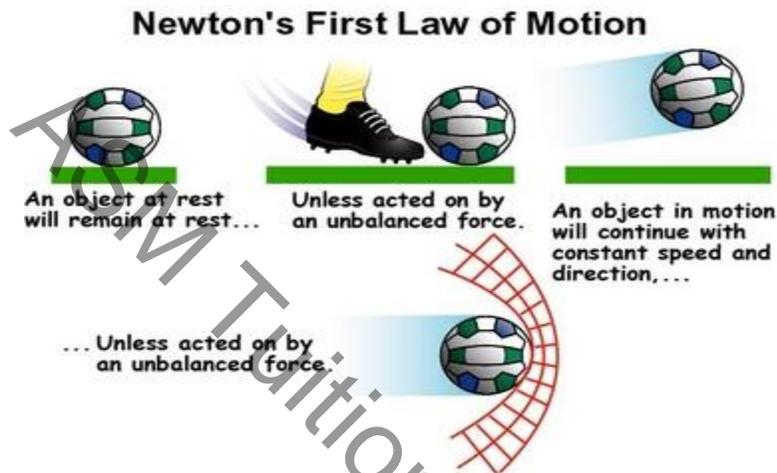# Newton's 1ˢᵗ and 2ⁿᵈ Law

> In 1660 someone named Newton's work as laws of motion

1- Newton's First Law of Motion:

"An object at rest will remain at rest and the object moving with uniform velocity will continue the uniform velocity until we apply some external force."

> If the resultant force of stationary object is Zero→object will remain stationary
> If the resultant force of moving object is Zero→ object move with the constant velocity
> Non zero resultant force always produce Acceleration or deceleration in the direction of force
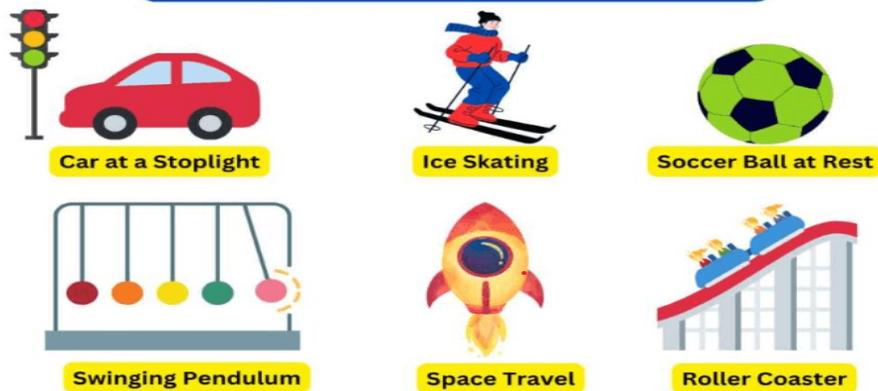
2- Newton 2nd Law of motion:

"The rate of change of momentum of any object is directly proportional to the force applied on the object in the direction of the force**."**
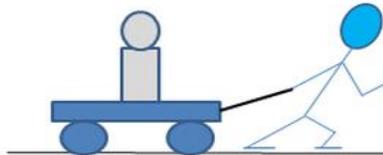
➢ **We can write it as Equation**

F=ma

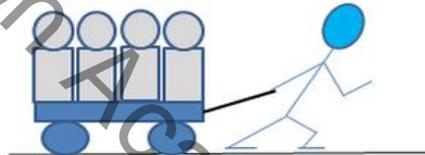**Where F=force, m=mass, a= acceleration**

➢ Acceleration is inversely proportional to mass➔ **Greater mass= less acceleration**

M= F/a

To get the wagon to *accelerate*, you have to apply a PULL (Force).

If the MASS of the wagon increases, a greater PULL is necessary to accelerate it.

NEWTON'S SECOND LAW OF MOTION EXAMPLES IN EVERYDAY LIFE

Pushing a Grocery Cart   **Using a Hammer**   **Stepping on a Gas Pedal**   **Using a Bicycle**

Launching a Rocket   **Using a Blender**   **Swinging on a Swing**   **Jumping**

EXAMPLES.COM

EXAMPLE

Q: Estimate the resultant force on a car as it accelerates from rest to a typical speed.

