Chapter 4: 3, 6, 22, 30, 38, 42, 47, 51, 56, 62, 65, 66, 79, 90, 97

3 • [**SSM**] You are riding in a limousine that has opaque windows which do not allow you to see outside. The car can accelerate by speeding up, slowing down, or turning. Equipped with just a small heavy object on the end of a string, how can you use it to determine if the limousine is changing either speed or direction? Can you determine the limousine's velocity?

Determine the Concept The sum of the external forces on the object is always proportional to its acceleration relative to an inertial reference frame. Any reference frame that maintains a zero acceleration relative to an inertial reference frame is itself an inertial reference frame, and vice versa. The ground is an inertial reference frame. If the limo does not accelerate (that is if it does not change direction or speed) relative to the ground, the pendulum will dangle straight down so that the net force on the bob is zero (no acceleration). In that case, the limo is an inertial reference frame. Just with this apparatus and not looking outside you cannot tell the limo's velocity; all you know is that it is constant.

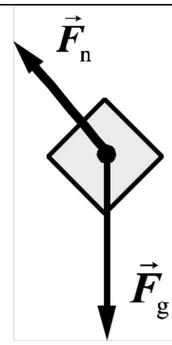
6 •• A truck moves away from you at constant velocity, as observed by you at rest on the surface of the Earth. It follows that (*a*) no forces act on the truck, (*b*) a constant force acts on the truck in the direction of its velocity, (*c*) the net force acting on the truck is zero, (*d*) the net force acting on the truck is its weight.

Determine the Concept An object in an inertial reference frame accelerates if there is a *net* force acting on it. Because the object is moving at constant velocity, the net force acting on it is zero. **(*c*)** is correct.

22 •• (*a*) Which of the free-body diagrams in Figure 4-34. represents a block sliding down a frictionless inclined surface? (*b*) For the correct figure, label the forces and tell which are contact forces and which are action-at-a-distance forces. (*c*) For each force in the correct figure, identify the reaction force, the object it acts on and its direction.

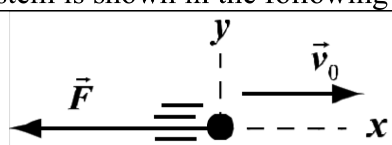
Determine the Concept Identify the objects in the block's environment that are exerting forces on the block and then decide in what directions those forces must be acting if the block is sliding *down* the inclined plane.

(*a*) Free-body diagram **(*c*)** is correct.

(*b*) Because the incline is frictionless, the force $\vec{F}_n$ the incline exerts on the block must be normal to the surface and is a contact force. The second object capable of exerting a force on the block is the earth and its force; the gravitational force $\vec{F}_g$ acting on the block acts directly downward and is an action-at-a-distance force. The magnitude of the normal force is less than that of the weight because it supports only a portion of the weight.	
(*c*) The reaction to the normal force is the force the block exerts perpendicularly on the surface of the incline. The reaction to the gravitational force is the upward force the block exerts on the Earth.	

30 • A particle of mass *m* is traveling at an initial speed $v_0 = 25.0$ m/s. Suddenly a constant force of 15.0 N acts on it, bringing it to a stop in a distance of 62.5 m. (*a*) What is the direction of the force? (*b*) Determine the time it takes for the particle to come to a stop. (*c*) What is its mass?

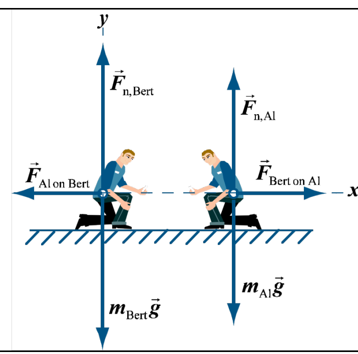
Picture the Problem The acceleration of the particle, its stopping time, and its mass can be found using constant-acceleration equations and Newton's 2nd law. A convenient coordinate system is shown in the following diagram.



