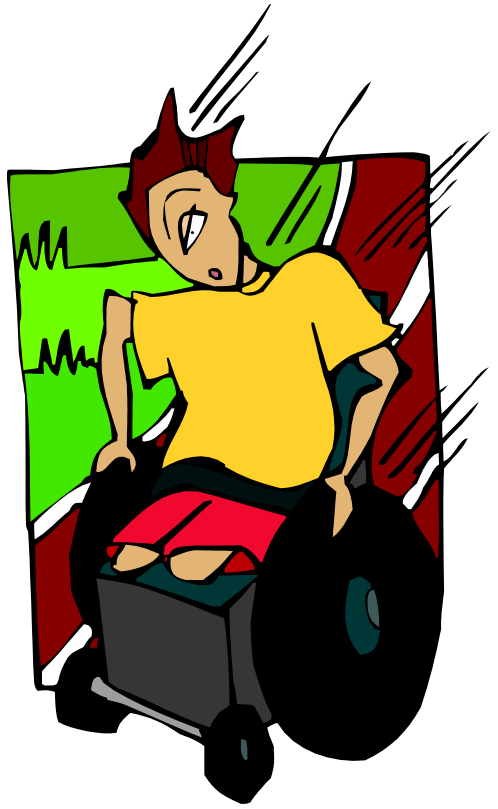
Applied Physics NS (101)

LECTURE # 8 & 9

DATE: 13TH OCTOBER , 2020

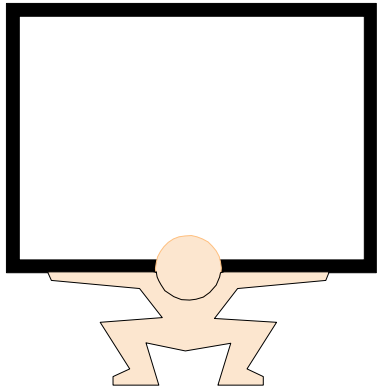
Forces and Motion

Forces can create changes in motion (acceleration or deceleration).

