Dear all,

I am very sorry for my mistake. I should have posted these solutions with those have been posted.

Hope your homework is going well.

Thanks,

Zengming

4.4. IDENTIFY: $F_x = F\cos\theta$, $F_y = F\sin\theta$.

SET UP: Let $+x$ be parallel to the ramp and directed up the ramp. Let $+y$ be perpendicular to the ramp and directed away from it. Then $\theta = 30.0°$.

EXECUTE: **(a)** $F = \dfrac{F_x}{\cos\theta} = \dfrac{60.0\,\text{N}}{\cos 30°} = 69.3$ N.

(b) $F_y = F\sin\theta = F_x \tan\theta = 34.6$ N.

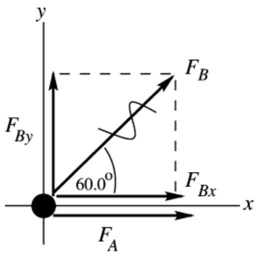
EVALUATE: We can verify that $F_x^2 + F_y^2 = F^2$. The signs of F_x and F_y show their direction.

4.5. IDENTIFY: Vector addition.

SET UP: Use a coordinate system where the $+x$-axis is in the direction of $\vec{F}_A$, the force

applied by
dog A. The forces are sketched in Figure 4.5.

EXECUTE:



$F_{Ax} = +270\text{ N}, \quad F_{Ay} = 0$

$F_{Bx} = F_B \cos 60.0° = (300\text{ N})\cos 60.0° = +150\text{ N}$

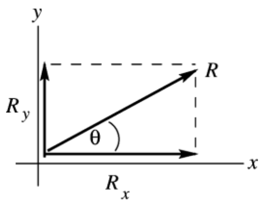
$F_{By} = F_B \sin 60.0° = (300\text{ N})\sin 60.0° = +260\text{ N}$

Figure 4.5a

$\vec{\boldsymbol{R}} = \vec{\boldsymbol{F}}_A + \vec{\boldsymbol{F}}_B$

$R_x = F_{Ax} + F_{Bx} = +270\text{ N} + 150\text{ N} = +420\text{ N}$

$R_y = F_{Ay} + F_{By} = 0 + 260\text{ N} = +260\text{ N}$



$R = \sqrt{R_x^2 + R_y^2}$

$R = \sqrt{(420\text{ N})^2 + (260\text{ N})^2} = 494\text{ N}$

$\tan\theta = \dfrac{R_y}{R_x} = 0.619$

$\theta = 31.8°$

Figure 4.5b

EVALUATE: The forces must be added as vectors. The magnitude of the resultant force is less than the sum of the magnitudes of the two forces and depends on the angle between the two forces.

4.8. IDENTIFY: The elevator and everything in it are accelerating upward, so we apply Newton's second law in the vertical direction.

SET UP: Your mass is $m = w/g = 63.8$ kg. Both you and the package have the same acceleration as the elevator. Take $+y$ to be upward, in the direction of the acceleration of the elevator, and apply $\sum F_y = ma_y$.

EXECUTE: **(a)** Your free-body diagram is shown in Figure 4.8a, where n is the scale reading.

$\sum F_y = ma_y$ gives $n - w = ma.$ Solving for n gives

$n = w + ma = 625\text{ N} + (63.8\text{ kg})(2.50\text{ m/s}^2) = 784\text{ N}.$

(b) The free-body diagram for the package is given in Figure 4.8b. $\sum F_y = ma_y$ gives

$T - w = ma,$ so $T = w + ma = (3.85\text{ kg})(9.80\text{ m/s}^2 + 2.50\text{ m/s}^2) = 47.4\text{ N}.$

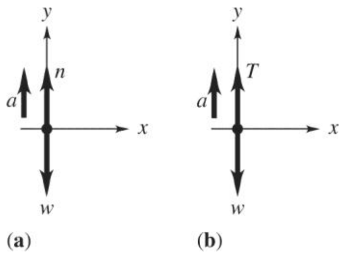


Figure 4.8

EVALUATE: The objects accelerate upward so for each of them the upward force is greater than the downward force.

4.11.IDENTIFY and **SET UP:** Use Newton's second law in component form (Eq. 4.8) to calculate the acceleration produced by the force. Use constant acceleration equations to calculate the effect of the acceleration on the motion.

EXECUTE: **(a)** During this time interval the acceleration is constant and equal to

$$a_x = \frac{F_x}{m} = \frac{0.250\text{ N}}{0.160\ kg} = 1.562\text{ m/s}^2$$

We can use the constant acceleration kinematic equations from Chapter 2.