(*a*) Because the constant force slows the particle, we can conclude that, as shown in the diagram, its direction is opposite the direction of the particle's motion.	
(*b*) Use a constant-acceleration equation to relate the initial and final velocities of the particle to its acceleration and stopping time:	$v_x = v_{0x} + a_x\Delta t$ or, because $v_x = 0$, $0 = v_{0x} + a_x\Delta t \Rightarrow \Delta t = -\dfrac{v_{0x}}{a_x}$ (1)
Use a constant-acceleration equation to relate the initial and final velocities of the particle to its acceleration and stopping distance:	$v_x^2 = v_{0x}^2 + 2a_x\Delta x$ or, because $v_x = 0$, $0 = v_{0x}^2 + 2a_x\Delta x \Rightarrow a_x = \dfrac{-v_{0x}^2}{2\Delta x}$
Substituting for a_x in equation (1) yields:	$\Delta t = \dfrac{2\Delta x}{v_{0x}}$

Substitute numerical values and evaluate Δt:	$\Delta t = \frac{2(62.5\ \text{m})}{25.0\ \text{m/s}} = \boxed{5.00\ \text{s}}$
(*c*) Apply Newton's 2nd law to the particle to obtain:	$\sum \boldsymbol{F}_x = -\boldsymbol{F}_{\text{net}} = \boldsymbol{m}\boldsymbol{a}_x$
Solving for m yields:	$m = \frac{-F_{\text{net}}}{a_x}$ (2)
Because the force is constant, you can use a constant-acceleration equation to relate the particle's initial and final speeds, acceleration, and stopping distance:	$v_x^2 = v_{0x}^2 + 2a_x\Delta x$ or, because $v_x = 0$, $0 = v_{0x}^2 + 2a_x\Delta x \Rightarrow a_x = \frac{-v_{0x}^2}{2\Delta x}$
Substitute for a_x in equation (2) to obtain:	$m = \frac{2\Delta x F_{\text{net}}}{v_{0x}^2}$
Substitute numerical values and evaluate m:	$\boldsymbol{m} = \frac{2(62.5\,\text{m})(15.0\,\text{N})}{(25.0\,\text{m/s})^2} = \boxed{3.00\,\text{kg}}$

38 •• Al and Bert stand in the middle of a large frozen lake (frictionless surface). Al pushes on Bert with a force of 20 N for 1.5 s. Bert's mass is 100 kg. Assume that both are at rest before Al pushes Bert. (*a*) What is the speed that Bert reaches as he is pushed away from Al? (*b*) What speed does Al reach if his mass is 80 kg?

Picture the Problem The speed of either Al or Bert can be obtained from their accelerations; in turn, they can be obtained from Newtons 2nd law applied to each person. The free-body diagrams to the right show the forces acting on Al and Bert. The forces that Al and Bert exert on each other are action-and-reaction forces.	

(*a*) Apply $\sum F_x = ma_x$ to Bert:	$-F_{\text{Al on Bert}} = m_{\text{Bert}}a_{\text{Bert}} \Rightarrow \boldsymbol{a}_{\text{Bert}} = \frac{-\boldsymbol{F}_{\text{Al on Bert}}}{\boldsymbol{m}_{\text{Bert}}}$
Substitute numerical values and evaluate a_{Bert}:	$\boldsymbol{a}_{\text{Bert}} = \frac{-20\,\text{N}}{100\,\text{kg}} = -0.200\,\text{m/s}^2$

Using a constant-acceleration equation, relate Bert's speed to his initial speed, speed after 1.5 s, and acceleration:	$v_x = v_{0x} + a_{\text{Bert},x}\Delta t$
Substitute numerical values and evaluate Bert's speed at the end of 1.5 s:	$v_x = 0 + (-0.200\text{ m/s}^2)(1.5\text{ s})$ $= \boxed{-0.30\text{ m/s}}$
(*b*) From Newton's 3rd law, an equal but oppositely directed force acts on Al while he pushes Bert. Because the ice is frictionless, Al speeds off in the opposite direction. Apply $\sum F_x = ma_x$ to Al:	$\sum \boldsymbol{F}_{x,\text{Al}} = \boldsymbol{F}_{\text{Bert on Al},x} = \boldsymbol{m}_{\text{Al}}\boldsymbol{a}_{\text{Al},x}$
Solving for Al's acceleration yields:	$\boldsymbol{a}_{\text{Al,x}} = \dfrac{\boldsymbol{F}_{\text{Bert on Al},x}}{\boldsymbol{m}_{\text{Al}}}$
Substitute numerical values and evaluate $a_{\text{Al},x}$:	$\boldsymbol{a}_{\text{Al},x} = \dfrac{20\text{ N}}{80\text{ kg}} = 0.250\text{ m/s}^2$
Using a constant-acceleration equation, relate Al's speed to his initial speed, speed after 1.5 s, and acceleration:	$v_x = v_{0x} + a_{\text{Al},x}\Delta t$
Substitute numerical values and evaluate Al's speed at the end of 1.5 s:	$v_x(1.5\text{ s}) = 0 + (0.250\text{ m/s}^2)(1.5\text{ s})$ $= \boxed{0.38\text{ m/s}}$

