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UNIT 7 PRACTICE PROBLEMS **AP PHYSICS**

7.1 NORMAL FORCES

1. A 23-kg suitcase is being pulled with constant speed by a handle that is at an angle of 25° above the horizontal. If the normal force exerted on the suitcase is 180 N, what is the force *F* applied to the handle?
2. **(a)** Find the normal force exerted on a 2.7-kg book resting on a surface inclined at 32° above the horizontal. **(b)** If the angle of the incline is reduced, do you expect the normal force to increase, decrease, or stay the same? Explain.
3. A gardener mows a lawn with an old-fashioned push mower. The handle of the mower makes an angle of 32° with the surface of the lawn. **(a)** If a 209-N force is applied along the handle of the 18-kg mower, what is the normal force exerted by the lawn on the mower? **(b)** If the angle between the surface of the lawn and the handle of the mower is increased, does the normal force exerted by the lawn increase, decrease, or stay the same? Explain.
4. Fernando, who has a mass of 43.0 kg, slides down the banister at his grandparents' house. **(a)** If the banister makes an angle of 35.0° with the horizontal, what is the normal force between Fernando and the banister? **(b)** If the friction is negligible, what is Fernando's acceleration down the banister?

7.2 FRICTIONAL FORCES

5. When you push a 1.80-kg book resting on a tabletop, it takes 2.25 N to start the book sliding. Once it is sliding, however, it takes only 1.50 N to keep the book moving with constant speed. What are the coefficients of static and kinetic friction between the book and the tabletop?
6. A baseball player slides into third base with an initial speed of 4.0 m/s. If the coefficient of kinetic friction between the player and the ground is 0.46, how far does the player slide before coming to rest?
7. A 45-kg crate is placed on an inclined ramp. When the angle the ramp makes with the horizontal is increased to 23°, the crate begins to slide downward. What is the coefficient of static friction between the crate and the ramp?
8. A child goes down a playground slide with an acceleration of 1.16 m/s^2. Find the coefficient of kinetic friction between the child and the slide if the slide is inclined at an angle of 31.0° below the horizontal.
9. To move a large crate across a rough floor, you push on it with a force *F* at an angle of 21° below the horizontal, as shown in the figure to the right. Find the force necessary to start the crate moving, given that the mass of the crate is 32 kg and the coefficient of static friction between the crate and the floor is 0.57.

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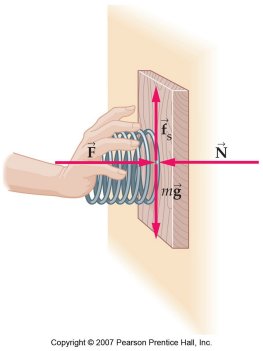
7.3 SPRING FORCES

10. When a 9.29-kg mass is placed on top of a vertical spring, the spring compresses 4.11 cm. Find the force constant of the spring.
11. A 110-kg box is loaded into the trunk of a car. If the height of the car's bumper decreases by 13 cm, what is the force constant of its rear suspension?
12. The equilibrium length of a certain spring with a force constant of k = 250 N/m is 0.18 m. **(a)** What is the magnitude of the force that is required to hold this spring at twice its equilibrium length? **(b)** Is the magnitude of the force required to keep the spring compressed to half its equilibrium length greater than, less than, or equal to the force found in part (a)? Explain.
13. A spring with a force constant of 120 N/m is used to push a 0.27-kg block of wood against a wall, as shown in the figure to the right. **(a)** Find the minimum compression of the spring needed to keep the block from falling, given that the coefficient of static friction between the block and the wall is 0.46. **(b)** Does your answer to part (a) change if the mass of the block of wood is doubled? Explain.



7.4 TENSION FORCES

14. Pulling up on a rope, you lift a 4.25-kg bucket of water from a well with an acceleration of 1.80 m/s^2. What is the tension in the rope?
15. A 50.0-kg person takes a nap in a backyard hammock. Both ropes supporting the hammock are at an angle of 15.0° above the horizontal. Find the tension in the ropes.
16. You are helping to repair a roof by loading equipment into a bucket that workers hoist to the rooftop. If the rope is guaranteed not to break as long as the tension does not exceed 450 N and you fill the bucket until it has a mass of 42 kg, what is the greatest acceleration that the workers can give the bucket as they pull it to the roof?

7.5 TRANSLATIONAL EQUILIBRIUM

17. Joe wishes to hang a sign weighing 7.50x10^2 N so that cable A, attached to the store, makes a 30.0° angle, as shown in Figure 5-20. Cable B is horizontal and attached to an adjoining building. What is the tension in cable B?

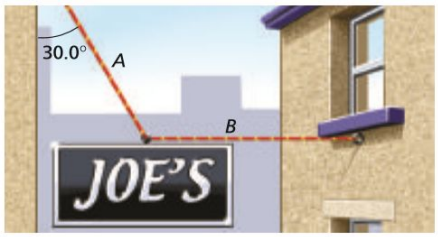


Figure 5-20

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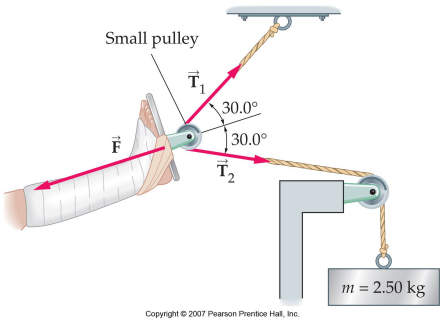
18. After a skiing accident, your leg is in a cast and supported in a traction device, as shown in the figure to the right. Find the magnitude of the force exerted by the leg on the small pulley. (By Newton's third law, the small pulley exerts an equal and opposite force on the leg.) Let the mass *m* be 2.50 kg.



7.6 CONNECTED OBJECTS

19. Two blocks, one of mass 5.0 kg and the other of mass 3.0 kg, are tied together with a massless rope as in **Figure 4-24**. This rope is strung over a massless, resistance-free pulley. The blocks are released from rest. Find the **(a)** the tension in the rope and **(b)** the acceleration of the blocks.

Figure 4-24

20. A 3.50-kg block on a smooth tabletop is attached by a string to a hanging block of mass 2.80 kg, as shown in the figure below. The blocks are released from rest and allowed to move freely. **(a)** Is the tension in the string greater than, less than, or equal to the weight of the hanging mass? Find **(b)** the acceleration of the blocks and **(c)** the tension in the string.