

Forces are measured in the unit of the **Newton (N)**.
One Newton of force is needed to accelerate a 1-kg mass 1 m/s^2
A force is a **vector** quantity.

Forces include such physical quantities as magnetism, gravity, electricity, friction, lift, thrust, etc.

When a force is applied to a mass, the motion of the mass is changed.

Newton's 1st Law:
Inertia - the resistance of an object to a change in motion.
An object in straight line motion will stay in straight-line motion until acted upon by an unbalanced outside force.

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An object is pulled down a hill with a constant velocity. All the forces acting on the wagon are

- balanced
- unbalanced
- increasing
- decreasing

The answer is A, balanced.

Forces act in pairs

Newton's 3rd Law:
Action and Reaction = Interaction
When one object exerts a force on another object, the second object exerts an equal in magnitude and opposite in direction force on the first object.

Image of action reaction pairs.

An action force and its reaction force are

- equal in size and direction
- equal in size and opposite in direction
- different in size but in the same direction
- different in size and direction

The answer is B, equal in size and opposite in direction.

An object is at rest on a table with no outside forces acting on it. The force due to gravity of the object is 10 Newtons. What is the magnitude and direction of the support force provided by the table?

- 10 Newtons downward
- 10 Newtons upward
- 10 Newtons to the left
- Not enough information provided.

The answer is B, 10 Newtons upward.

Force and mass determine acceleration.

Newton's 2nd Law:
 $F = ma$
The acceleration of an object increases with increased force and decreases with increased mass, and is in the same direction as the force.

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Newton's 2nd Law states that to increase acceleration, you

- increase force
- decrease force
- increase mass
- increase inertia

The answer is A, increased force.

Motion and Forces

Define Motion: Motion is the change in position of an object

Define Force: A push or a pull. A force changes motion

Question:
If an object is observed to be in the same position at two distinctly different times, do you know enough to determine whether it was in motion at any point during this time?
Yes No
The answer is NO.

Question:
An object is observed to be at rest. Moments later the object is observed to be moving away from you, the observer. Has there been a force applied to the object to cause its motion.
Yes No
The answer is YES.

Motion is measured through the quantities of Speed, Velocity, and Acceleration.

Speed measures how fast position changes.
The units of measurement for Speed are meters per second, or m/s.
Speed is a **scalar** quantity.
A quantity with just magnitude

Velocity measures how fast position changes in a specific direction.
The units of measurement for velocity are meters per second East, North, up, down, left, etc., or m/s East.
Velocity is a **vector** quantity.
A quantity with magnitude and direction.

Acceleration measures how fast velocity changes
The units of measurement for acceleration are meters per second per second, or m/s².
Acceleration is a **vector** quantity.

Mathematically, Speed is written as the quotient of distance and time
 $S = d/t$

Mathematically, Velocity is similar to Speed. However, you must denote the direction of travel for the object in question.
 $v = d/t, \text{ East}$
NOTICE: The v representing velocity is bold and italicized because velocity is a vector quantity. Also, after the equation, you see the direction the object is travelling

Mathematically, Acceleration is the quotient of the change in velocity and the change in time.
 $a = \Delta v / \Delta t$

Solve:
A wheelchair racer completes a 100-meter course in twenty seconds. What is his speed?
a. 5 m/s
b. 10 m/s
c. 15 m/s
d. 20 m/s

Solve:
A wheelchair racer travelling north completes a 100-meter course in 20 seconds. What is his velocity?
a. 5 m/s, East
b. 5 m/s, West
c. 5 m/s, North
d. 5 m/s

Solve:
A cheetah can go from 0 m/s to 20 m/s in 2 seconds. What is the cheetah's acceleration?
a. 5 m/s²
b. 10 m/s²
c. 20 m/s²
d. 40 m/s²

The answer is A, 5 m/s.

The answer is C, 5 m/s, North.

The answer is B, 10 m/s²