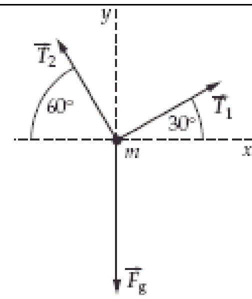
42 • On the moon, the acceleration due to gravity is only about 1/6 of that on Earth. An astronaut, whose weight on earth is 600 N, travels to the lunar surface. His mass, as measured on the moon, will be (*a*) 600 kg, (*b*) 100 kg, (*c*) 61.2 kg, (*d*) 9.81 kg, (*e*) 360 kg.

Picture the Problem The mass of the astronaut is independent of gravitational fields and will be the same on the moon or, for that matter, out in deep space.

Express the mass of the astronaut in terms of his weight on earth and the gravitational field at the surface of the earth:	$m = \dfrac{w_{\text{earth}}}{g_{\text{earth}}} = \dfrac{600\text{ N}}{9.81\text{ N/kg}} = 61.2\text{ kg}$ and $\boxed{(c)}$ is correct.

47 • A traffic light (mass 35.0 kg) is supported by two wires as in Figure 4-36. (*a*) Draw the light's free body diagram and use it to answer the following question qualitatively: Is the tension in wire 2 greater than or less than the tension in wire 1? (*b*) Prove your answer by applying Newton's laws and solving for the two tensions.

Picture the Problem Because the traffic light is not accelerating, the *net* force acting on it must be zero; i.e., $\vec{T}_1+\vec{T}_2+\vec{F}_g = 0$.

Construct a free-body diagram showing the forces acting on the support point:	
Apply $\sum F_x = ma_x$ to the support point:	$T_1\cos 30° - T_2\cos 60° = ma_x = 0$
Solve for T_2 in terms of T_1:	$T_2 = \frac{\cos 30°}{\cos 60°}T_1 = 1.73T_1$ Thus T_2 is greater than T_1.

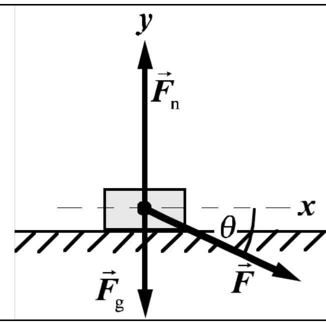
51 •• **[SSM]** A 10-kg object on a frictionless table is subjected to two horizontal forces, $\vec{F}_1$ and $\vec{F}_2$, with magnitudes $F_1 = 20$ N and $F_2 = 30$ N, as shown in Figure 4-40. Find the third force $\vec{F}_3$ that must be applied so that the object is in static equilibrium.

Picture the Problem The acceleration of *any* object is directly proportional to the *net* force acting on it. Choose a coordinate system in which the positive *x* direction is the same as that of $\vec{F}_1$ and the positive *y* direction is to the right. Add the two forces to determine the net force and then use Newton's 2nd law to find the acceleration of the object. If $\vec{F}_3$ brings the system into equilibrium, it must be true that $\vec{F}_3+\vec{F}_1+\vec{F}_2 = 0$.

