26. Professional Application: Blood is accelerated from rest to 30.0 cm/s in a distance of 1.80 cm by the left ventricle of the heart. (a) Make a sketch of the situation. (b) List the knowns in this problem. (c) How long does the acceleration take? To solve this part, first identify the unknown, and then discuss how you chose the appropriate equation to solve for it. After choosing the equation, show your steps in solving for the unknown, checking your units. (d) Is the answer reasonable when compared with the time for a heartbeat?
t=.120 s

47. (a) Calculate the height of a cliff if it takes 2.35 s for a rock to hit the ground when it is thrown straight up from the cliff with an initial velocity of 8.00 m/s. (b) How long would it take to reach the ground if it is thrown straight down with the same speed?
H=8.26 m, t=.717

49. You throw a ball straight up with an initial velocity of 15.0 m/s. It passes a tree branch on the way up at a height of 7.00 m. How much additional time will pass before the ball passes the tree branch on the way back down?
t1=.58, t2=2.49, interval t= 1.91

50. A kangaroo can jump over an object 2.50 m high. (a) Calculate its vertical speed when it leaves the ground. (b) How long is it in the air?
t=.714 s

The subway stops in downtown New York are so close together that the subway train must start deaccelerating before it reaches its maximum possible speed. Thus the train accelerates at +1.25 m/s^2 for the first half the distance between stops and then deaccelerates at -1.25 m/s^2 for the second half of the distance between stops. The 23rd and 28th Street stations are just 500 m apart. What is the total travel time between those two stops?
40 s

44. A rescue helicopter is hovering over a person whose boat has sunk. One of the rescuers throws a life preserver straight down to the victim with an initial velocity of 1.40 m/s and observes that it takes 1.8 s to reach the water. (a) List the knowns in this problem. (b) How high above the water was the preserver released?
H=18 m

57. A coin is dropped from a hot-air balloon that is 300 m above the ground and rising at 10.0 m/s upward. For the coin, find (a) the maximum height reached, (b) its position and velocity 4.00 s after being released, and (c) the time before it hits the ground.
H=5.1+300=305 m, y=262 m, v=-29.2 m/s, t=8.91 s

53. There is a 250-m-high cliff at Half Dome in Yosemite National Park in California. Suppose a boulder breaks loose from the top of this cliff. (a) How fast will it be going when it strikes the ground? (b) Assuming a reaction time of 0.300 s, how long will a tourist at the bottom have to get out of the way after hearing the sound of the rock breaking loose (neglecting the height of the tourist, which would become negligible anyway if hit)? The speed of sound is 335 m/s on this day.
v=-70 m/s, t=7.143-1.046=6.10 s

55. Suppose you drop a rock into a dark well and, using precision equipment, you measure the time for the sound of a splash to return. (a) Neglecting the time required for sound to travel up the well, calculate the distance to the water if the sound returns in 2.0000 s. (b) Now calculate the distance taking into account the time for sound to travel up the well. The speed of sound is 332.00 m/s in this well.
H=19.6 m, 18.5 m

22. A farmer wants to fence off his four-sided plot of flat land. He measures the first three sides, shown as A, B, and C in Figure 3.62, and then correctly calculates the length and orientation of the fourth side D. What is his result?
2.97 km 22.2° W of S

23. In an attempt to escape his island, Gilligan builds a raft and sets to sea. The wind shifts a great deal during the day, and he is blown along the following straight lines: 2.50 km 45.0° north of west; then 4.70 km 60.0° south of east; then 1.30 km 25.0° south of west; then 5.10 km straight east; then 1.70 km 5.00° east of north; then 7.20 km 55.0° south of west; and finally 2.80 km 10.0° north of east. What is his final position relative to the island?
7.34 km 63.5° S of E

56. A football quarterback is moving straight backward at a speed of 2.00 m/s when he throws a pass to a player 18.0 m straight downfield. The ball is thrown at an angle of 25.0° relative to the ground and is caught at the same height as it is released. What is the initial velocity of the ball relative to the quarterback? 17.0 m/s 22.1°

62. The velocity of the wind relative to the water is crucial to sailboats. Suppose a sailboat is in an ocean current that has a velocity of 2.20 m/s in a direction 30.0° east of north relative to the Earth. It encounters a wind that has a velocity of 4.50 m/s in a direction of 50.0° south of west relative to the Earth. What is the velocity of the wind relative to the water? 6.68 m/s, 53.3° S of W

25. A projectile is launched at ground level with an initial speed of 50.0 m/s at an angle of 30.0° above the horizontal. It strikes a target above the ground 3.00 seconds later. What are the x and y distances from where the projectile was launched to where it lands?
x=130 m, y=30.9 m

34. An arrow is shot from a height of 1.5 m toward a cliff of height H. It is shot with a velocity of 30 m/s at an angle of 60° above the horizontal. It lands on the top edge of the cliff 4.0 s later. (a) What is the height of the cliff? (b) What is the maximum height reached by the arrow along its trajectory? (c) What is the arrow's impact speed just before hitting th
e cliff?
H=1.5+25.5=27.0 m, max=1.5+34.4=35.9, vy=-13.2, v= 20 m/s

40. An eagle is flying horizontally at a speed of 3.00 m/s when the fish in her talons wiggles loose and falls into the lake 5.00 m below. Calculate the velocity of the fish relative to the water when it hits the water.
vy=-9.90 m/s, v=10.3 m/s