$x - x_0 = v_{0x}t + \frac{1}{2}a_x t^2 = 0 + \frac{1}{2}(1.562\text{ m/s}^2)(2.00\text{ s})^2,$

so the puck is at $x = 3.12$ m.

$v_x = v_{0x} + a_x t = 0 + (1.562\text{ m/s}^2)(2.00\text{ s}) = 3.12\text{ m/s}.$

(b) In the time interval from $t = 2.00\text{ s}$ to 5.00 s the force has been removed so the acceleration is zero. The speed stays constant at $v_x = 3.12\text{ m/s}$. The distance the puck travels is $x - x_0 = v_{0x}t = (3.12\text{ m/s})(5.00\text{ s} - 2.00\text{ s}) = 9.36\text{ m}$. At the end of the interval it is at $x = x_0 + 9.36\text{ m} = 12.5\text{ m}$.

In the time interval from $t = 5.00\text{ s}$ to 7.00 s the acceleration is again $a_x = 1.562\text{ m/s}^2$. At the start of this interval $v_{0x} = 3.12\text{ m/s}$ and $x_0 = 12.5\text{ m}$.

$x - x_0 = v_{0x}t + \frac{1}{2}a_x t^2 = (3.12\text{ m/s})(2.00\text{ s}) + \frac{1}{2}(1.562\text{ m/s}^2)(2.00\text{ s})^2$.

$x - x_0 = 6.24\text{ m} + 3.12\text{ m} = 9.36\text{ m}$.

Therefore, at $t = 7.00\text{ s}$ the puck is at $x = x_0 + 9.36\text{ m} = 12.5\text{ m} + 9.36\text{ m} = 21.9\text{ m}$.

$$v_x = v_{0x} + a_x t \approx 3.12\text{ m/s} + (1.562\text{ m/s}^2)(2.00\text{ s}) = 6.24\text{ m/s}$$

EVALUATE: The acceleration says the puck gains 1.56 m/s of velocity for every second the force acts. The force acts a total of 4.00 s so the final velocity is $(1.56\text{ m/s})(4.0\text{ s}) = 6.24\text{ m/s}$.

4.17. **IDENTIFY** and **SET UP:** $F = ma$. We must use $w = mg$ to find the mass of the boulder.

EXECUTE: $m = \dfrac{w}{g} = \dfrac{2400\text{ N}}{9.80\text{ m/s}^2} = 244.9\text{ kg}$

Then $F = ma = (244.9\text{ kg})(12.0\text{ m/s}^2) = 2940\text{ N}$.

EVALUATE: We must use mass in Newton's second law. Mass and weight are proportional.

4.22. **IDENTIFY:** Newton's third law problem.

SET UP: The car exerts a force on the truck and the truck exerts a force on the car.

EXECUTE: The force and the reaction force are always exactly the same in magnitude, so the force that the truck exerts on the car is 1200 N, by Newton's third law.

EVALUATE: Even though the truck is much larger and more massive than the car, it cannot exert a larger force on the car than the car exerts on it.

4.31. **IDENTIFY:** Identify the forces on the chair. The floor exerts a normal force and a friction force.

SET UP: Let $+y$ be upward and let $+x$ be in the direction of the motion of the chair.

EXECUTE: **(a)** The free-body diagram for the chair is given in Figure 4.31.

(b) For the chair, $a_y = 0$ so $\sum F_y = ma_y$ gives $n - mg - F\sin 37° = 0$ and $n = 142\text{ N}$.

EVALUATE: n is larger than the weight because $\vec{F}$ has a downward component.

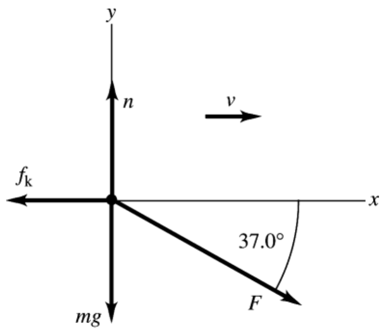
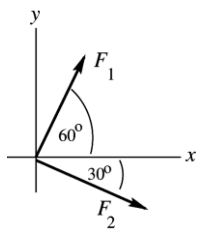


Figure 4.31

4.37. **IDENTIFY:** If the box moves in the $+x$-direction it must have $a_y = 0,$ so $\sum F_y = 0.$



The smallest force the child can exert and still produce such motion is a force that makes the y-components of all three forces sum to zero, but that doesn't have any x-component.

Figure 4.37

SET UP: $\vec{F}_1$ and $\vec{F}_2$ are sketched in Figure 4.37. Let $\vec{F}_3$ be the force exerted by the child.