Express $\vec{F}_3$ in terms of $\vec{F}_1$ and $\vec{F}_2$:	$\vec{F}_3 = -\vec{F}_1 - \vec{F}_2$ (1)
Express $\vec{F}_1$ and $\vec{F}_2$ in unit vector notation:	
$\vec{F}_1 = (20\,\text{N})\hat{i}$ and $\vec{F}_2 = \{(-30\,\text{N})\sin 30°\}\hat{i} + \{(30\,\text{N})\cos 30°\}\hat{j} = (-15\,\text{N})\hat{i} + (26\,\text{N})\hat{j}$	

Substitute for $\vec{F}_1$ and $\vec{F}_2$ in equation (1) and simplify to obtain:
$\vec{F}_3 = -(20\ \text{N})\hat{i} - \left[(-15\ \text{N})\hat{i} + (26\ \text{N})\hat{j}\right] = \boxed{(-5.0\ \text{N})\hat{i} + (-26\ \text{N})\hat{j}}$

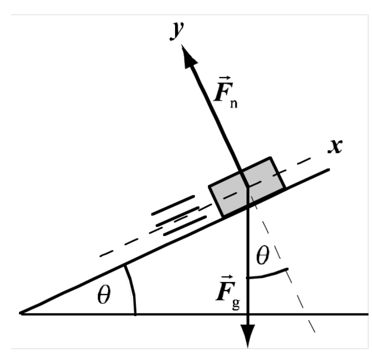
56 • A large box whose mass is 20.0 kg rests on a frictionless floor. A mover pushes on the box with a force of 250 N at an angle 35.0º below the horizontal. Draw the box's free body diagram and use it to determine the acceleration of the box.

Picture the Problem The free-body diagram shows the forces acting on the box as the man pushes it across the frictionless floor. We can apply Newton's 2nd law to the box to find its acceleration.	

Apply $\sum F_x = ma_x$ to the box:	$F\cos\theta = ma_x \Rightarrow a_x = \dfrac{F\cos\theta}{m}$
Substitute numerical values and evaluate a_x:	$a_x = \dfrac{(250\ \text{N})\cos 35.0°}{20.0\ \text{kg}} = \boxed{10.2\ \text{m/s}^2}$

62 •• A block of mass m slides across a frictionless floor and then up a frictionless ramp (Figure 4-48). The angle of the ramp is θ and the speed of the block before it starts up the ramp is v_0. The block will slide up to some maximum height h above the floor before stopping. Show that h is independent of θ by deriving an expression for h in terms of v_0 and g.

Picture the Problem The free-body diagram for the block sliding up the incline is shown to the right. Applying Newton's 2nd law to the forces acting in the x direction will lead us to an expression for a_x. Using this expression in a constant-acceleration equation will allow us to express h as a function of v_0 and g.



Relate the height h is related to the distance Δx traveled up the incline:

$$h = \Delta x \sin\theta \qquad (1)$$

Using a constant-acceleration equation, relate the final speed of the block to its initial speed, acceleration, and distance traveled:

$$v_x^2 = v_{0x}^2 + 2a_x\Delta x$$

or, because $v_x = 0$,

$$0 = v_{0x}^2 + 2a_x\Delta x \Rightarrow \Delta x = \frac{-v_{0x}^2}{2a_x}$$

Substituting for Δx in equation (1) yields:

$$\boldsymbol{h} = \frac{-\boldsymbol{v}_{0x}^2}{2\boldsymbol{a}_x}\sin\boldsymbol{\theta} \qquad (2)$$

Apply $\sum F_x = ma_x$ to the block and solve for its acceleration:

$$-\boldsymbol{F}_g\sin\boldsymbol{\theta} = \boldsymbol{ma}_x$$

Because $\boldsymbol{F}_g = \boldsymbol{mg}$:

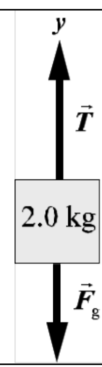
$$-\boldsymbol{mg}\sin\boldsymbol{\theta} = \boldsymbol{ma}_x \Rightarrow \boldsymbol{a}_x = -\boldsymbol{g}\sin\boldsymbol{\theta}$$

Substitute for a_x in equation (2) and simplify to obtain:

$$\boldsymbol{h} = \left(\frac{\boldsymbol{v}_{0x}^2}{2\boldsymbol{g}\sin\boldsymbol{\theta}}\right)\sin\boldsymbol{\theta} = \boxed{\frac{\boldsymbol{v}_{0x}^2}{2\boldsymbol{g}}}$$

which is independent of the ramp's angle θ.

