

Chapter 6 Newton's Second Law of Motion

Example Problems

6.1 Force and Acceleration

- Example 1:
 - Your car has a mass of 2000 kg and applies a force of 5000 N to the road, calculate the acceleration?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$

- Example 2:
 - A monkey catches a 0.5 kg softball and applies a force of 25 N. What is the acceleration of softball?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$

- Example 3:
 - A 1650 kg car accelerates at a rate of 4.0 m/s². How much force is the car's engine producing?.

What are the givens and unknowns?

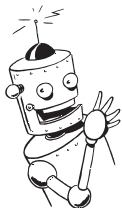
Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$

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- Example 4:

- A car of mass 2300 kg slows down at a rate of 3.0 m/s² when approaching a stop sign. What is the magnitude of the net force causing it to slow down?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$

- Example 5:

- A crate is dragged across an ice-covered lake. The box accelerates at 0.08 m/s² and is pulled by a 47 N force. What is the mass of the box?

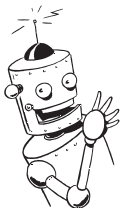
What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$



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- Example 6:
 - A sports car accelerates from 0 to 60 mph, 27 m/s, in 6.3 seconds. The car exerts a force of 4106 N. What is the mass of the car?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

$$a =$$

$$v_o =$$

$$v_f =$$

$$t =$$

- Example 7:
 - A 873-kg (1930-lb) dragster, starting from rest, attains a speed of 26.3 m/s (58.9 mph) in 0.59 s. Find the average acceleration of the dragster during this time interval and what is the magnitude of the average net force on the dragster during this time?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_{net} =$$

$$m =$$

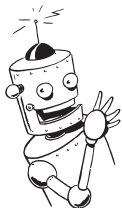
$$a =$$

$$v_o =$$

$$v_f =$$

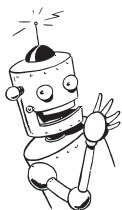
$$t =$$

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Student Problems

6.1 Force and Acceleration

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

1. A soccer player kicks a 0.600-kg soccer ball with a force of 80.0 N. What is the acceleration of the soccer ball?

What are the givens and unknowns?

Write the formula you are using

$$F_{net} =$$

$$m =$$

$$a =$$

Substitute the known values and solve.

a) _____ ← units

2. A 68 kg runner exerts a force of 59 N with each step she takes 59 N. What is the acceleration of the runner?

What are the givens and unknowns?

Write the formula you are using

$$F_{net} =$$

$$m =$$

$$a =$$

Substitute the known values and solve.

a) _____ ← units

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3. A cable is designed to support a maximum tension of 1,000 N. If a busted down car has a mass of 2,100 kg what is the maximum acceleration the car can towed at before the cable breaks?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

a) _____ ← units

4. A tennis ball, 0.314 kg, is accelerated at a rate of 164 m/s² when hit by a professional tennis player. What force does the player's tennis racket exert on the ball?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

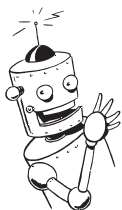
$m =$

$a =$

Substitute the known values and solve.

a) _____ ← units

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5. A monkey pulls a wagon with his dog in it. The mass of the dog and wagon together is 45 kg. The wagon accelerates at 0.85 m/s². Calculate the force the monkey applies.

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

a) _____ ← units

6. A monkey hits a 0.15 kg baseball and accelerated it at a rate of 3,000 m/s². How much force did the monkey exert on the ball?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

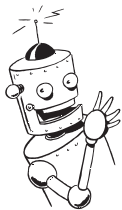
$m =$

$a =$

Substitute the known values and solve.

a) _____ ← units

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7. Three Monkeys push a stalled car. Each monkey pushes with a force of 425 N. What is the mass of the car if the car accelerates at 0.85 m/s².

