DUY TAN UNIVERSITY
DEPARTMENT OF NATURAL SCIENCE

Newton's Laws of Motion

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Motions


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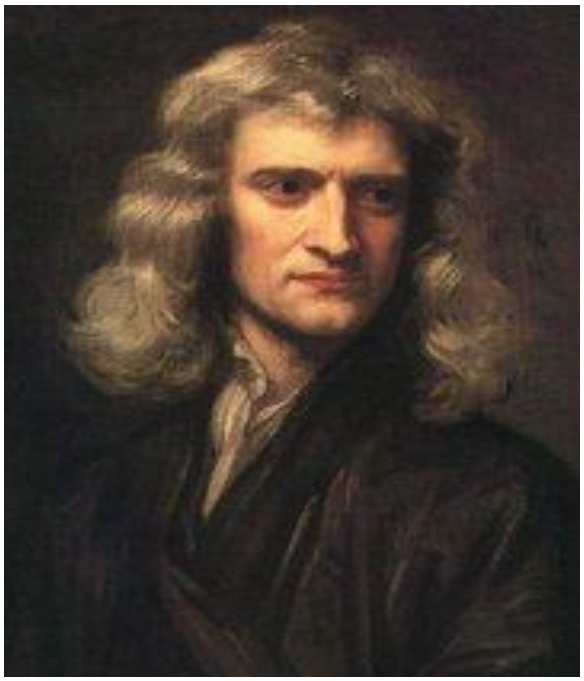
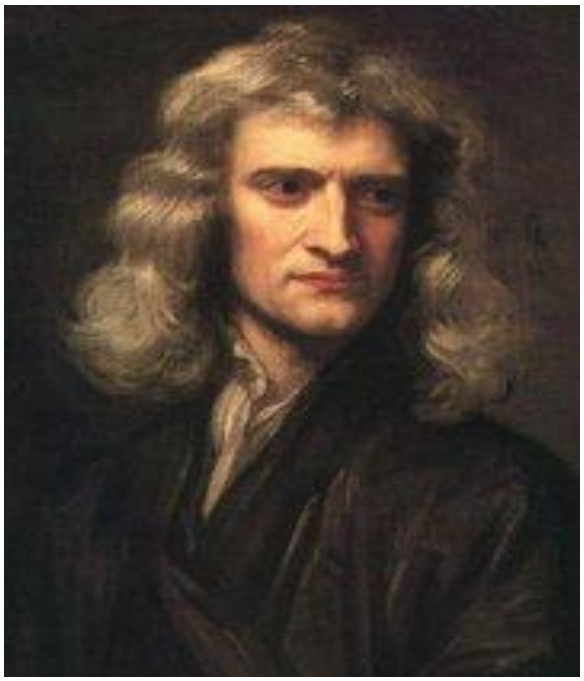
Newton's Contributions



Sir Isaac Newton (1643-1727) an English scientist and mathematician.

- *Calculus*
- *Light is composed of rainbow colors*
- *Reflecting Telescope*
- *Laws of Motion*
- *Theory of Gravitation*

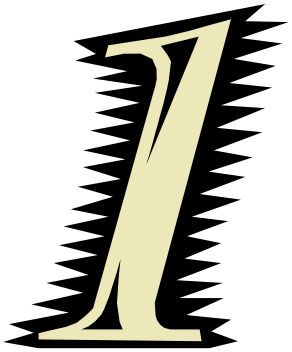
Newton's Contributions



Newton famous for his discovery of the law of gravity also discovered the three *laws of motion*. He published them in his book "mathematic principles of natural philosophy" in 1687.

Today these laws are known as *Newton's Laws of Motion* and describe the motion of all objects on the scale we experience in our everyday lives.