65 •• A 2.0-kg block hangs from a spring scale calibrated in newtons that is attached to the ceiling of an elevator (Figure 4-49).What does the scale read when (*a*) the elevator is ascending with a constant speed of 30 m/s, (*b*) the elevator is descending with a constant speed of 30 m/s, (*c*) the elevator is ascending at 20 m/s and gaining speed at a rate of 3.0 m/s^2? (*d*) Suppose that from $t = 0$ to $t = 5.0$ s, the elevator ascends at a constant speed of 10 m/s. Its speed is then steadily reduced to zero during the next 4.0 s, so that it is at rest at $t = 9.0$ s. Describe the reading of the scale during the interval $0 < t < 9.0$ s.

Picture the Problem The free-body diagram shows the forces acting on the 2-kg block as the elevator ascends at a constant velocity. Because the acceleration of the elevator is zero, the block is in equilibrium under the influence of $\vec{T}$ and $m\vec{g}$. Apply Newton's 2nd law of motion to the block to determine the scale reading.	

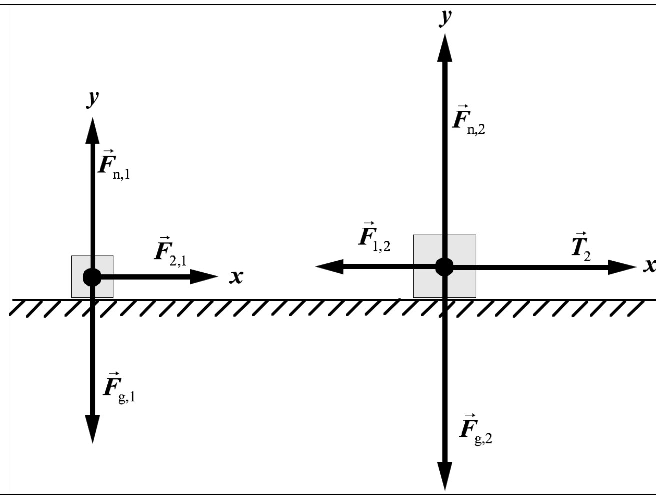
(*a*) Apply $\sum F_y = ma_y$ to the block to obtain:	$\boldsymbol{T} - \boldsymbol{F}_g = \boldsymbol{ma}_y$ or, because $F_g = mg$, $\boldsymbol{T} - \boldsymbol{mg} = \boldsymbol{ma}_y$ (1)
For motion with constant velocity,	$T - mg = 0 \Rightarrow T = mg$

$a_y = 0$ and:	
Substitute numerical values and evaluate T:	$\boldsymbol{T} = (2.0\,\text{kg})(9.81\,\text{m/s}^2) = \boxed{20\,\text{N}}$
(*b*) As in part (*a*), for constant velocity, $a_y = 0$. Hence:	$\boldsymbol{T} - \boldsymbol{mg} = 0$ and $\boldsymbol{T} = (2.0\,\text{kg})(9.81\,\text{m/s}^2) = \boxed{20\,\text{N}}$
(*c*) Solve equation (1) for T and simplify to obtain:	$T = mg + ma_y = m(g + a_y)$ (2)
Because the elevator is ascending and its speed is increasing, we have $a_y = 3.0\text{ m/s}^2$. Substitute numerical values and evaluate T:	$\boldsymbol{T} = (2.0\,\text{kg})(9.81\,\text{m/s}^2 + 3.0\,\text{m/s}^2)$ $= \boxed{26\,\text{N}}$
(*d*) During the interval $0 < t < 5.0$ s, $a_y = 0$. Hence:	$\boldsymbol{T}_{0\to 5.0\,\text{s}} = \boxed{20\text{ N}}$
Using its definition, calculate a for $5.0\text{ s} < t < 9.0$ s:	$a = \frac{\Delta v}{\Delta t} = \frac{0 - 10\,\text{m/s}}{4.0\,\text{s}} = -2.5\,\text{m/s}^2$
Substitute in equation (2) and evaluate T:	$\boldsymbol{T}_{5\,\text{s}\to 9\,\text{s}} = (2.0\,\text{kg})(9.81\,\text{m/s}^2 - 2.5\text{m/s}^2)$ $= \boxed{15\,\text{N}}$