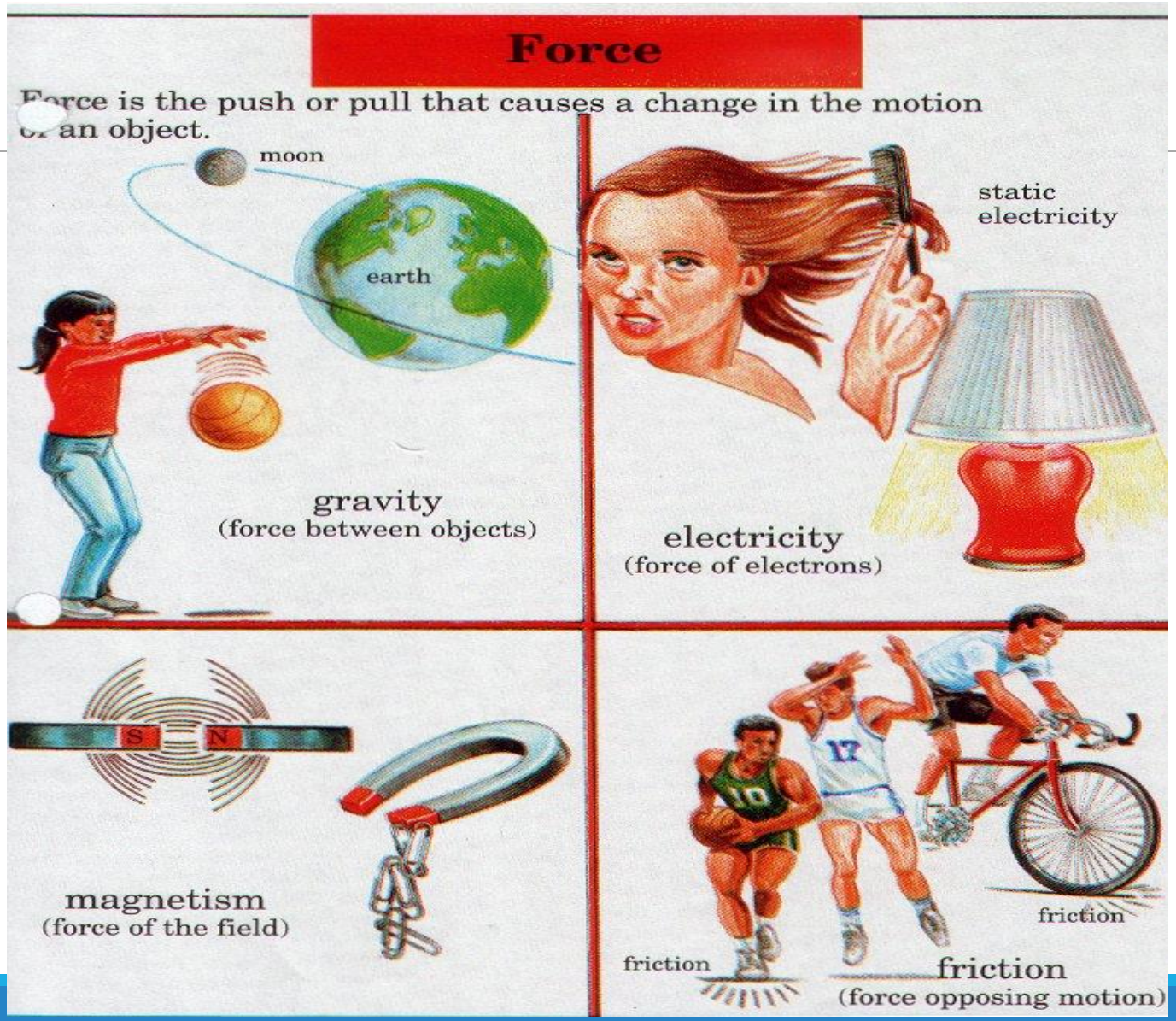


Definition of a Force

A force is a push or a pull.



THE CONCEPT OF FORCE



➢Four Fundamental Forces.

So practically there are just four fundamental forces in the Universe.

Two of them are very familiar to us which we experience in our every day life,

- **The electromagnetic force, and**
- **The gravitational force.**

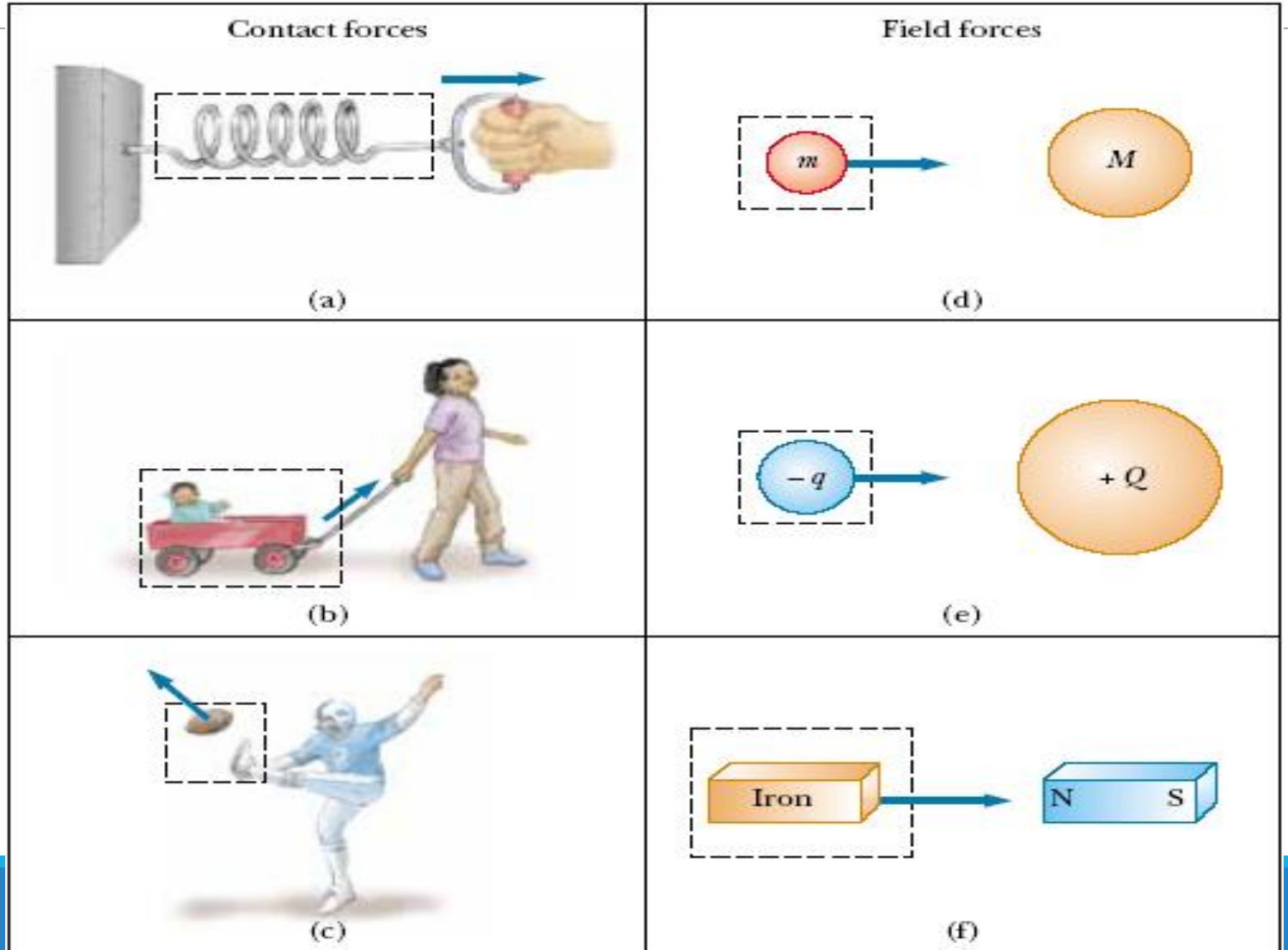
The other two are invisible unless we probe deep inside the nucleus of the atom. They are called “

