Newton's First Law of Motion-1

by

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P3.2 Net Forces

Forces have magnitude and direction. The net force on an object is the sum of all the forces acting on the object. Objects change their speed and/or direction only when a net force is applied. If the net force on an object is zero, there is no change in motion (Newton's First Law).

P3.2B Compare work done in different situations.

P3.2C Calculate the net force acting on an object.

Isaac Newton (ca. 1687) came up with three laws of motion which form the basis of (classical) mechanics.They describe the effects of forces on objects with mass.

Newton's First Law of Motion

An object continues in a state of rest or in a state of motion at a constant speed along a straight line. A net force (F net) can change that state.

The *net force* is the vector sum of all of the forces acting on an object.

The SI unit of force is the Newton (N).

How to calculate the net force;

Step One: Add all the forces in the same direction.

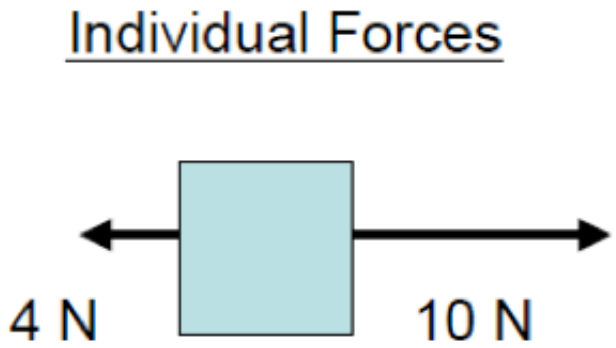
Step Two: Choose a positive direction. Then, the opposite direction would be the negative direction.

Step Three: Calculate the net force by subtracting the forces in the different directions, as shown in the formula below:

Net Force (F net) = All forces in the positive direction - All forces in the negative direction

Sample Problem 1:

This is an example of individual forces acting on an object.



1. What is the net force?
2. Does the object move forward or backward?

Step One: *Add all the forces in the same direction*

There are two forces acting on this object:

One is 10 N pushing the object forward to the right.

The other force is 4 N pulling the object back to the left.

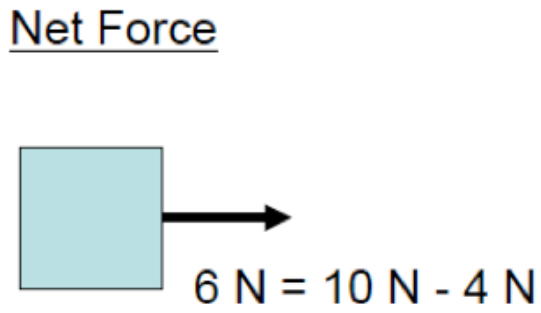
Step Two: *Choose a positive direction. Then, the opposite direction would be the negative direction.*

Assume that the east direction (forward, to the right) is the positive direction. So, the west direction (backward, to the left) is the negative direction.

Step Three: *Net Force = All forces in the positive direction - All forces in the negative direction*

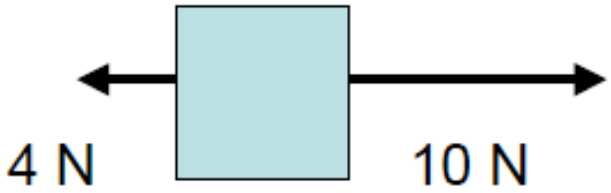
The net force = 10 N - 4 N = 6 N.

The net force is positive, so the object moves forward.

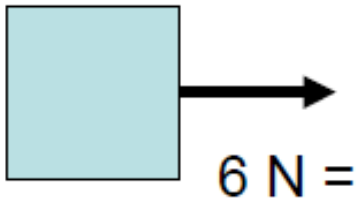


This is a summary of the sample problem.

Individual Forces

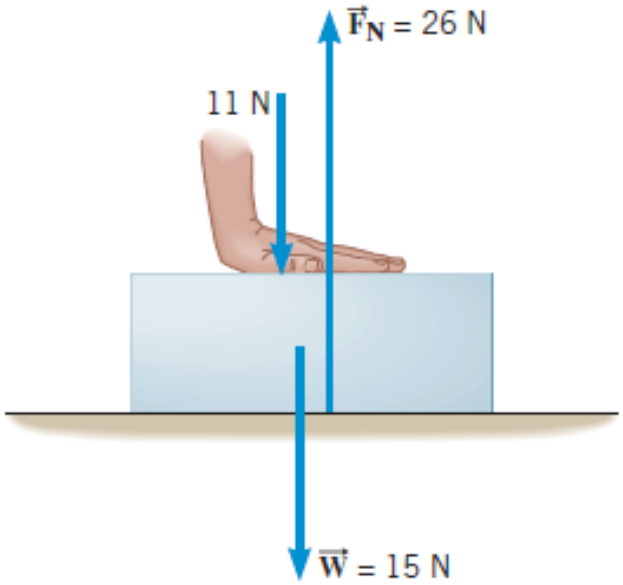


Net Force



6 N = 10 N - 4 N

Sample Problem 2



Step One: *Add all the forces in the same direction*

Downward direction: A box has weight W =15 N directed downward toward the earth. Also, a hand pushes the box downward, also, with a force FH = 11 N. So, the sum of the downward forces = 15 + 11 = 26 N.