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

a) _____ ← units

8. A sports car accelerates from 0 to 60 mph, 27 m/s, in 6.3 seconds. The car exerts a force of 4106 N. What is the mass of the car?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

$v_o =$

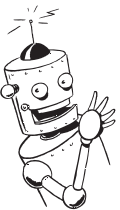
$v_f =$

$t =$

Substitute the known values and solve.

a) _____ b) _____

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9. A Porsche of mass of 1,430 Kg is heading north at 26.82 m/s when the brakes are applied causing the car to slow and come to rest in 2.32 seconds with a force of 16,530.8 N. What is the magnitude and direction of the acceleration on the car?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

$v_o =$

$v_f =$

$t =$

- a) _____ b) _____

10. A 204.11 kg motorcycle accelerates from rest to 24.59 m/s in 6.0 s. What is the magnitude of the average acceleration and the net force?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

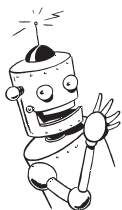
$v_o =$

$v_f =$

$t =$

- a) _____ b) _____

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11. A 1,200-kilogram car traveling at 10 m/s hits a tree and is brought to rest in 0.10 second. What is the magnitude of the average acceleration and net force?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

$v_o =$

$v_f =$

$t =$

a) _____ b) _____

12. A 0.149-kilogram baseball, initially moving at 15 m/s, is brought to rest in 0.040 second by a baseball glove on a catcher's hand. What is the magnitude of the average acceleration and net force exerted on the ball by the glove?

What are the givens and unknowns?

Write the formula you are using

$F_{net} =$

$m =$

$a =$

Substitute the known values and solve.

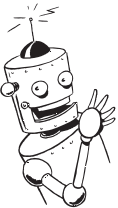
$v_o =$

$v_f =$

$t =$

a) _____ ← units

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Example Problems**6.2 Friction**

• Example 1:

- A monkey is dragging a box full of books from his office to his car. The box and books together have a combined weight of 134 N. If the coefficient of static friction between the pavement and the box is 0.55, how hard must the monkey push the box in order to start it moving?

What are the givens and unknowns?

Write your formula(s) and show your work

$$f_f =$$

$$N =$$

$$\mu =$$

• Example 2:

- A monkey is walking through the school cafeteria but does not realize that the person in front of him has just spilled his glass of chocolate milk. As the monkey, who weighs 420 N, steps in the milk, the coefficient of sliding friction between the monkey and the floor is suddenly reduced to 0.040. What is the force of sliding friction between the monkey and the slippery floor?

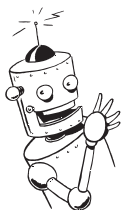
What are the givens and unknowns?

Write your formula(s) and show your work

$$f_f =$$

$$N =$$

$$\mu =$$



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• Example 3:

- The coefficient of static friction between a 40.0-kg picnic table and the ground below it is 0.43. What is the greatest horizontal force that could be exerted on the table while it remains stationary?

What are the givens and unknowns?

Write your formula(s) and show your work

$f_f =$

$N =$

$\mu =$

• Example 4:

- You need to move a 105 kg sofa to a different location in the room. It takes a force of 102 N to start the sofa sliding across the floor. What is the coefficient of static friction between the sofa and the floor?

What are the givens and unknowns?

Write your formula(s) and show your work

$f_f =$

$N =$

$\mu =$

• Example 5:

- A monkey exerts a 36 N horizontal force as he pulls sled across a cement sidewalk at constant speed. If the coefficient of friction between the runners on the sled and the cement sidewalk is 0.69 what is the weight and the mass of the sled?

What are the givens and unknowns?

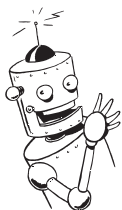
Write your formula(s) and show your work

$f_f =$

$N =$

$\mu =$

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Student Problems

6.2 Friction

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

13. At a wedding reception, you notice a small monkey who looks like his mass is about 25 kg, running part way across the dance floor, then sliding on his knees until he stops. If the kinetic coefficient of friction between the monkey's pants and the floor is 0.15, what is the frictional force acting on him as he slides?

What are the givens and unknowns?

Write the formula you are using

$f_f =$

$N =$

$\mu =$

Substitute the known values and solve.

a) _____ ← units

14. A gorilla has just bought a new refrigerator. The delivery man has left and the gorilla has realize that the refrigerator is not quite in the right position, so the gorilla plans to move it. If the refrigerator has a mass of 180 kg and the coefficient of static friction between the bottom of the refrigerator and the floor is 0.21, how hard does the gorilla have to push horizontally to get the refrigerator to start moving?

What are the givens and unknowns?

