Newton's Model 2:

Newton's Model: A qualitative interpretation of Newton's First and Second Laws.

Situation	**Motion**
An object is not moving, and no net force acts on the object.	The object remains not moving.
An object is moving, and no net force acts on the object.	The object continues moving without changing speed.
An object is moving and the net force is in the *same direction* as the velocity of the object.	The object moves faster.
The object is moving and the net force is in the *opposite direction* as the velocity of the object.	The object slows down.

1. If the net force on an object is zero, there are two options for its motion:

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2. True or false: if the net force on an object is zero, it must not be moving.

3. True or false: if no force at all are acting on an object, then it must be not moving.

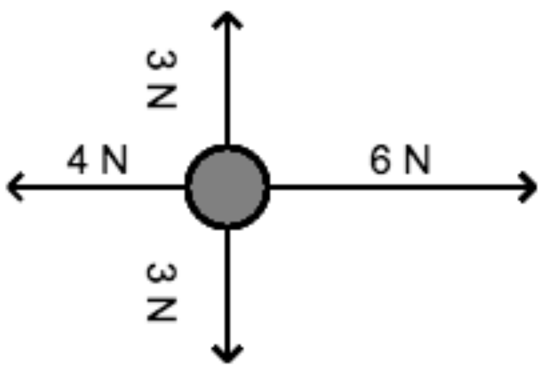
We are going to apply Newton's model to lifting something up.
When you lift something up, you typically do so at a constant velocity.

4a. A box has a weight of 145 Newtons.
Someone is lifting the box at a constant velocity.
Draw a free-body diagram of the person lifting the box. Include the *magnitude* and the *direction* of each force.

4b. A box has a weight of 468 Newtons.
A rope is pulling the box upward, and the box is *accelerating upward*.
Draw a free-body diagram for the box. There are two forces: weight and tension.
Include the *magnitude* and *direction* of each force.
Draw the arrows with correct relative lengths of magnitudes.
You may invent any reasonable magnitude for the force of tension.

4c. A box has a weight of 514 Newtons.
A rope is pulling the box upward, however, the box is *decelerating* (slowing down) is it is pulled up.
Draw a free-body diagram for the box. There are two forces: weight and tension.
Include the *magnitude* and *direction* of each force.
Draw the arrows with correct relative lengths of magnitudes.
You may invent any reasonable magnitude for the force of tension.

Questions **5** requires you to explain the motion of a toy car.
A perfect answer will a) say whether the car is accelerating, decelerating, or moving at a constant rate, and b) using Newton's Model, explain why.
A toy car is driving to the RIGHT. Four forces are acting on the toy car:



5**a.** Does the toy car accelerate, decelerate, or move at a constant speed? Using Newton's Model, explain why:

Now, somebody *adds* a force to the left of 3 Newtons. All other forces are unchanged.
5b. Does the toy car accelerate, decelerate, or move at a constant speed? Using Newton's Model, explain why:

The person relaxes his pull, so now the extra force to the left is 2 N.
5c. Does the toy car accelerate, decelerate, or move at a constant speed? Using Newton's Model, explain why:

Answers:

1.
- Moving at a constant velocity
- Not Motion

2. False, the object may be moving at a constant velocity

3. False, the object may be moving at a constant velocity

4a. The free-body diagram has two forces.
- Gravity pulls down with 145 N
- The person lifting the box pulls up with 145 N.
- The net force is zero and the box moves upward at a constant velocity

4b. The free-body diagram has two forces.
- Gravity pulls downward with 468 N.
- Tension pulls upward with a force **greater than** 468 N.
- The net force is upward and the box accelerates upward.

4c. The free-body diagram has two forces
- Gravity pulls downward with 514 N.
- Tension pulls upward with a force **less than** 514 N
- The net force is downward and the box decelerates.

[Net force and velocity are in opposite directions.]

5a. The car accelerates because the net force is 2 N to the right, and the car is moving to the right, as stated in the problem. According to Newton's Model, if net force and velocity are in the same directions, the car will accelerate.

5b. The car decelerates. Net force is 3 N to the left, and the car is moving to the right. According to Newton's Model, if net force and velocity are in opposite directions, the car will decelerate.

5c. The car moves at a constant speed, because the net force is now equal to zero.