

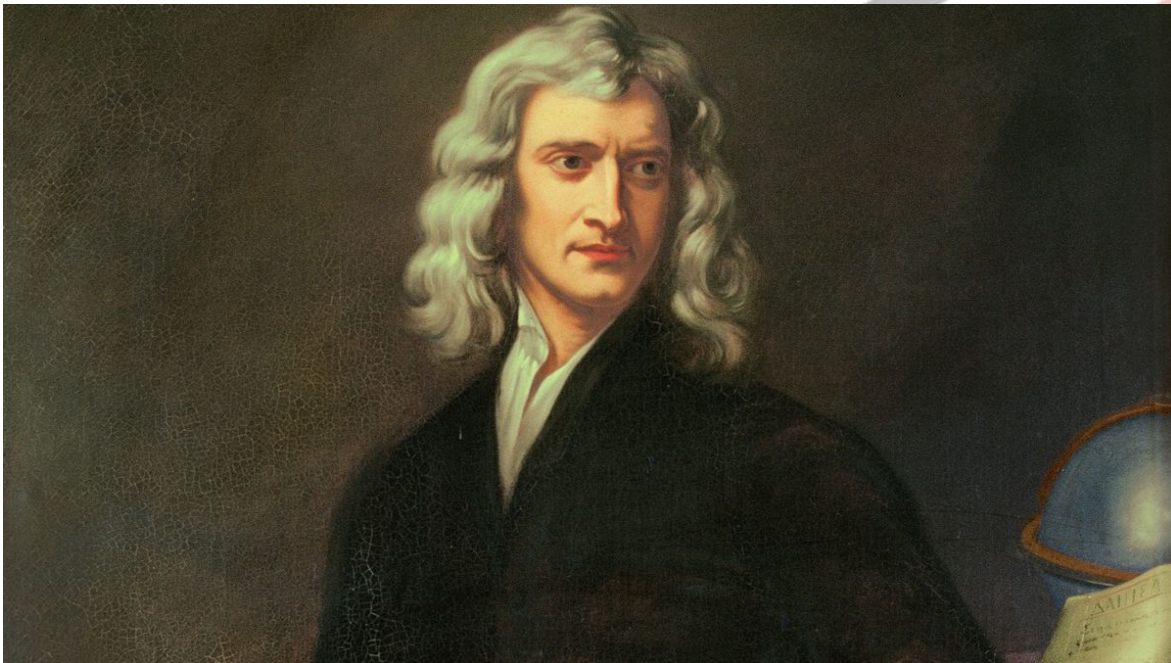


# Contributions of Sir Isaac Newton

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## Why in News?

Sir Isaac Newton, born on **25<sup>th</sup> December 1642**, is one of history's most influential scientists. On his **382<sup>nd</sup> birth anniversary**, it is important to reflect on the groundbreaking contributions made to science, which continue to shape the understanding of the world today.



## Who was Isaac Newton?

- **Early Life:** Isaac Newton was born in Woolsthorpe, England. He attended Trinity College, Cambridge, where he developed interests in mathematics, optics, physics, and astronomy.
  - Upon graduating, he became a professor at Cambridge and later held the prestigious second **Lucasian Chair of Mathematics**.
    - The Lucasian Chair of Mathematics, established in 1664 by **King Charles II** at Cambridge University, is one of the **most prestigious academic positions in the world**.
  - In 1705, Queen Anne (Queen of Great Britain) knighted Isaac Newton, giving him the title "**Sir**."
- **Contributions of Newton:**
  - **Laws of Motion:**
    - **First Law (Inertia):** Objects remain at rest or in uniform motion unless acted upon by an external force.
      - This principle is foundational in modern physics, explaining everything

from **car crashes to satellite motion in space.**

- **Second Law (Force and Acceleration):** Newton established that the force on an object is equal to its mass multiplied by its acceleration ( **$F=ma$** ).
  - This principle is applied in engineering, aerospace, and vehicle design to help **structures and machines withstand forces.**
- **Third Law (Action and Reaction):** For every action, there is an equal and opposite reaction.
  - This law underpins [rocket propulsion](#) and everyday activities like walking.
- **Gravity (g) and Gravitation (G):**
  - **Gravity:** Sir Isaac Newton discovered the existence of **gravity** in the late 1660s.
    - Gravity is a force by which a planet or other body draws objects toward its center.
  - **Universal Law of Gravitation:** Newton identified that the **gravitational force between two objects** is directly proportional to the **product of their masses** and **inversely proportional to the square of the distance between them**, meaning **gravity weakens as objects move further apart.**
    - His work revolutionized the understanding of [planetary motion](#) and the forces that govern the universe.
    - This law explains planetary motion and is vital for [satellite orbits](#), and **space exploration.**
- **Optics:** His research on the **nature of light** led to the discovery that **white light is a combination of different colors**, which he demonstrated using a prism (three-dimensional solid object).
- **Reflecting Telescope:** To solve the problem of **chromatic aberration** (color distortion) in telescopes that used lenses, **Isaac Newton created the reflecting telescope** in 1668.
  - By **substituting the primary lens with a mirror**, he was able to eliminate **chromatic aberration** and enhance **image clarity.**
- **Mathematics:** As a mathematician, Newton is credited with developing **calculus**, alongside **Gottfried Wilhelm Leibniz**, a tool that greatly impacted science and engineering.
- **Notable Works:** *Philosophiae Naturalis Principia Mathematica*, also known as *Principia*, published by Isaac Newton in 1687, laid the foundations of **classical mechanics** (study of the motion of objects and the forces).
  - Newton spent decades on **alchemy (related to the study of transforming base metals into gold)**, while unsuccessful, his alchemical work influenced his discoveries in optics and the understanding of matter, **blending chemistry with physics.**
- **Legacy:** The **Isaac Newton Medal and Prize** is an annual award given by the **Institute of Physics (IOP)**, a society for physics in the UK and Ireland, to recognize **outstanding contributions to physics.**

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### Prelims

**Q. The known forces of nature can be divided into four classes, viz., gravity, electromagnetism, weak nuclear force and strong nuclear force. With reference to them, which one of the following statements is not correct? (2013)**

- (a) Gravity is the strongest of the four
- (b) Electromagnetism acts only on particles with an electric charge
- (c) Weak nuclear force causes radioactivity
- (d) Strong nuclear force holds protons and neutrons inside the nucleus of an atom

**Ans: (a)**

**Exp:**

- **Gravitational Force:** According to Newton's Law of Gravitation, every particle in the universe attracts every other particle with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. It is the weakest of all the four natural forces.
- **Electromagnetic Force:** It is the force that acts between charged particles and is the combination of all electrical and magnetic forces. It can be attractive or repulsive. Its strength is inversely proportional to the inverse square of the distance between the particles. It acts on particles with an electric charge.
- **Nuclear Force:** It is an attractive force in nature and strong enough to overcome the electrostatic force of repulsion between two protons. It is a short range force. The force decreases with increase in distance between nucleons whereas it increases with decrease in the distance. It is of two kinds:
  - **Strong Nuclear Force:** It is the force responsible for holding the nucleons inside the nucleus. It holds protons and neutrons inside the nucleus of the atom.
  - **Weak Nuclear Force:** It is the mechanism of interaction between subatomic particles that is responsible for the radioactive decay of atoms.
- **Therefore, option (a) is the correct answer.**

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