- **Strong nuclear force** and the “
- **Weak nuclear force**.

Classes of forces

Contact forces :

Field Force / Action at a distance force

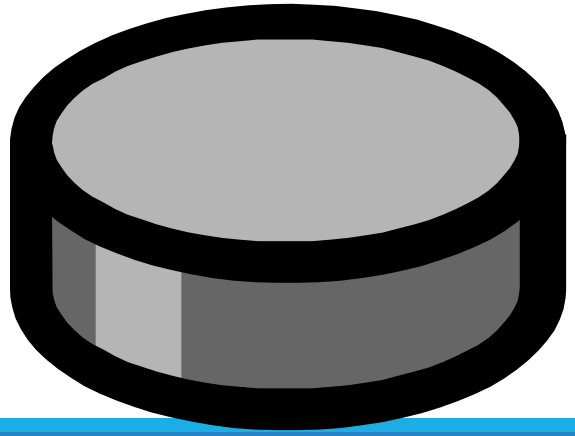


Friction

A force that opposes, or works against, motion of two objects that are touching.

Friction

- Friction causes an object to slow down and stop.
- Since the amount of energy stays constant, the energy becomes heat.



Frictional Forces

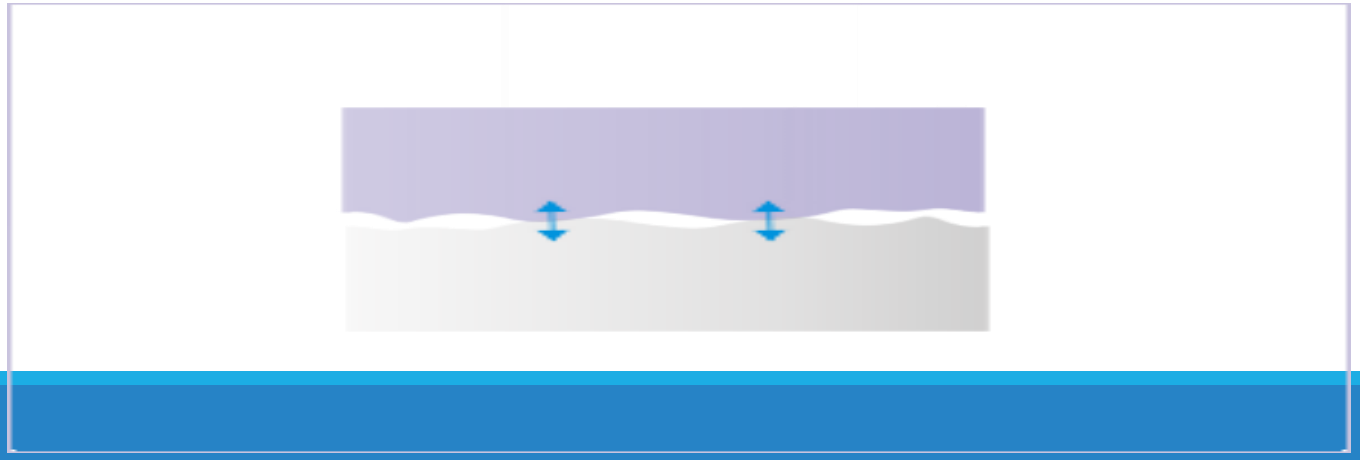
Friction: a contact force *parallel* to the contact surfaces.