Write the formula you are using

$f_f =$

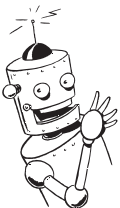
$N =$

$\mu =$

Substitute the known values and solve.

a) _____ ← units

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15. A monkey exerts a 21-N horizontal force as she pulls a 38-N sled across a cement sidewalk at constant speed. What is the coefficient of kinetic friction between the sidewalk and the metal sled runners?

What are the givens and unknowns?

Write the formula you are using

$$f_f =$$

$$N =$$

$$\mu =$$

Substitute the known values and solve.

a) _____ ← units

16. A monkey has a weight of 325 N. The monkey is taking a shower and then steps on a bar of soap. If the monkey slides forward and the frictional force between the soap and the tub is 50 N, what is the coefficient of friction between these two surfaces?

What are the givens and unknowns?

Write the formula you are using

$$f_f =$$

$$N =$$

$$\mu =$$

Substitute the known values and solve.

a) _____ ← units



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17. A big gorilla slides a 0.60-kg root beer from one the end of the counter to a thirsty monkey at the other end. A force of friction of 1.2 N brings the drink to a stop right in front of the monkey. What is the coefficient of sliding friction between the glass and the counter?

What are the givens and unknowns?

Write the formula you are using

$f_f =$

$N =$

$\mu =$

Substitute the known values and solve.

a) _____ ← units

18. A 50-kg block is at rest on a horizontal surface. The block is pulled by a string but it will not move unless the tension exceeds 350 N. What is the coefficient of static friction between the block and the surface?

What are the givens and unknowns?

Write the formula you are using

$f_f =$

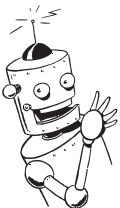
$N =$

$\mu =$

Substitute the known values and solve.

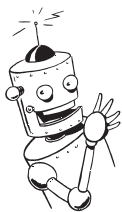
a) _____ ← units

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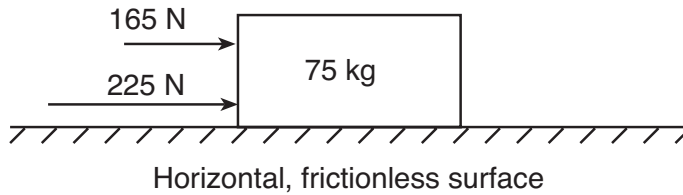


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Example Problems

6.3 Net Force

- Example 1:
 - Two horizontal forces, 225 N and 165 N, are exerted in the same direction on a 75 kg crate as shown. Find the net force and the acceleration of the crate.



What are the givens and unknowns?

Write your formula(s) and show your work

$F_{net} =$

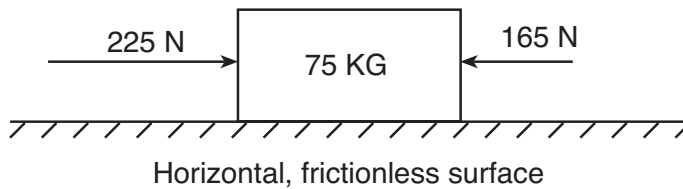
$F_1 =$

$F_2 =$

$m =$

$a =$

- Example 1:
 - Two horizontal forces, 225 N and 165 N, are exerted in opposite directions on a 75 kg crate as shown. Find the net force and the acceleration of the crate.



What are the givens and unknowns?

Write your formula(s) and show your work

$F_{net} =$

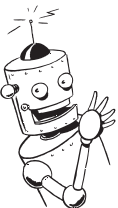
$F_1 =$

$F_2 =$

$m =$

$a =$

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- Example 3:

- SpongeBob and Patrick are playing tug-of-war with Squidward. SpongeBob pulls to the east with a force of 90 N and Patrick pulls to the west with a force of 92 N. If Squidward has a mass of 25-kg what is the magnitude and direction of the acceleration of Squidward Tentacles?

What are the givens and unknowns?

Write your formula(s) and show your work

$$F_1 =$$

$$F_2 =$$

$$m =$$

$$a =$$

- Example 4:

- A 900 kg car is traveling down the highway. The wheels exerts 5,000 N of traction force to the east while being opposed by 1,000 Newtons of friction and drag forces combined to the west, what is the magnitude and direction of the acceleration?

What are the givens and unknowns?

