

## Unit P3 Review (Forces)

1. What is true about the net force of an object that is moving forward at a constant speed?

**Solution:** The net force is zero. *or* The forces are balanced.

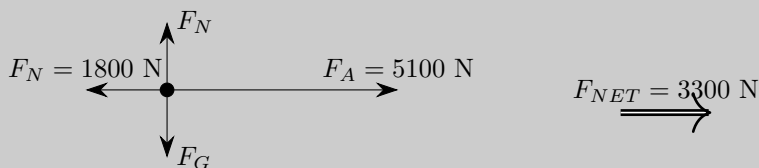
2. What is true about the net force of an object that is moving forward and speeding up?

**Solution:** The net force points forward. *or* The forces are unbalanced.

3. A car's engine pushes the car forward with a force of 5100 Newtons. The friction on the car is 1800 Newtons.

- (a) Draw a free body diagram.
- Make sure all the forces are labeled with letters.
  - Put the numbers in the diagram at the proper place
  - Draw the direction of the net force and calculate its magnitude

**Solution:**



- (b) The car has a mass of 970 kg. What is the acceleration of the car?

**Solution:**  $3.40 \text{ m/s}^2$

4. What is **inertia** and what law does it correspond to?

**Solution:** Inertia is the tendency of object's to resist changes in motion. It corresponds to Newton's First Law.

5. Which of Newton's laws best explains each of these? Explain your answer in at least one complete sentence.

- (a) Jen goes shopping at the grocery store. She notices that as she adds items to the cart it gets harder to push.

**Solution:** Second Law. As the mass of the cart increases, it accelerates less.

- (b) A rocket flies upward because of the fuel being pushed down out the bottom.

**Solution:** Third law. The action is the rocket pushing the fuel down; the reaction is the fuel pushing the rocket up.

- (c) When you are in a car and you slam on your brakes, your body keeps moving forward.

**Solution:** First law. Your body is in motion. It tries to stay in motion even though the car stops

6. You want a 6-kg bowling ball and a 0.5-kg whiffle ball to have the same acceleration. Which one needs more force?

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**Solution:** The bowling ball needs more force because of the Second Law. More mass leads to less acceleration, so you need more force to compensate.

7. Identify the Reaction Force in each of these cases:

- (a) You jump off the ground by pushing off of it. The action force is the force of your feet pushing the ground down.

**Solution:** The force of the ground pushing your feet up.

- (b) A tennis player hits a ball with his racket. The action force is the force of the racket on the ball.

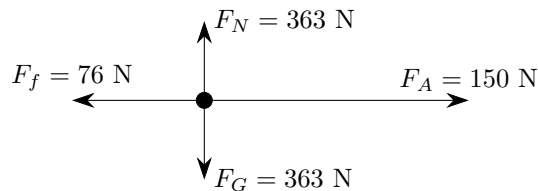
**Solution:** The force of the ball on the racket.

8. A 37-kg crate accelerates at a rate of 2 m/s/s.

- (a) Calculate the net force on the crate.

**Solution:**  $F_{NET} = 74 \text{ N}$

- (b) Assume that the net force is in the forward direction. Fill in the blanks in the following free-body diagram



9. What is the difference between mass and weight?

**Solution:**

- mass is a measure of an object's inertia
- weight is the force of gravity on the object

10. If you go to a different planet, what happens to your mass and your weight?

**Solution:** Your mass stays the same, but your weight changes.

11. Consider a 12-kg bowling ball.

- (a) What is the bowling ball's weight on earth?

**Solution:** 117.6 N

- (b) What is the bowling ball's weight on Mars where  $g = 3.71 \text{ m/s}^2$ ?

**Solution:** 44.52 N

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12. A rocket has a mass of 430 kg.

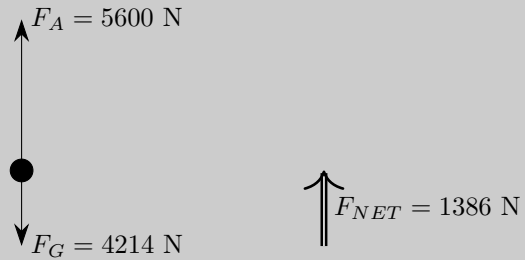
- (a) Calculate the weight (that is, Force of Gravity) of the rocket.

**Solution:** 4214 N

- (b) Its engines apply an upward force of 5600 Newtons. Assume there is no air resistance. Draw a free body diagram.

- Make sure all the forces are labeled with letters.
- Put the numbers in the diagram at the proper place
- Draw the direction of the net force and calculate its magnitude

**Solution:**



- (c) The rocket has a mass of 430 kg. What is the acceleration of the rocket?

**Solution:**  $3.22 \text{ m/s}^2$