Static friction acts to prevent objects from sliding.

$$f_s^{max} = \mu_s N$$

Kinetic friction acts to make sliding objects slow down. Sometimes called Dynamic friction.

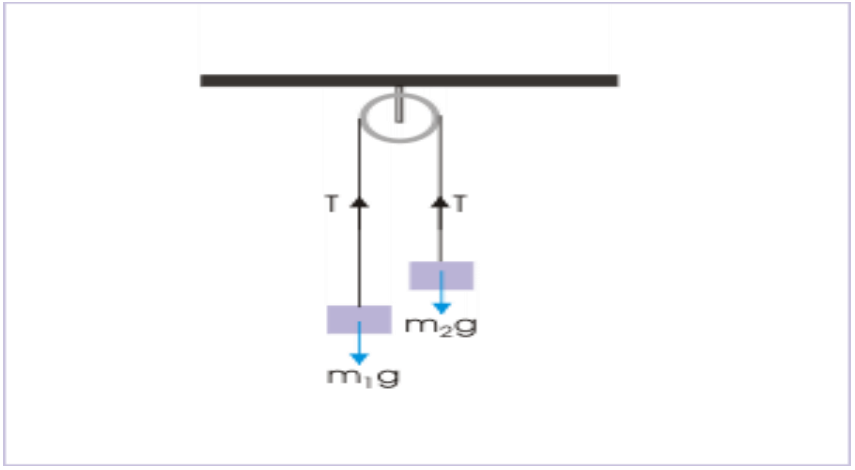
$$f_d = \mu_d N$$

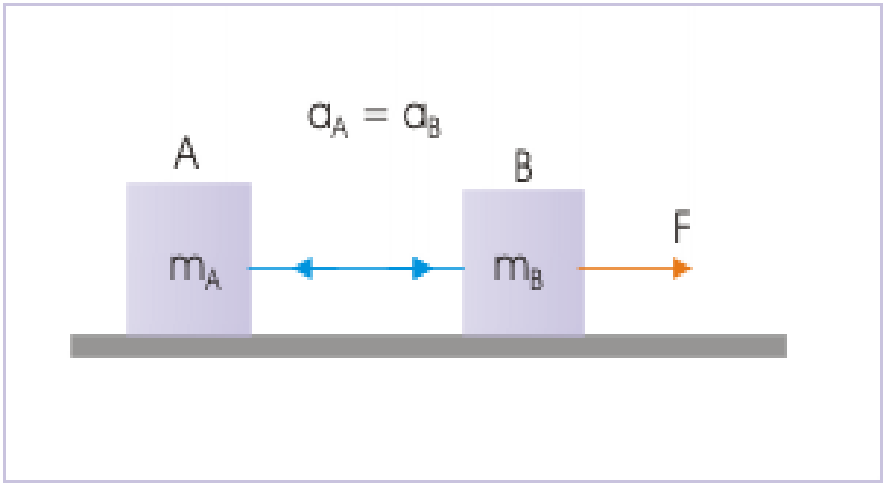


Tension

This is the force transmitted through a “rope” from one end to the other.