Solution:

A typical car speed is **~25m/s** and takes **~10s** to reach this. Mass of car is **~1000kg.**

So, **Acceleration = speed/time**

$$= 25/10 = 2.5m/s2$$

Using the Formula:
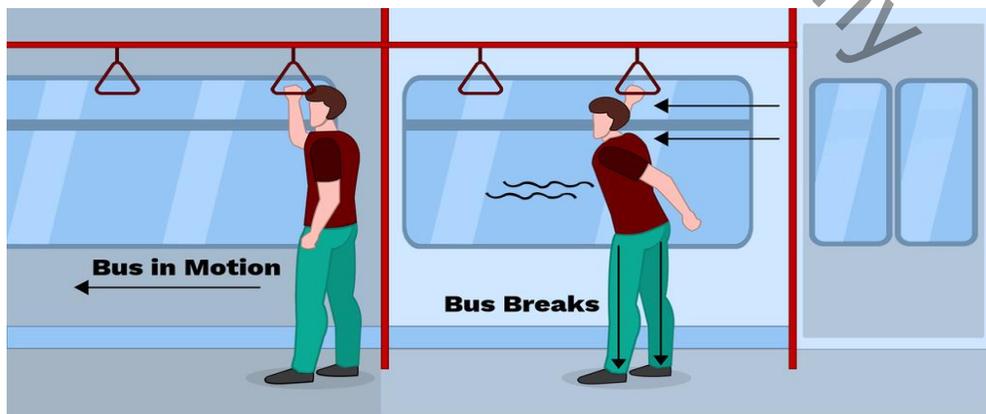
$$F=ma$$

$$F= 1000*2.5 = 2500N$$
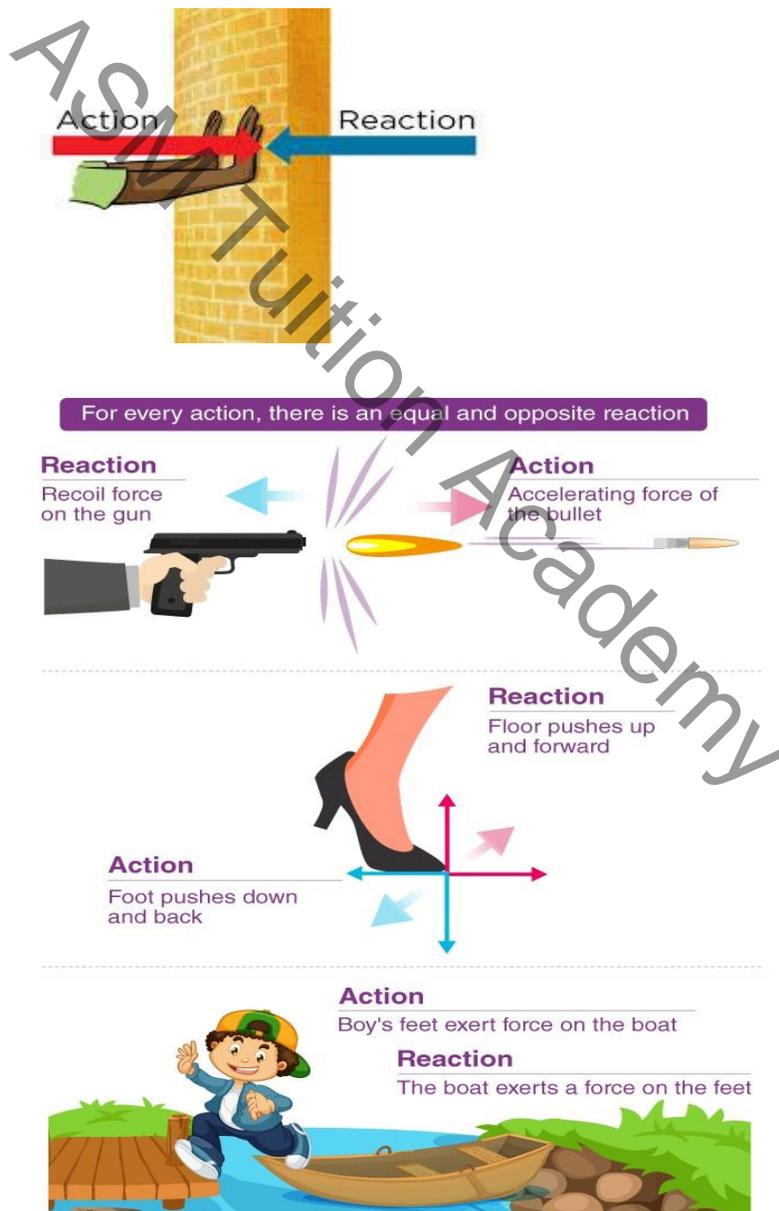
The resultant force is 2500N

Inertia

Definition: Inertia is the tendency to continue in the same state of motion.

