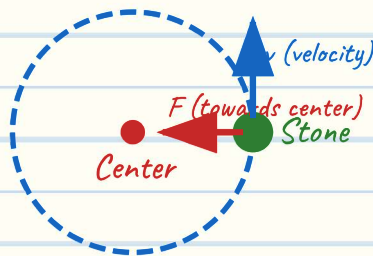
⚠️ **Tricky Point (Board loves this!):** In UCM, the **speed is constant** but the **velocity is NOT constant**. Why? Because **velocity = speed + direction**. Since direction keeps changing, velocity changes. And if velocity changes → there is **acceleration**!

3. Centripetal Force

Definition: The force that acts on an object moving in a circular path and is directed towards the center of the circle is called **Centripetal Force**. ("Centripetal" means "center-seeking")

Simple Example: Imagine you tie a stone to a rope and spin it around your head. Your hand keeps pulling the rope inward (towards the center). That inward pull = Centripetal Force!

If you let go of the string, the stone flies away in a straight line (tangent). This proves that centripetal force is **NEEDED** to keep circular motion going.



↑ Centripetal Force points **INWARD**, Velocity is always **TANGENT**

Formula for Centripetal Force:

$$F = mv^2 / r$$

- **F** = Centripetal Force (in Newtons, N)
- **m** = Mass of the object (in kg)
- **v** = Speed of the object (in m/s)
- **r** = Radius of the circular path (in m)



Real Life Examples of Centripetal Force:

-  Car turning on a curved road → friction provides centripetal force.
-  Earth orbiting the Sun → gravity provides centripetal force.
-  Moon orbiting the Earth → gravity provides centripetal force.

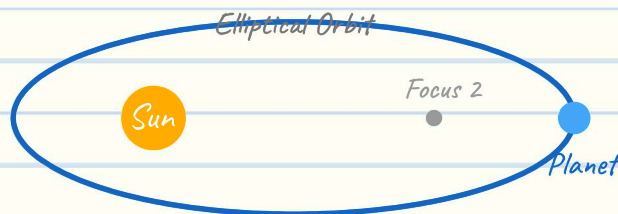
4. Kepler's Laws of Planetary Motion 🪐

A scientist named *Johannes Kepler* studied how planets move and gave 3 important laws.

Law 1: Law of Orbits 🌐

Statement: The orbit of a planet is an **ellipse** (oval shape) with the **Sun at one of its foci**.

Simple Words: Planets don't go in a perfect circle. They go in a slightly squashed circle called an ellipse. The Sun is not exactly in the middle – it's off to one side!



Law 2: Law of Areas 📐

Statement: The line joining a planet and the Sun sweeps **equal areas in equal intervals of time**.

Simple Words: Imagine a string from the Sun to a planet. As the planet moves, it "paints" an area. The planet paints equal sized areas in equal time.

This means: Planet is **closer to Sun** → **moves FASTER**. Farther from Sun → **moves SLOWER**.



Law 3: Law of Periods 🕒

Statement: The square of the time period (T) of revolution is directly proportional to the cube of the average distance (r) from the Sun.

$$T^2 \propto r^3 \text{ or } T^2/r^3 = \text{constant}$$

Simple Words: Planets far away from the Sun take much longer to go around it.