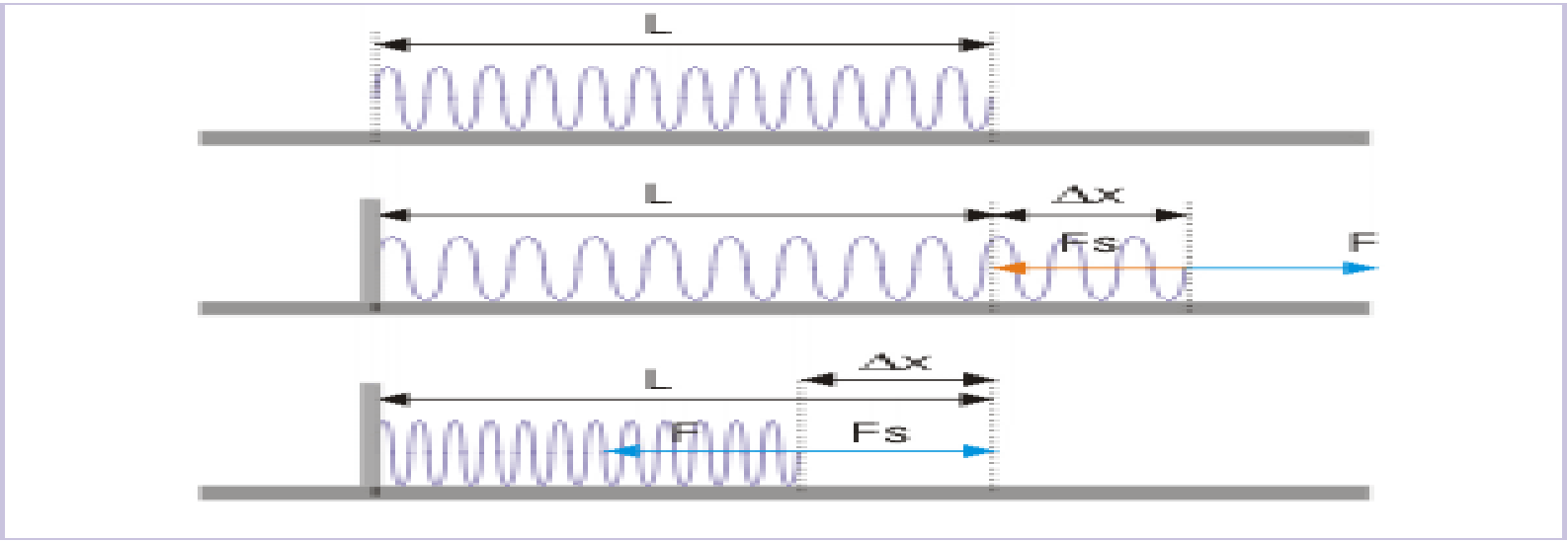
An **ideal** cord has zero mass, does not stretch, and the tension is the same throughout the cord.





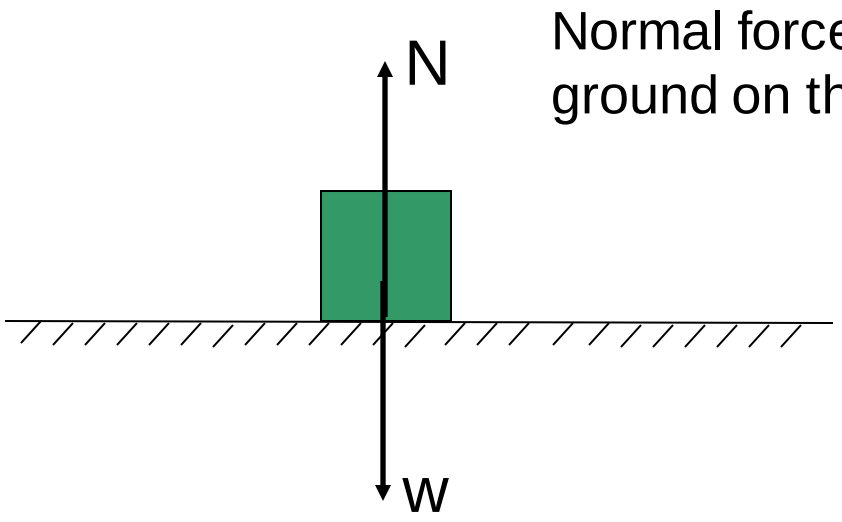
Spring Force

The spring force is the force exerted by a compressed or stretched spring upon any object that is attached to it. An object that compresses or stretches a spring is always acted upon by a force that restores the object to its rest or equilibrium position.

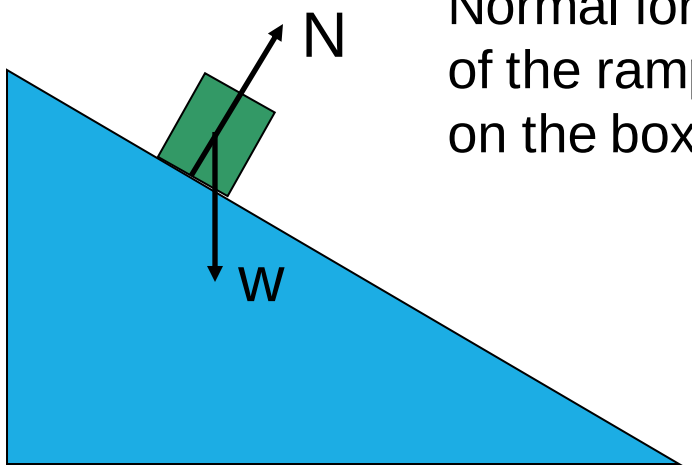


Normal Forces

Normal force: this force acts in the direction perpendicular to the contact surface.