3- Newton's 3rd Law of motion(action and Reaction)

"3rd law states that for every action (force) in nature there is an equal and opposite reaction"

Example: An example of Newton's Third Law in an equilibrium situation is a man pushing against a wall. As the man pushes the wall, there is a normal contact force acting back on him. These two forces are the same size. As the man applies a force and pushes the wall, the wall pushes back' on him with an equal force.

Investigating Motion

To investigate the effect of **mass** on acceleration, change the mass of the trolley

Mask size 1 cm

trolley

washers

light gates

To investigate the effect of **force** on acceleration, change the mass on the string

(resourcefulphysics.org)

Accelerating washers
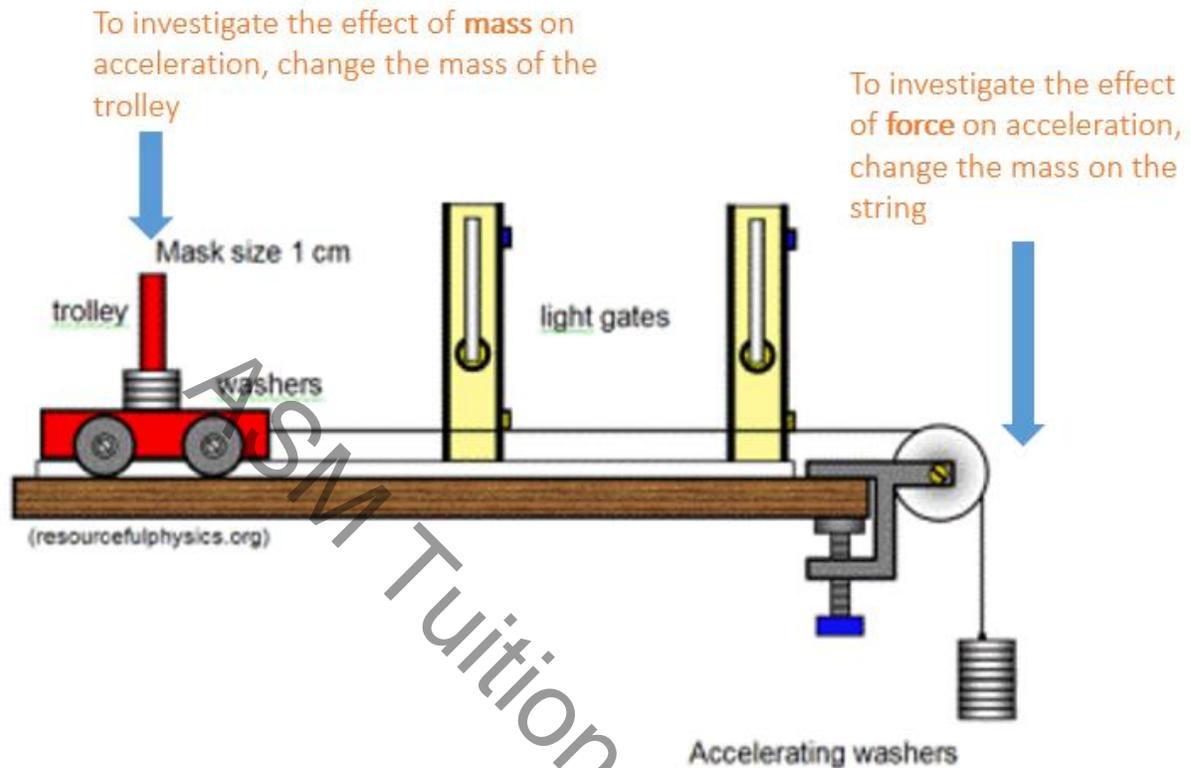
Procedure:

1. Select the falling mass to be 100 g. Pull the trolley back so that the mass is raised to just below the pulley. Position the light gate so that it will detect the motion of the trolley soon after it has started moving.
2. Set the software to record data, then release the trolley. Observe the measurement for the acceleration of the trolley.
3. Repeat this measurement from the same starting position for the trolley several times. Enter from the keyboard '1' (1 newton) in the force column of the table (see below).
4. Transfer 100 g from the trolley to the slotted mass, to increase it to 200 g. Release the trolley from the same starting point as before. Repeat this several times. Enter '2' (2 newtons) in the force column of the table.

5. Repeat the above procedure for slotted masses of 300 g and 400 g to get average acceleration

Newton 2nd law can explain the result:

Newton 2nd law stated that F=ma

Where F=weight of hanging masses, m= mass of whole system, a= acceleration of the system

Added masses to the trolley, mass of whole system increase, force is still same but acceleration decrease as **a=F/m** means acceleration in inversely proportional to mass.