Newton's First Law

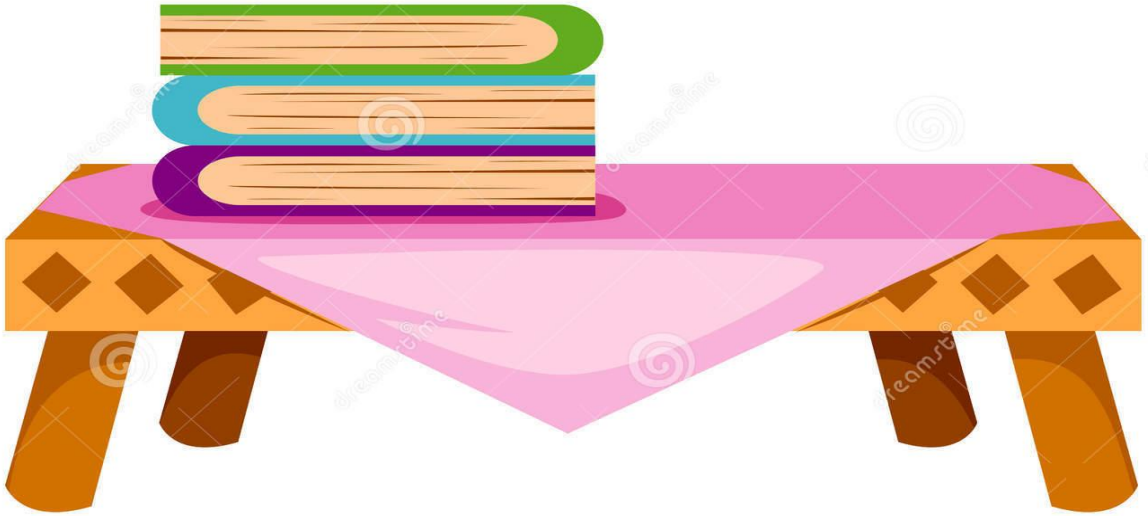


An object at rest tends to stay at rest, and an object in motion tends to stay in motion at constant velocity, unless acted upon by an unbalanced force.

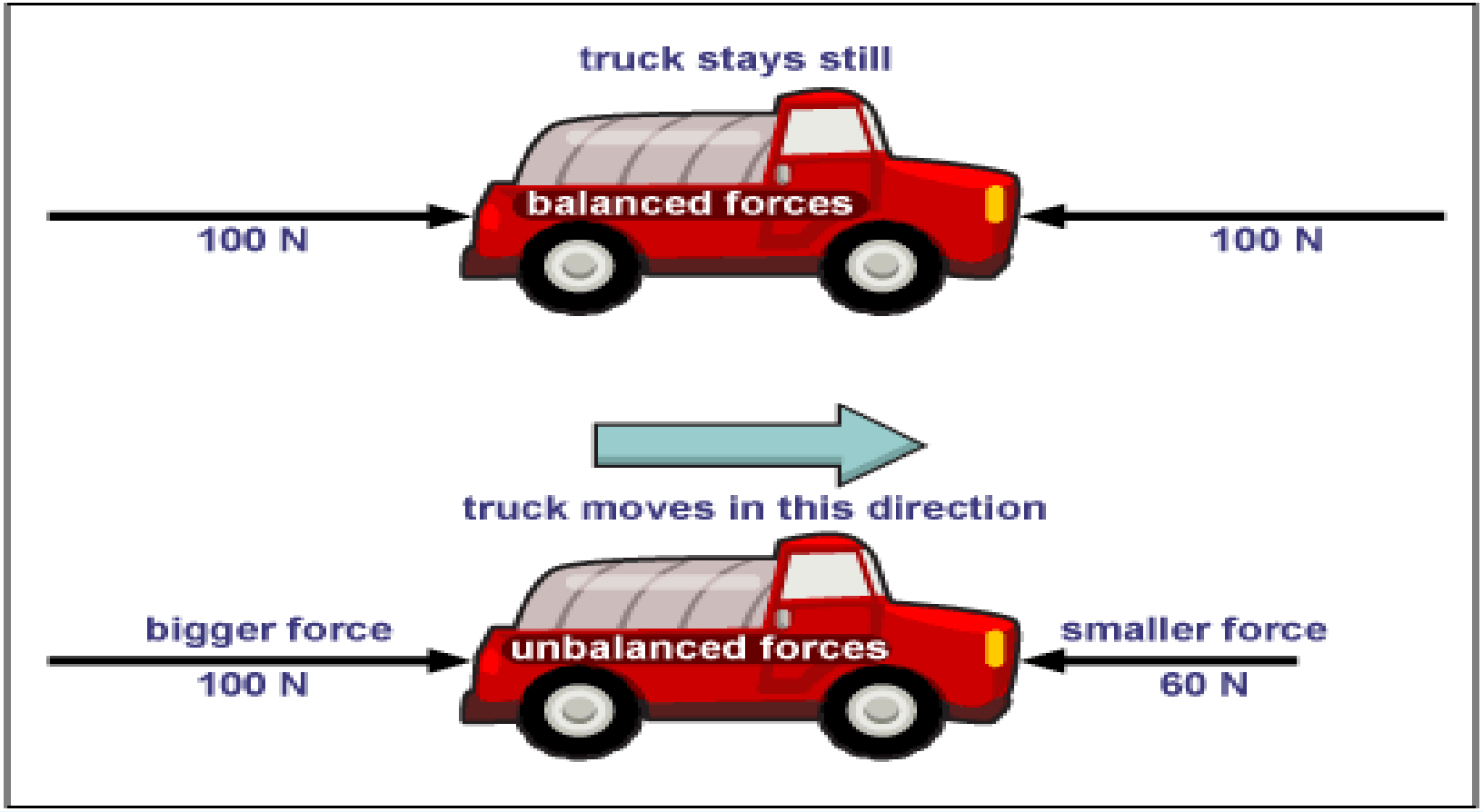
What does this mean?