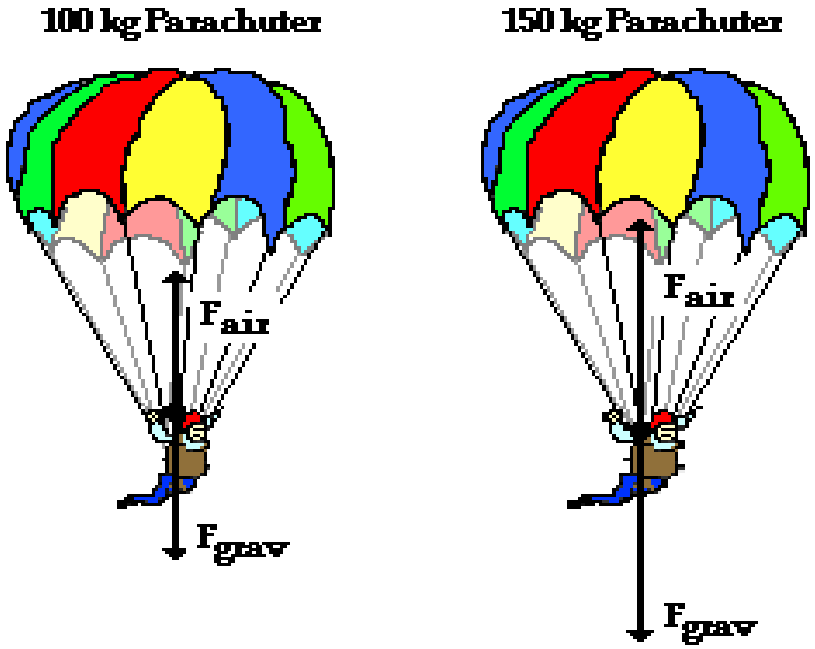
Normal force of the ground on the box



Normal force of the ramp on the box

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.



Applied Force

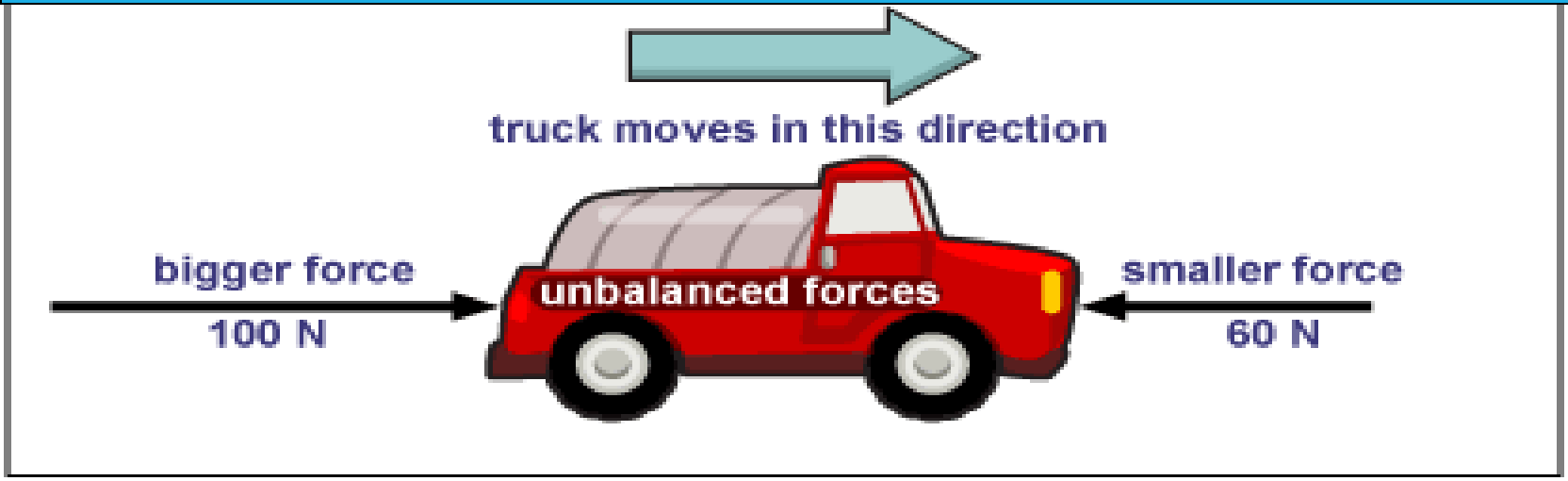
An applied force is a force that is applied to an object by a person or another object. If a person is pushing a desk across the room, then there is an applied force acting upon the object. The applied force is the force exerted on the desk by the person.