Upward direction: There is an upward force called normal force FN = 26 N acting on the box and pushes it up.

Step Two: *Choose a positive direction. Then, the opposite direction would be the negative direction.*

Assume that the upward direction is the positive direction.

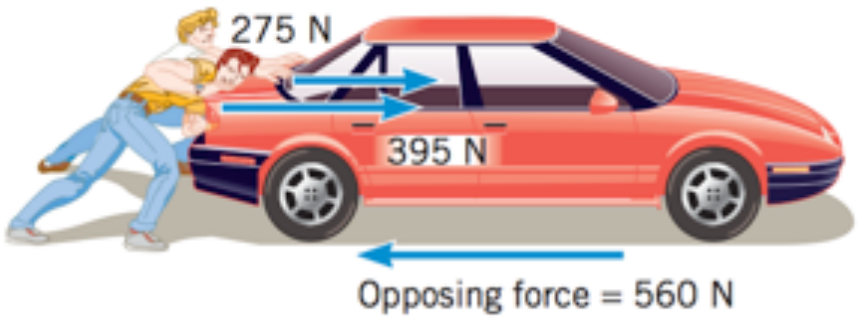
So, the downward direction is the negative direction.

Step Three: *Net Force = All forces in the positive direction - All forces in the negative direction*

The net force = 26 N - 26 N = 0 N.

The net force is zero, so the object does not move and remains at rest.

Practice Problems : Answer questions 1, 2 and 3.

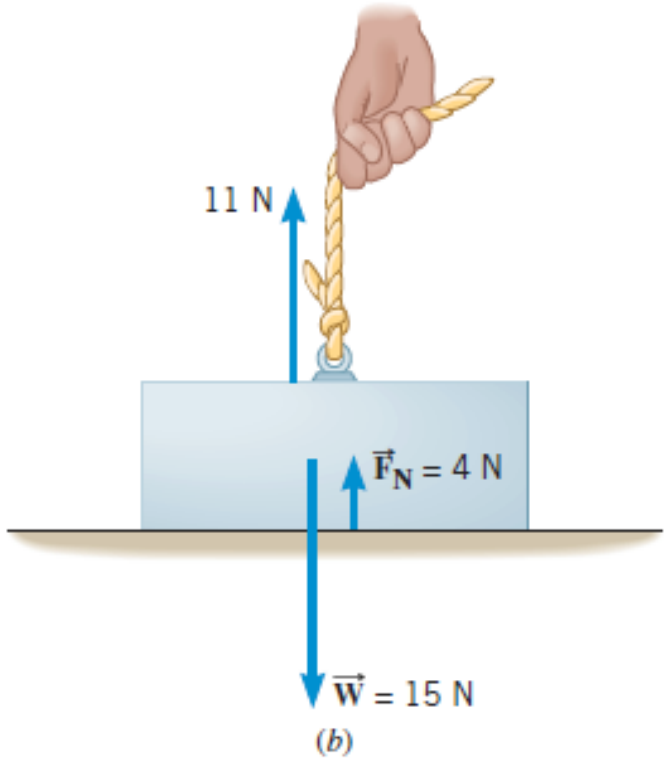


1. Two people push a stalled car. One person pushes with a force of 275 N. The other person pushes with a force of 395 N. A third opposing force of 560 N in acts on the car in the opposite direction caused by friction. Assume that the east direction is the positive direction.

a) Calculate the net force on the car.

b) Does the car move forward?

2.



A box has a weight W = 15 N directed downward toward the earth is placed on a table. A person uses a rope and is trying to pull is the box upward with a force FH = 11 N. There is an upward force called normal force FN = 4 N acting on the

box and pushes it up. Assume that the upward direction (north) is the positive direction.

a) Calculate the net force F net acting on the box

b) Does the box move? So, is the person pulling with enough force or he needs to pull stronger to move the box?

3. Find one example where forces acting an on object either change or does not change its motion. You can use pictures with explanations.