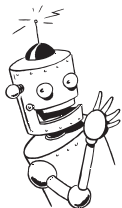
Write your formula(s) and show your work

$$F_p =$$

$$f_f =$$

$$m =$$

$$a =$$



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• Example 5:

- A big gorilla is playing tug-of-war with his pet monkey using a stuffed toy. At one instant during the game, the gorilla pulls on the toy with a force of 22 N, the monkey pulls in the opposite direction with a force of 19.5 N, and the toy experiences an acceleration of 6.25 m/s². What is the mass of the toy?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_1 =$

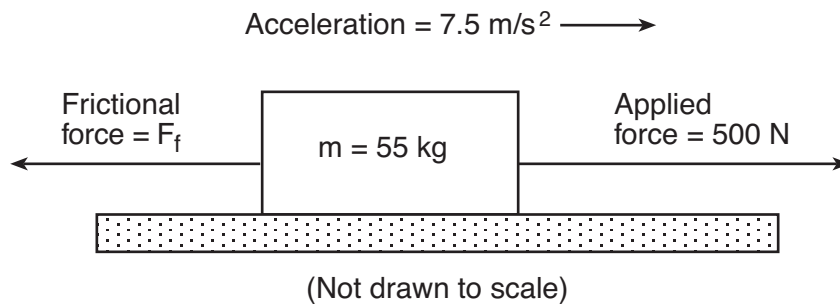
$F_2 =$

$m =$

$a =$

• Example 6:

- A 55 kg crate is pushed across the floor at 7.5 m/s² with a force of 500 N to the left, what is magnitude and direction of the frictional force?



What are the givens and unknowns?

Write your formula(s) and show your work

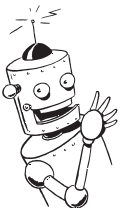
$F_p =$

$f_f =$

$m =$

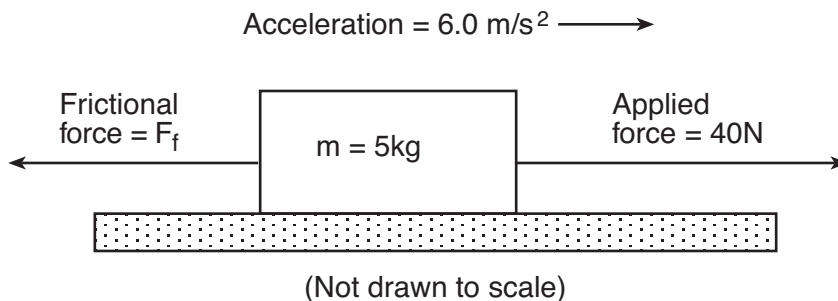
$a =$

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- Example 7:
 - A 5 kg crate is pushed across the floor at 6.0 m/s^2 with a force of 40 N to the left, what is magnitude and direction of the frictional force?



What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$f_f =$

$m =$

$a =$

- Example 8:
 - A car of mass 2,300 kg slows down at a rate of 3.0 m/s^2 when approaching a stop sign. What is the magnitude and direction of the net force?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$f_f =$

$m =$

$a =$



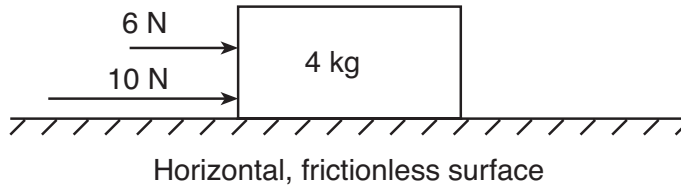
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Student Problems

6.3 Net Force

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

- Two horizontal forces, 6 N and 10 N, are exerted in the same direction on a 4 kg crate as shown. Find the net force and the acceleration of the crate.



What are the givens and unknowns?

Write your formula(s) and show your work

$F_{net} =$

$F_1 =$

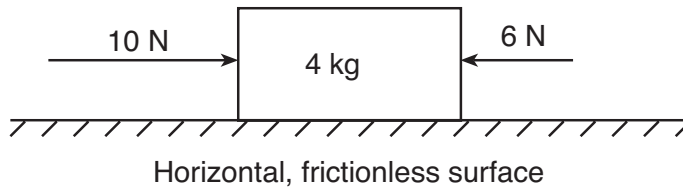
$F_2 =$

$m =$

$a =$

- a) _____ b) _____

- Two horizontal forces, 6 N and 10 N, are exerted in opposite directions on a 4 kg crate as shown. Find the net force and the acceleration of the crate.



