

# GED Physics Note [Motion And Forces]

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## What is motion?

Motion is the action or process of moving or being moved.

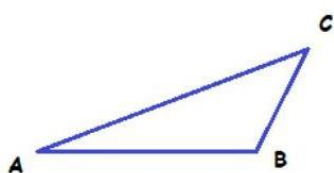
## What is distance?

Distance is the length of the space between two points.

## What is displacement?

Displacement is the distance covered in a specific direction. It is a vector quantity whereas distance is a scalar quantity.

The minimum distance between two points is called **displacement** while the actual path covered is called **distance**. The displacement is a vector term and distance is scalar term. Distance and displacement both have SI unit as meter.



AB + BC = distance moved and AC = displacement .

The effect of AB + BC is same as effect of AC.

## What is speed?

Speed can be defined as the distance covered by a moving object in unit time taken. Speed is a scalar quantity and hence it can only be represented by magnitude not by direction. In other words, **“The speed of an object can also be considered as the magnitude of the velocity of the object”**.

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}} = \frac{d}{t}$$

Its unit is m/s

## What is velocity?

**Velocity is the measure of the speed of the object in a specific direction.** Velocity is a vector quantity so both the magnitude and the direction of the object are required to define the velocity of the object. The speed and velocity of an object are interrelated terms.

To understand it better, consider the following example. An object is moving at, say, 50 m/sec in northwest direction. Here, 50 m/sec is the speed of the object in the northwest direction. And “50 m/sec” is the magnitude of the velocity while the “northwest” is the direction in which the object is moving.

$$\text{Velocity}(V) = \frac{\text{Displacement}}{\text{Time taken}}$$

Its unit is m/s

## What is Acceleration?

If the velocity changes from time to time, then the parameter which is responsible for change in velocity is called acceleration. In other words, it is defined as the rate of change of velocity with respect to time. Like velocity, acceleration imparted on an object is also a vector quantity.

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$$\text{Acceleration (a)} = \frac{\text{Change in velocity}}{\text{Short time change}} = \frac{\Delta V}{\Delta t}$$

Its unit is  $\text{m/s}^2$

### What is the difference between scalar and vector quantity?

Scalar quantity is any quantity which has magnitude only. Example of a scalar quantity is distance.

And vector quantity has magnitude as well as a direction also. Example of a vector quantity is force.

### Newton's First Law of Motion:

The first law of motion is related to the law of **inertia**, it says that the body will remain in rest or in continue motion, unless some external force is applied on it. The First Law States that:

**Every body continues its state of rest or of uniform motion in a straight line, unless compelled by some external force to act otherwise.**

**Inertia:** It is the property of body by the virtue of which the body remains in rest or in continues motion, unless some external force is applied. This is also called as **Law of inertia**.

### Newton's Second Law of Motion:

Newton's second law of motion states that:

**Rate of change of momentum is directly proportional to applied force and takes place in the same direction as the applied force.**

**Momentum**,  $p = \text{mass} \times \text{velocity}$

Momentum is a property of the body possessed by virtue of its mass and velocity. It is the product of mass of the body and its velocity.

So from Newton's second law we get  **$F=ma$**

### Newton's Third Law of Motion

According to the third law of motion:

**To every action there is equal and opposite reaction.**

### Equations of motion

There are three equation of motion, which are nothing but kinematics equations, which are :

1)  $v = u + at$

2)  $S = ut + \frac{1}{2}at^2$

3)  $v^2 = u^2 + 2as$ .

Where,

$v$  = Final Velocity,

$u$  = Initial velocity,

$a$  = acceleration,

$s$  = distance traveled by a body,

$t$  = time taken.

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## What is force?

A force is a push or a pull. Objects move in response to forces acting on them. When you kick a ball, it rolls. A force is also required to stop motion. The ball stops rolling because of the frictional force. Force can also change the shape of an object. Force is measured in Newton (N)

## What are the basic types of forces?

Two types of forces

1. Contact force
2. Non contact force

The following forces come under Contact Forces.

