A box that has a mass of 50 kg is sliding westward on a level floor. A boy pushes eastward on the box with a force of 90 N and friction exerts a force of 60 N on the box. Answer questions 1 - 5 for this situation.

1. ____ What is the net force acting on the box?
   A. 0 N
   B. 30 N eastward
   C. 150 N eastward
   D. 90 N eastward

2. ____ Which of the following describes the motion of the box?
   A. The box moves with a constant velocity.
   B. The box speeds up with an acceleration of .6 m/s² eastward
   C. The box slows down with an acceleration of 3 m/s² eastward.
   D. The box slows down with an acceleration of 1.8 m/s² eastward.

3. ____ What is the direction of the frictional force on the box?
   A. downward
   B. upward
   C. westward
   D. eastward

4. ____ What is the normal force that the surface exerts on the box?
   A. 490 N upward
   B. 50 kg downward
   C. 50 kg eastward
   D. 490 N eastward

5. ____ Which of the following forces is a reaction force to the frictional force that the surface exerts on the box?
   A. The box pushes downward on the surface.
   B. The box pulls on the surface in the westward direction.
   C. The box pushes against the boy with a force that is westward.
   D. The box pulls upward on the earth.
Turn the page for question 6.
6. A(3) In a complete sentence state Newton’s second law of motion.

B(3) On figure 1 draw a graph of force versus acceleration for an object that has a mass of .5 kg.

C(3) What are the values of the slope and intercept?

slope = ____________  intercept = ____________
Solutions and Answers:

1. C. Since the box is sliding westward the frictional force is eastward since it acts opposite the velocity. The net force is the vector sum of the boy’s force and the frictional force, \(90 \text{ N eastward} + 60 \text{ N eastward} = 150 \text{ N eastward}\).

2. C. Since the net force is 150 N eastward the acceleration is \(F/m = 150 \text{ N} / 50 \text{ kg eastward} = 3 \text{ m/s}^2 \text{ eastward}\).

3. D. Eastward, opposite the direction of the velocity.

4. A. The normal force must balance the downward force of the box’s weight, \(m g\). So the normal force must be upward and equal to \(50 \text{ kg times } 9.8 \text{ m/s}^2 = 490 \text{ N}\).

5. B. Because of friction the floor exerts an eastward force on the box. The reaction force to this is a westward force that the box exerts on the floor in the amount of 60 N.

6. Part A: Newton’s second law of motion states that the net force acting on an object equals the product of its mass and its acceleration.

6. Part C: The slope of the force versus acceleration curve is the mass, \(0.5 \text{ kg}\). The intercept is zero since the force is directly proportional to the acceleration, \(F = m a\), the y intercept is zero, the F versus a graph passes through the origin.