What are the givens and unknowns?

Write your formula(s) and show your work

$F_{net} =$

$F_1 =$

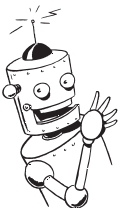
$F_2 =$

$m =$

$a =$

- a) _____ b) _____

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3. In a modified game of tug-of-war, two ropes are attached to a 25 kg tire and two people pull in opposite directions. If the participants exert forces of 156 N to the east and 148 N to the west, what is the magnitude and direction of the acceleration of the tire?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_1 =$

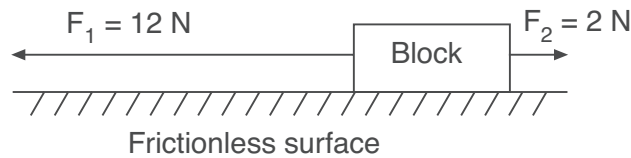
$F_2 =$

$m =$

$a =$

a) _____ b) _____

4. Two forces, F_1 and F_2 , are applied to a block on a frictionless, horizontal surface as shown below. If the magnitude of the block's acceleration is 2.0 m/s^2 , what is the mass of the block?



What are the givens and unknowns?

Write your formula(s) and show your work

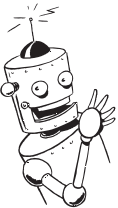
$F_1 =$

$F_2 =$

$m =$

$a =$

a) _____ ← units



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5. Two forces are applied to a block on a frictionless, horizontal surface. A 65 N force is applied to the east and a 71 N force is applied to the west. If the magnitude of the block's acceleration is 1.6 m/s^2 to the west, what is the mass of the block?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_1 =$

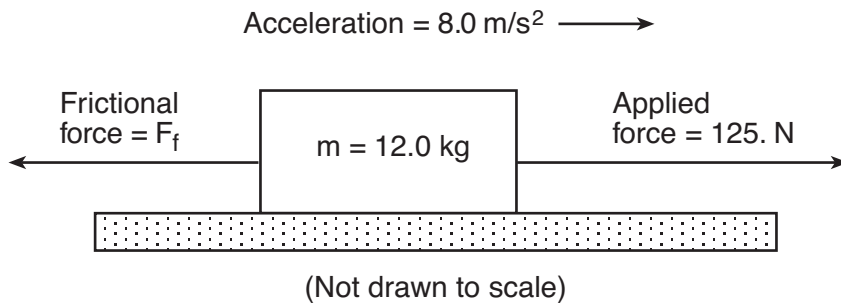
$F_2 =$

$m =$

$a =$

a) _____ ← units

6. The diagram below a 125 N force is applied to a 12.0 kg block accelerating the block at a rate of 8 m/s^2 . What is the magnitude of the frictional force acting on the block?



What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$f_f =$

$m =$

$a =$

a) _____ ← units

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7. A 100 kg crate is pushed across the floor at 2.58 m/s^2 with a force of 400 N to the left, what is magnitude and direction of the frictional force?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$f_f =$

$m =$

$a =$

a) _____ b) _____

8. A 225-kg crate is pushed horizontally with a force of 710 N. If the coefficient of friction is 0.20, What is the size of the frictional force and what is the acceleration of the crate.

What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$m =$

$a =$

$f_f =$

$N =$

$\mu =$

a) _____ b) _____

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9. You have run out of gas on the highway so and a buddy push your 2,000-kg car to the nearest gas station by each applying a horizontally force of 800 N. If the coefficient of friction is 0.08, what is the size of the frictional force and the acceleration of the car?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

$m =$

$a =$

$f_f =$

$N =$

$\mu =$

a) _____ b) _____

10. A 1.4-kg block slides across a rough surface such that it slows down with an acceleration of 1.25 m/s². What is the size of the frictional force?

What are the givens and unknowns?

Write your formula(s) and show your work

$F_p =$

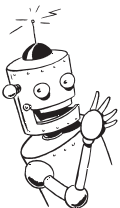
$f_f =$

$m =$

$a =$

a) _____ ← units

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Chapter 6 Newton's Second Law of Motion

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