1. Frictional forces
2. Normal reaction force
3. Tension force as applied through strings
4. Force exerted by a spring
5. Force exerted during collision
6. Force applied as a pull or push

The following forces come under non-contact forces :

1. Gravitational Force
2. Electrostatic Force
3. Magnetic Force

## What is Gravitational force?

Gravitation is an attractive force that exists between all objects. It is proportional to the masses of the objects and inversely proportional to the square of the distance between them.

$$\text{Gravitational force} = \frac{GM_1M_2}{r^2}$$

Here  $G = 6.673 \times 10^{-11} \text{ N m}^2/\text{kg}^2$

## Effects of Gravity

1. Use gravity on the downward swing. Overcome gravity when he swings his body upward.
2. Use gravity to pull the ball down into the basket. Overcome gravity by aiming and pushing the shot to go into the basket.
3. Use gravity to pull her down toward the water. Overcome gravity by springing on a diving board.
4. Use gravity to pull the body toward Earth. Overcoming gravity by slowing descent with glider.

## What is normal force?

The normal force is the support force exerted upon an object that is in contact with another stable object. For example, if a book is resting upon a surface, then the surface is exerting an upward force upon the book in order to support the weight of the book.

## What is Air Resistance Force?

The air resistance is a special type of frictional force that acts upon objects as they travel through the air. The force of air resistance is often observed to oppose the motion of an object. This force will frequently be neglected due to its negligible magnitude (and due to the fact that it is mathematically difficult to predict its value). It is most noticeable for objects that travel at high speeds (e.g., a skydiver or a downhill skier) or for objects with large surface areas.

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### What is Tension force?

The tension force is the force that is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends. The tension force is directed along the length of the wire and pulls equally on the objects on the opposite ends of the wire.

### What is friction force?

The friction force is the force exerted by a surface as an object moves across it or makes an effort to move across it. There are at least two types of friction force - sliding and static friction. Though it is not always the case, the friction force often opposes the motion of an object. For example, if a book slides across the surface of a desk, then the desk exerts a friction force in the opposite direction of its motion.

**Disadvantages of friction:** overheating in bearings, increase fuel consumption in cars, lowers the top speed of cars, bicyclists or skiers, tries to slow down any moving object, overheating in objects moving through the air at high speed.

**Advantages of friction:** Allows cars, bicycles, etc to speed up, slow down or change direction. Without friction we would not be able to walk, run, stop, or change direction. Friction helps to stop things (eg furniture) from sliding around. Air resistance can be used to slow down a fast moving object (eg using a parachute).

| Friction Is Used                          | Friction Is Reduced                   |
|---|---------------------------------------|
| Rubbing two sticks together starts a fire | A door hinge is oiled                 |
| Build a house of cards                    | Lotion helps remove a tight gold ring |
| Press on a car's brakes                   | A dolphin glides through the water    |
| Walk across the road                      | Grease a bicycle chain                |
| Grate cheese                              | Skate across the ice                  |
| Smooth wood with sandpaper                | Butter a cake pan                     |
| Walk across a wood floor in shoes         | Walk across a wood floor in socks     |
| Pedal your bicycle                        | Slide down a snowy hill               |
| Rub your hands together to warm them      | Swan dive into a pool                 |
|   | A canoe glides down a river           |

### What is NUCLEAR force?

Nuclear forces are very strong forces that hold the nucleus of an atom together. If nuclei of different atoms come close enough together, they can interact with one another and reactions between the nuclei can occur.

### What is Electromagnetic force?

Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces. The electromagnetic force exists between any two charged or magnetic objects, such as a proton and an electron or two electrons. Opposite charges attract (an electron and a proton), while like charges repel (two protons or two electrons). The strength of the force depends on the charges and on the distance between them. The greater the charges, the greater the force. The closer the charges are to each other, the greater the force between them.