Basically, an object will “keep doing what it was doing” unless acted on by an unbalanced force.

If the object was sitting still, it will *remain stationary*. If it was moving at a constant velocity, it will *keep moving*.



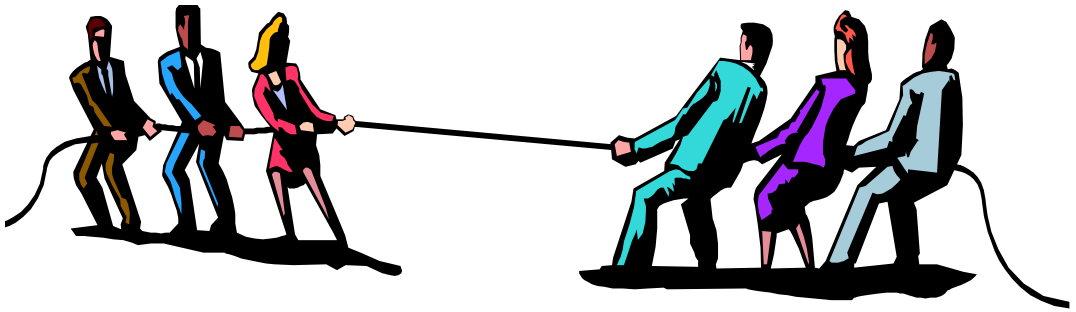
What is meant by *unbalanced force?*



If the forces on an object are equal and opposite, they are said to be balanced, and the object experiences no change in motion. If they are not equal and opposite, then the forces are unbalanced and the motion of the object changes.

Some Examples from Real Life

A soccer ball is sitting at rest. It takes an unbalanced force of a kick to change its motion.



Two teams are playing tug of war. They are both exerting equal force on the rope in opposite directions. This balanced force results in no change of motion.

