

Physics

Chapter 4: Forces and the Laws of Motion

Section 4.1:

Changes in Motion

Mechanics, Kinematics, and Dynamics

- Mechanics is the study of motion and its causes.
- The study of motion (displacement, velocity, acceleration) is called kinematics. (Studied in chapters 2 and 3)
- The study of the causes of motion is called dynamics.

Force

- Changes in the motion of an object (acceleration) are caused by forces; a force is a push or pull on an object.
- Forces that act through contact between two bodies are called contact forces.

--Forces that act at a distance are called field forces.

--Examples of field forces include

gravitational forces,
magnetic forces,
and electrical forces.

The Newton

- The SI unit of force is the newton (N), named after Isaac Newton.
- The newton is the size of the force that is needed to cause an object with a mass of 1.0 kilogram to accelerate at 1.0 m/s².

$$1 \text{ N} = 1 \text{ kg} \times 1 \frac{\text{m}}{\text{s}^2}$$

Forces are Vectors

- The effect that a force has on the motion of an object depends upon both its magnitude and direction; therefore forces are vector quantities.
- As vector quantities, forces can be added, subtracted, etc., in the same way as other vector quantities.
- The effect that two or more forces acting on the same object have on that objects motion depends upon the vector sum or resultant of the forces, called the net force.

Example: What is the net force acting on a cart if a force F_1 of 50.0 N acts at an angle of 30° from a force F_2 of 60.0 N?

Free-Body Diagrams

- The forces acting on a body can be understood by a sketch called a free-body diagram; a free-body diagram shows the direction of each force acting on the object.
- The object may be represented with a simple sketch of the object or with a small rectangle, etc.; if a rectangle is used, label it with the name of the object.

--The direction of each force that is acting on the object is sketched from a center point; the length of the vector only approximates the size of each force.

--For example, a free-body diagram of a car moving at a constant velocity might look like this: