

3D Net Force and Newton's First Law

Read:

Newton's first law tells us that when the net force is zero, objects at rest stay at rest and objects in motion keep moving with the same speed and direction. Changes in motion come from unbalanced forces.

In this skill sheet, you will practice identifying balanced and unbalanced forces in everyday situations.

Example:

- An empty shopping cart is pushed along a grocery store aisle at constant velocity. Find the cart's weight and the friction force if the shopper produces a force of 40.0 newtons between the wheels and the floor, and the normal force on the cart is 105 newtons.

- Looking for:** You are asked for the cart's weight and the friction force.
- Given:** You are given the normal force and the force produced by the shopper pushing the cart.
- Relationships:** Newton's first law states that if the shopping cart is moving at a constant velocity, the net force must be zero.
- Solution:** The weight of the cart balances the normal force. Therefore, the weight of the cart is a downward force: -105 N. The forward force produced by the shopper balances the friction force, so the friction force is -40.0 N.

Practice:

- Identify the forces on the same cart at rest.

- While the cart is moving along an aisle, it comes in contact with a smear of margarine that had recently been dropped on the floor. Suddenly the friction force is reduced from -40.0 newtons to -20.0 newtons. What is the net force on the cart if the "pushing force" remains at 40.0 newtons? Does the grocery cart move at constant velocity over the spilled margarine?

3. Identify the normal force on the shopping cart after 75 newtons of groceries are added to the cart.

4. The shopper pays for his groceries and pushes the shopping cart out of the store, where he encounters a ramp that helps him move the cart from the sidewalk down to the parking lot. What force accelerates the cart down the ramp?

5. Compare the friction force on the cart when it is rolling along the blacktop parking lot to the friction force on the cart when it is inside the grocery store (assume the flooring is smooth vinyl tile).

6. Why is it easy to get one empty cart moving but difficult to get a line of 20 empty carts moving?