Balanced Force

Equal forces in opposite directions produce no motion

Unbalanced Forces

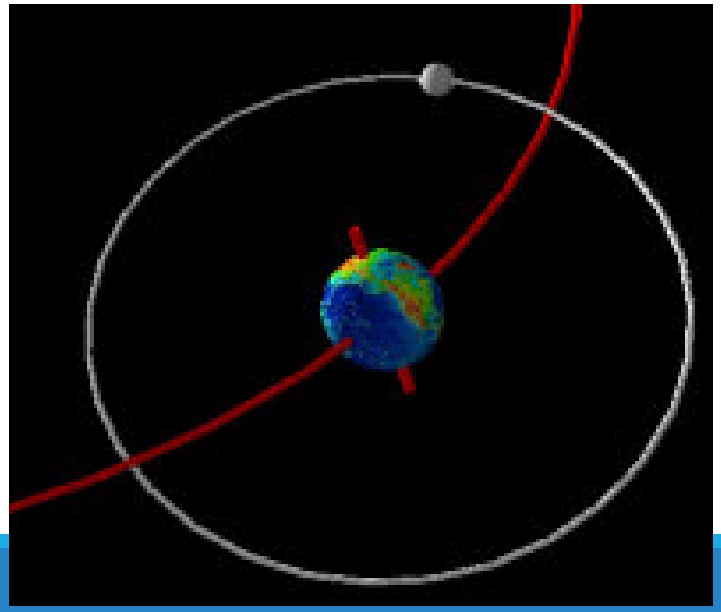
Unequal opposing forces produce an unbalanced force causing motion

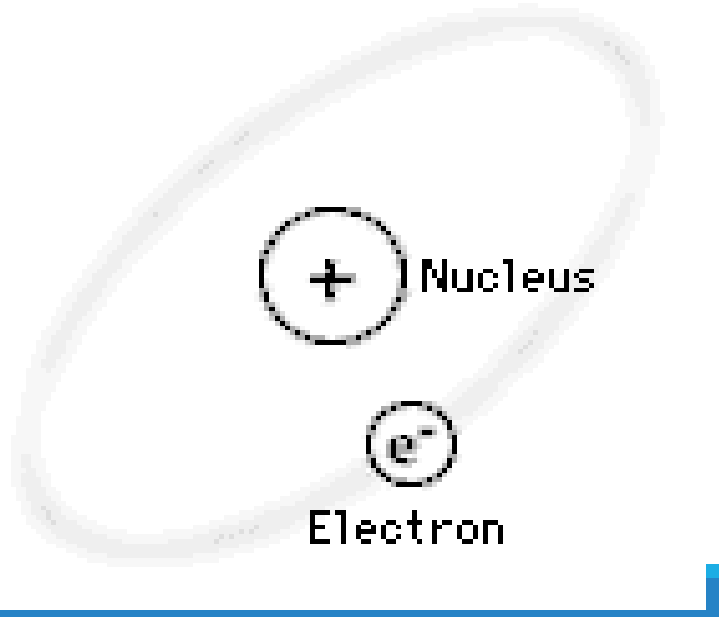


Laws of Motion

If an object moves with uniform motion (constant velocity),no force is required for the motion to be maintained.

Moon-Earth system , Electron revolves around nucleus



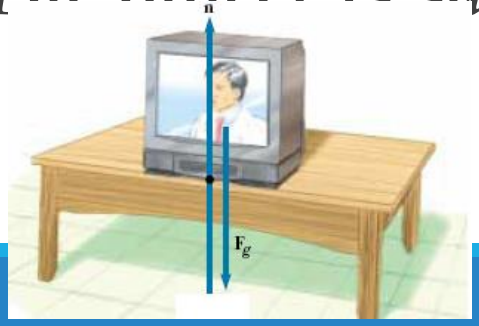


Laws of Motion

What happens when several forces act simultaneously on an object?

The object accelerates only if the net force(total/resultant/unbalance), acting on it is not equal to zero.