66 •• Two boxes of mass m_1 and m_2 connected by a massless string are being pulled along a horizontal frictionless surface, as shown in Figure 4-50.
(*a*) Draw the free body diagram of both boxes separately and show that $\boldsymbol{T}_1/\boldsymbol{T}_2 = \boldsymbol{m}_1/(\boldsymbol{m}_1 + \boldsymbol{m}_2)$. (*b*) Is this result plausible? Explain. Does your answer make sense both in the limit that**Error! Objects cannot be created from editing field codes.**and in the limit that $\boldsymbol{m}_2/\boldsymbol{m}_1 << 1$? Explain.

Picture the Problem Draw a free-body diagram for each box and apply Newton's 2nd law. Solve the resulting simultaneous equations for the ratio of T_1 to T_2.

(*a*) The free-body diagrams for the two boxes are shown below:



Apply $\sum F_x = ma_x$ to the box on the left:	$F_{2,1} = m_1 a_{1x}$ or, because $F_{2,1} = T_1$, $T_1 = m_1 a_{1x}$
Apply $\sum F_x = ma_x$ to the box on the right:	$T_2 - F_{1,2} = m_2 a_{2x}$ or, because $F_{1,2} = T_1$, $T_2 - T_1 = m_2 a_{2x}$
Because the boxes have the same acceleration, we can divide the second equation by the first to obtain:	$\frac{T_1}{T_2 - T_1} = \frac{m_1}{m_2} \Rightarrow \frac{T_1}{T_2} = \boxed{\frac{m_1}{m_1 + m_2}}$
(b) Divide the numerator and denominator of the expression inside the parentheses by m_1 to obtain:	$\frac{T_1}{T_2} = \frac{1}{1 + \frac{m_2}{m_1}}$
For **Error! Objects cannot be created from editing field codes.**:	$\frac{T_1}{T_2} \to \boxed{0}$, as expected.
For $m_2/m_1 << 1$:	$\frac{T_1}{T_2} \to \boxed{T_2}$, as expected.

79 •• **[SSM]** A 60-kg housepainter stands on a 15-kg aluminum platform. The platform is attached to a rope that passes through an overhead pulley, which allows the painter to raise herself and the platform (Figure 4-57). (a) To accelerate herself and the platform at a rate of 0.80 m/s^2, with what force F must she pull down on the rope? (b) When her speed reaches 1.0 m/s, she pulls in such a way that she and the platform go up at a constant speed. What force is she exerting on the rope now? (Ignore the mass of the rope.)

Picture the Problem Choose a coordinate system in which the upward direction is the positive y direction. Note that $\vec{F}$ is the force exerted by the painter on the rope and that $\vec{T}$ is the resulting tension in the rope. Hence the net upward force on the painter-plus-platform is $2\vec{T}$.

(*a*) Letting $m_{tot} = m_{frame} + m_{painter}$, apply $\sum F_y = ma_y$ to the frame-plus-painter:

$$2\boldsymbol{T} - \boldsymbol{m}_{tot}\boldsymbol{g} = \boldsymbol{m}_{tot}\boldsymbol{a}_y$$

Solving for T yields:

$$\boldsymbol{T} = \frac{\boldsymbol{m}_{tot}(\boldsymbol{a}_y + \boldsymbol{g})}{2}$$

Substitute numerical values and evaluate T:

$$\boldsymbol{T} = \frac{(75\,\text{kg})(0.80\,\text{m/s}^2 + 9.81\,\text{m/s}^2)}{2} = 398\,\text{N}$$

Because $F = T$:

$$\boldsymbol{F} = 398\text{ N} = \boxed{0.40\,\text{kN}}$$

(*b*) Apply $\sum \boldsymbol{F}_y = 0$ to obtain:

