

Unit II: Dynamics

Kinematics: The study of how objects move or the description of motion.
(Velocity, speed, displacement, distance, acceleration)

Dynamics: The study of why objects move or the causes of motion. (Mass, force, momentum, kinetic energy)

Section 2.1: What is Force?

A force is a push or pull. It is a vector quantity that has both magnitude and direction. The unit of force is a Newton or kgm/s^2 .

A force can

- i) make things speed up,
- ii) make things slow down,
- iii) change the direction of motion and
- iv) distort things (compressing, stretching, twisting).

There are presently 4 basic forces in nature.

1. Gravitational Force:

- exists between any two masses
- most noticeable between large masses like stars, planets, and moons. It holds them together and controls their motion the same way that it controls the motion of falling objects.

2. Electric and Magnetic Forces - which are lumped together. (you will learn why in Physics 3204).

You can create an electric force by rubbing a balloon in your hair. Your hair will be forced to stand on end, and the balloon will "attract" small pieces of paper. In fact, the small pieces of paper can be lifted upwards (say from a table top) thus proving that the electric force is greater than the force of gravity on the paper. As for magnetic forces, you can probably recall the fun you had with magnets in elementary school.

How is it that we put magnetic force and electric force together? After all, the electric force affects things like paper and your hair, while magnetic force most obviously affects certain types of metals. For now, let's just say that both forces have something to do with the movement of electrons.

- The electric and magnetic forces are often referred to as electromagnetic forces.
- This is the force between electric charges. It is the force that holds atoms and molecules together. Most common forces are electric.
- Mechanical forces and magnetism are all electric forces.
- It is the force responsible for making diamonds hard and rubber weak. It tenses muscles and explodes sticks of dynamite.

- Some mechanical forces are:
 - ⇒ elastic forces you have to overcome when you stretch something.
 - ⇒ the compression forces you have to overcome when you squeeze something.
 - ⇒ the frictional force that is both helpful(to keep a car on the road) and a nuisance(in wearing out the moving parts of the engine).
 - ⇒ the tensional force that exists in a cable to support a heavy weight.
 - ⇒ the ordinary push and pull forces that we exert to move an object.

3. Weak Nuclear Force:

The force involved in the breakup of unstable atomic particles such as the electron and neutron.

4. Strong Nuclear Force:

This is the strongest force in nature. It is the force that is responsible for holding the protons (positively charged particles in the nucleus of an atom) in an atom, even when they are influenced by the electric force of repulsion. This nuclear force is a short range force (10^{-12} cm) but is much stronger than the electric force.