37. Serving at a speed of 170 km/h, a tennis player hits the ball at a height of 2.5 m and an angle θ below the horizontal. The service line is 11.9 m from the net, which is 0.91 m high. What is the angle θ such that the ball just crosses the net? Will the ball land in the service box, whose out line is 6.40 m from the net?
6.1°, yes

10. A powerful motorcycle can produce an acceleration of 3.50 m/s^2 while traveling at 90.0 km/h. At that speed the forces resisting motion, including friction and air resistance, total 400 N. (Air resistance is analogous to air friction. It always opposes the motion of an object.) What is the magnitude of the force the motorcycle exerts backward on the ground to produce its acceleration if the mass of the motorcycle with rider is 245 kg?
1.26 kN

20. Suppose a 60.0-kg gymnast climbs a rope. (a) What is the tension in the rope if he climbs at a constant speed? (b) What is the tension in the rope if he accelerates upward at a rate of 1.50 m/s^2 ?
T1=588 N, T2=678 N

42. A 76.0-kg person is being pulled away from a burning building as shown in Figure 4.41. Calculate the tension in the two ropes if the person is momentarily motionless. Include a free-body diagram in your solution.
Ta=736 N, Tb=194 N

A spider of mass m=9E-5 kg hangs straight down on a 30 cm long thread she has just created. What is the tension in the thread? A steady breeze from the south pushes the hanging spider towards the north so that the thread makes an angle of 20° with the vertical. What is the tension in the thread now? Please draw a free body diagram for each situation!
T=.882 mN, .939 mN

34. Figure 4.39 shows Superhero and Trusty Sidekick hanging motionless from a rope. Superhero’s mass is 90 kg, while Trusty Sidekick’s is 55 kg, and the mass of the rope is negligible. (a) Draw a free-body diagram of the situation showing all forces acting on Superhero, Trusty Sidekick, and the rope. (b) Find the tension in the rope above Superhero. (c) Find the tension in the rope between Superhero and Trusty Sidekick. Indicate on your free-body diagram the system of interest used to solve each part.
Tb=1.42 kN, Tc=539 N

35. A nurse pushes a cart by exerting a force on the handle at a downward angle 35.0° below the horizontal. The loaded cart has a mass of 28 kg, and the force of friction is 60 N. (a) Draw a free-body diagram for the system of interest. (b) What force must the nurse exert to move at a constant velocity?
F=73 N

31. Two children pull a third child on a snow saucer sled exerting forces F1 and F2 as shown from above in Figure 4.36. Find the acceleration of the 49 kg sled and child system. Note that the direction of the frictional force is unspecified; it will be in the opposite direction of the sum of F1 and F2 .
a=.14 m/s^2, direction: 12.4°

17. Consider the 52 kg mountain climber in Figure 5.22. (a) Find the tension in the rope and the force that the mountain climber must exert with her feet on the vertical rock face to remain stationary. Assume that the force is exerted parallel to her legs.
Assume negligible force exerted by her arms.
Flegs=272 N, T=512 N

4. Suppose you have a 120 kg wooden crate resting on a wood floor. (a) What maximum force can you exert horizontally on the crate without moving it? (b) If you continue to exert this force once the crate starts to slip, what will the magnitude of its acceleration then be? $\mu s=0.5$, $\mu k=0.3$
F=588 N; a=1.96 m/s^2

18. A contestant in a winter sporting event pushes a 45.0-kg block of ice across a frozen lake as shown in Figure 5.23(a). (a) Calculate the minimum force F he must exert to get the block moving. (b) What is the magnitude of its acceleration once it starts to move, if that force is maintained?
19. Repeat Exercise 5.18 with the contestant pulling the block of ice with a rope over his shoulder at the same angle above the horizontal as shown in Figure 5.23(b).
$\mu s=0.1$, $\mu k=0.03$
18: F=51.0 N, a=.720 m/s^2
19: F=46.5 N, a=.629 m/s^2

42. When water freezes, its volume increases by 9.05% (that is, ΔV / V0 = .0905). What force per unit area is water capable of exerting on a container when it freezes?
B=2.2e+9 N/m^2; 2e8 N/m^2 = 2e4 N/cm^2

25. Calculate the speed a spherical rain drop would achieve falling from 5 km (a) in the absence of air drag (b) with air drag. Take the radius of the drop to be 2 mm, the density to be 1000 kg/m^3 , and the surface area to be π r^2.
air density= 1.21 kg/m^3, C=.45
v=313 m/s; v=9.8 m/s

7. Consider the 65 kg ice skater being pushed by two others shown in Figure 5.21. (a) Find the direction and magnitude of Ftot, the total force exerted on her by the others, given that the magnitudes F1 and F2 are 26.4 N and 18.6 N, respectively. (b) What is her initial acceleration if she is initially stationary and wearing steel-bladed skates that point in the direction of Ftot ? (c) What is her acceleration assuming she is already moving in the direction of Ftot ?
μs=0.4 [sic: as in my hardcopy], μk=0.02
Ftot=32.3 N @35.3°
static friction < 255 N (no acceleration)
kinetic friction = 12.7 N; a=.3 m/s^2

33. (a) By how much does a 65 kg mountain climber stretch her 0.8 cm diameter nylon rope when she hangs 35 m below a rock outcropping?
Y=5e9 N/m^2
Δx=8.9e-2 m=8.9 cm

34. A 20 m tall hollow aluminum flagpole is equivalent in stiffness to a solid cylinder 4 cm in diameter. A strong wind bends the pole much as a horizontal force of 900 N exerted at the top would. How far to the side does the top of the pole flex?
S=25e9 N/m^2
Δx=5.7e-4 m = .57 mm