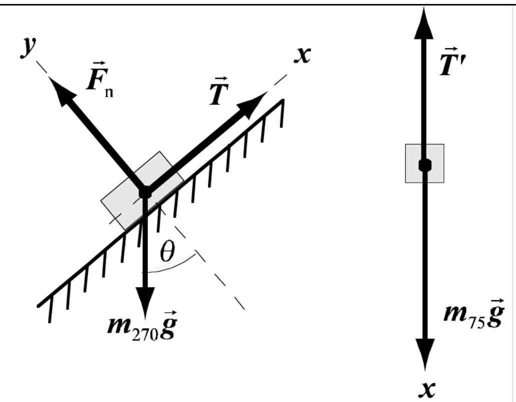
$$2\boldsymbol{T} - \boldsymbol{m}_{tot}\boldsymbol{g} = 0 \Rightarrow T = \tfrac{1}{2}m_{tot}g$$

Substitute numerical values and evaluate T:

$$\boldsymbol{T} = \tfrac{1}{2}(75\,\text{kg})(9.81\,\text{m/s}^2) = \boxed{0.37\,\text{kN}}$$

90 •• A frictionless surface is inclined at an angle of 30.0º to the horizontal. A 270-g block on the ramp is attached to a 75.0-g block using a pulley, as shown in Figure 4-62. (*a*) Draw two free-body diagrams, one for the 270-g block and the other for the 75.0-g block. (*b*) Find the tension in the string and the acceleration of the 270-g block. (*c*) The 270-g block is released from rest. How long does it take for it to slide a distance of 1.00 m along the surface? Will it slide up the incline, or down the incline?

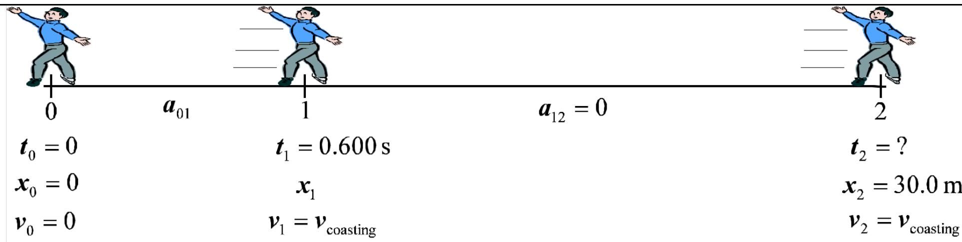
Picture the Problem The application of Newton's 2nd law to the block and the hanging weight will lead to simultaneous equations in their common acceleration a and the tension T in the cord that connects them. Once we know the acceleration of this system, we can use a constant-acceleration equation to predict how long it takes the block to travel 1.00 m from rest. Note that the magnitudes of $\vec{T}$ and $\vec{T}'$ are equal.

(a) The free-body diagrams are shown to the right. m_{270} represents the mass of the 270-g block and m_{75} the mass of the 75.0-g block.	
(b) Apply $\sum F_x = ma_x$ to the block and the suspended mass:	$T - m_{270} g \sin\theta = m_{270} a_{1x}$ and $m_{75} g - T = m_{75} a_{2x}$

Letting a represent the common acceleration of the two objects, eliminate T between the two equations and solve a:	$a = \frac{m_{75} - m_{270}\sin\theta}{m_{270} + m_{75}} g$
Substitute numerical values and evaluate a:	
$a = \frac{0.0750\,\text{kg} - (0.270\,\text{kg})\sin 30°}{0.0750\,\text{kg} + 0.270\,\text{kg}}(9.81\,\text{m/s}^2) = -1.706\,\text{m/s}^2 = \boxed{-1.71\,\text{m/s}^2}$ where the minus sign indicates that the acceleration is down the incline.	
Substitute for a in either of the force equations to obtain:	$T = \boxed{0.864\,\text{N}}$
(c) Using a constant-acceleration equation, relate the displacement of the block down the incline to its initial speed and acceleration:	$\Delta x = v_{0x}\Delta t + \frac{1}{2}a_x(\Delta t)^2$ or, because $v_{0x} = 0$, $\Delta x = \frac{1}{2}a_x(\Delta t)^2 \Rightarrow \Delta t = \sqrt{\frac{2\Delta x}{a_x}}$
Substitute numerical values and evaluate Δt:	$\Delta t = \sqrt{\frac{2(-1.00\,\text{m})}{-1.706\,\text{m/s}^2}} = \boxed{1.08\,\text{s}}$
Because the block is released from rest and its acceleration is negative, it will slide down the incline.	