Newton's Second Law

$\vec{F}$

$\vec{a} = ?$

m

Newton's Second Law

$$\vec{a} = \frac{\sum \vec{F}}{m}$$

The acceleration of an object is directly proportional to the net force acting on it, and is inversely proportional to the object's mass. The direction of the acceleration is in the direction of the net force acting on the object.

Acceleration: a measurement of how quickly an object is changing speed.

Example

Example 1.

Estimate the net force needed to accelerate a 1000 kg car at 5 m/s^2.

Example

Example 2.

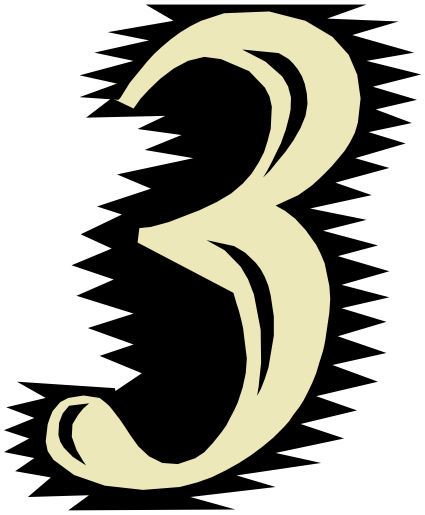
Calculate acceleration of an object (total mass 40 kg) is acted upon by a force of 100 N?

Example

Example 3. **Force to stop a car.**

What average net force is required to bring a 1000 kg car to rest from a speed of 100 km/h within a distance of 55 m?.

Newton's Third Law

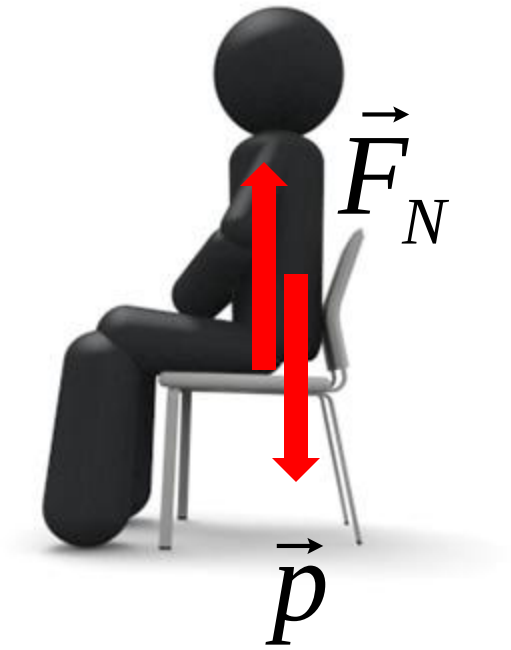


For every action there is an equal and opposite reaction.

What does this mean?

For every force acting on an object, there is an equal force acting in the opposite direction.

Right now, gravity is pulling you *down* in your seat, but Newton's Third Law says your seat is pushing *up* against you with *equal force*. This is why you are not moving. There is a *balanced force* acting on you– gravity pulling down, your seat pushing up.



Review

Newton's First Law:

Objects in motion tend to stay in motion and objects at rest tend to stay at rest unless acted upon by an unbalanced force.

Newton's Second Law:

Force equals mass times acceleration ($F = ma$).

Newton's Third Law:

For every action there is an equal and opposite reaction.

Homework

Problem 1:

A net force of 265 N accelerates a bike and rider at 2.3 m/s^2. What is the mass of the bike and rider together?

Problem 2:

What force is needed to accelerate a person on a sled (total mass 60 kg) at 1.1 m/s^2?

Problem 3:

What average force is required to stop a 950 kg car in 8 s if the car is traveling at 95 km/s?

Vocabulary

Inertia:

the tendency of an object to resist changes in its state of motion

Acceleration:

- a change in velocity
- a measurement of how quickly an object is changing speed, direction or both

Velocity:

The rate of change of a position along a straight line with respect to time

Force:

strength or energy

The end.

Thank you!