If the net force exerted on an object is zero, then the acceleration of the object is zero and its velocity remains constant. The object is said to be in equilibrium.



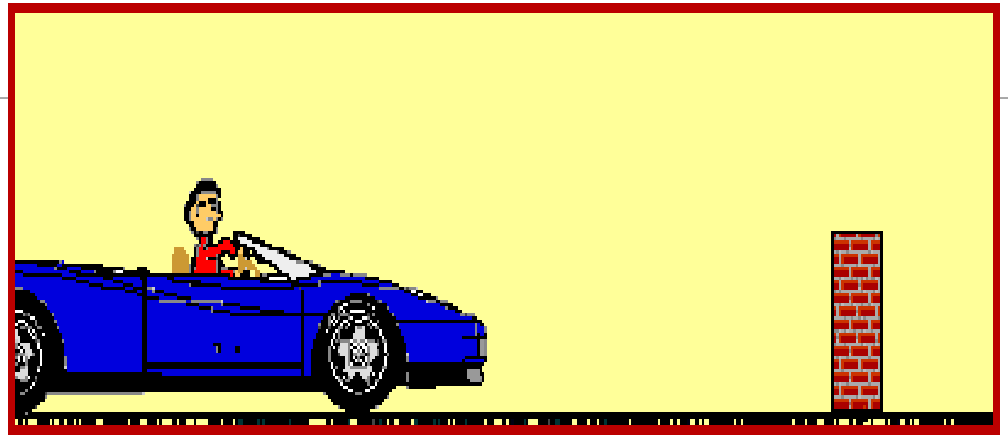
Newton's First Law

An object at rest will stay at rest, and an object in motion will stay in motion at constant velocity, unless acted upon by an unbalanced force.

Once airborne, unless acted on by an unbalanced force (gravity and air – fluid friction), it would never stop!
Unless acted upon by an unbalanced force, this golf ball would sit on the tee forever.

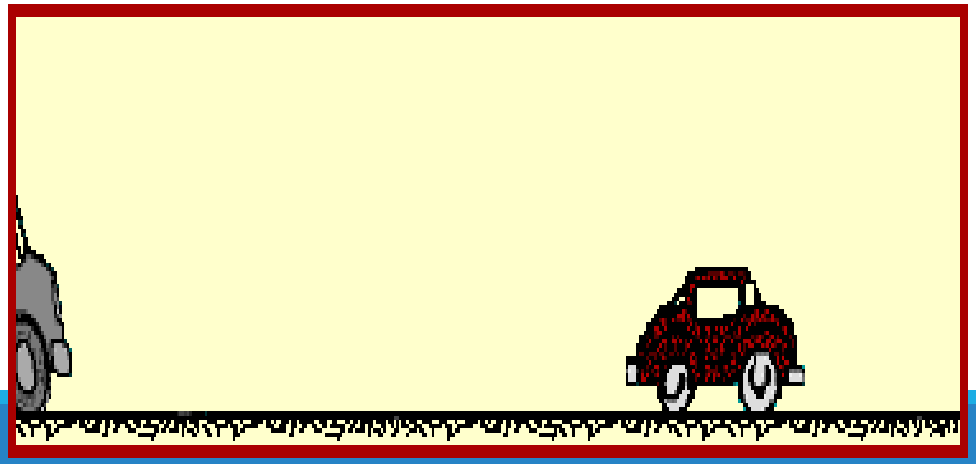
Inertia

The tendency of an object to resist any attempt to change its velocity is called the inertia of the object.



Don't let this be you. Wear seat belts.

Because of inertia, objects (including you) resist changes in their motion. When the car going 80 km/hour is stopped by the brick wall, your body keeps moving at 80 m/hour.



Mass:

Mass is that property of an object that specifies how much inertia the object has.

The greater the mass of an object, the less that object accelerates under the action of an applied force.

$$\frac{m_1}{m_2} \equiv \frac{a_2}{a_1}$$

Mass is an inherent property of an object and is independent of the object's surroundings and of the method used to measure it. Mass is a scalar quantity.

Weight :

The weight of an object is equal to the magnitude of the gravitational force exerted on the object and varies with location.

$$F = mg$$

For example, a person who weighs 180 lb on the Earth weighs only about 30 lb on the Moon. On the other hand, the mass of a body is the same everywhere: an object having a mass of 2 kg on the Earth also has a mass of 2 kg on the Moon. Weight is a vector quantity .