97 ••• As a prank, your friends have kidnapped you in your sleep, and transported you out onto the ice covering a local pond. When you wake up you are 30.0 m from the nearest shore. The ice is so slippery (i.e. frictionless) that you can not seem to get yourself moving. You realize that you can use Newton's third law to your advantage, and choose to throw the heaviest thing you have, one boot, in order to get yourself moving. Take your weight to be 595 N. (*a*) What direction should you throw your boot so that you will most quickly reach the shore? (*b*) If you throw your 1.20-kg boot with an average force of 420 N, and the throw takes 0.600 s (the time interval over which you apply the force), what is the magnitude of the average force that the boot exerts on you? (Assume constant acceleration.) (*c*) How long does it take you to reach shore, including the short time in which you were throwing the boot?

Picture the Problem The diagram shown below summarizes the information about your trip to the shore and will be helpful in solving Part (*c*) of the problem.



(*a*) You should throw your boot in the direction away from the closest shore.

(*b*) The magnitude of the average force you exert on the boot equals the magnitude of the average force the boot exerts on you:	$F_{\text{av, on you}} = \boxed{420\text{ N}}$
(*c*) The time required for you to reach the shore is the sum of your travel time while accelerating and your travel time while coasting:	$\Delta t_{\text{total}} = \Delta t_{01} + \Delta t_{12}$ or, because $\Delta t_{01} = 0.600$ s, $\Delta t_{\text{total}} = 0.600\text{ s} + \Delta t_{12}$ (1)
Use a constant-acceleration equation to relate your displacement Δx_{01} to your acceleration time Δt_{01}:	$\Delta x_{01} = \frac{1}{2}a_{01}(\Delta t_{01})^2$ (2)
Apply Newton's 2nd law to express your acceleration during this time interval:	$a_{01} = \frac{F_{\text{net}}}{m} = \frac{F_{\text{av}}}{w/g} = \frac{F_{\text{av}}g}{w}$
Substitute numerical values and evaluate a_{01}:	$a_{01} = \frac{(420\text{ N})(9.81\text{ m/s}^2)}{595\text{ N}} = 6.925\text{ m/s}^2$

Substitute numerical values in equation (2) and evaluate Δx_{01}:	$\Delta x_{01} = \frac{1}{2}\left(6.925\text{ m/s}^2\right)\left(0.600\text{ s}\right)^2$ $= 1.246\text{ m}$
Your coasting time is the ratio of your displacement while coasting to your speed while coasting:	$\Delta t_{12} = \dfrac{\Delta x_{12}}{v_1}$ or, because $\Delta x_{12} = 30.0\text{ m} - \Delta x_{01}$, $\Delta t_{12} = \dfrac{30.0\text{ m} - \Delta x_{01}}{v_1}$ (3)

Use a constant-acceleration equation to relate your terminal speed (your speed after the interval of acceleration) to your acceleration and displacement during this interval:	$v_1 = v_0 + a_{01}\Delta t_{01}$ or, because $v_0 = 0$, $v_1 = a_{01}\Delta t_{01}$
Substitute for v_1 in equation (3) to obtain:	$\Delta t_{12} = \dfrac{30.0\text{ m} - \Delta x_{01}}{a_{01}\Delta t_{01}}$
Substituting for $\Delta t_{\text{coasting}}$ in equation (1) yields:	$\Delta t_{\text{total}} = 0.600\text{ s} + \dfrac{30.0\text{ m} - \Delta x_{01}}{a_{01}\Delta t_{01}}$
Substitute numerical values and evaluate Δt_{total}:	
$\Delta t_{\text{total}} = 0.600\text{ s} + \dfrac{30.0\text{ m} - 1.246\text{ m}}{\left(6.925\text{ m/s}^2\right)\left(0.600\text{ s}\right)} = \boxed{7.52\text{ s}}$	