$\sum F_y = ma_y$ implies $F_{1y} + F_{2y} + F_{3y} = 0,$ so $F_{3y} = -(F_{1y} + F_{2y}).$

EXECUTE: $F_{1y} = +F_1 \sin 60° = (100\ \text{N}) \sin 60° = 86.6\ \text{N}$

$F_{2y} = +F_2 \sin(-30°) = -F_2 \sin 30° = -(140\ \text{N}) \sin 30° = -70.0\ \text{N}$

Then $F_{3y} = -(F_{1y} + F_{2y}) = -(86.6\ \text{N} - 70.0\ \text{N}) = -16.6\ \text{N};$ $F_{3x} = 0$

The smallest force the child can exert has magnitude 17 N and is directed at $90°$ clockwise from the $+x$-axis shown in the figure.

(b) IDENTIFY and **SET UP:** Apply $\sum F_x = ma_x.$ We know the forces and a_x so can solve for $m.$ The force exerted by the child is in the $-y$-direction and has no x-component.

EXECUTE: $F_{1x} = F_1 \cos 60° = 50\ \text{N}$

$F_{2x} = F_2 \cos 30° = 121.2\ \text{N}$

$\sum F_x = F_{1x} + F_{2x} = 50\ \text{N} + 121.2\ \text{N} = 171.2\ \text{N}$

$$m = \frac{\sum F_x}{a_x} = \frac{171.2\ \text{N}}{2.00\ \text{m/s}^2} = 85.6\ \text{kg}$$

Then $w = mg = 840\ \text{N}.$

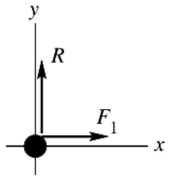
EVALUATE: In part (b) we don't need to consider the y-component of Newton's second law.

$a_y = 0$ so the mass doesn't appear in the $\sum F_y = ma_y$ equation.

4.35. IDENTIFY: Vector addition problem. Write the vector addition equation in component form. We know one vector and its resultant and are asked to solve for the other vector.

SET UP: Use coordinates with the $+x$-axis along $\vec{\boldsymbol{F}}_1$ and the $+y$-axis along $\vec{\boldsymbol{R}}$, as shown

in
Figure 4.35a.



$F_{1x} = +1300 \text{ N}, \quad F_{1y} = 0$

$R_x = 0,\ R_y = +1300 \text{ N}$

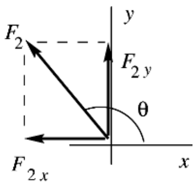
Figure 4.35a

$\vec{\boldsymbol{F}}_1 + \vec{\boldsymbol{F}}_2 = \vec{\boldsymbol{R}}$, so $\vec{\boldsymbol{F}}_2 = \vec{\boldsymbol{R}} - \vec{\boldsymbol{F}}_1$

EXECUTE: $F_{2x} = R_x - F_{1x} = 0 - 1300 \text{ N} = -1300 \text{ N}$

$F_{2y} = R_y - F_{1y} = +1300 \text{ N} - 0 = +1300 \text{ N}$

The components of $\vec{\boldsymbol{F}}_2$ are sketched in Figure 4.35b.



$F_2 = \sqrt{F_{2x}^2 + F_{2y}^2} = \sqrt{(-1300 \text{ N})^2 + (1300 \text{ N})^2}$

$F = 1840 \text{ N}$

$\tan\theta = \dfrac{F_{2y}}{F_{2x}} = \dfrac{+1300 \text{ N}}{-1300 \text{ N}} = -1.00$

$\theta = 135°$

Figure 4.35b

The magnitude of $\vec{\boldsymbol{F}}_2$ is 1840 N and its direction is $135°$ counterclockwise from the direction

of $\vec{\boldsymbol{F}}_1$.

EVALUATE: $\vec{\boldsymbol{F}}_2$ has a negative x-component to cancel $\vec{\boldsymbol{F}}_1$ and a y-component to equal $\vec{\boldsymbol{R}}$.

4.39. **IDENTIFY:** We can apply constant acceleration equations to relate the kinematic variables and we can use Newton's second law to relate the forces and acceleration.

(a) SET UP: First use the information given about the height of the jump to calculate the speed he has at the instant his feet leave the ground. Use a coordinate system with the $+y$-axis upward and the origin at the position when his feet leave the ground.

$v_y = 0$ (at the maximum height), $v_{0y} = ?$, $a_y = -9.80 \text{ m/s}^2$, $y - y_0 = +1.2 \text{ m}$

$$v_y^2 = v_{0y}^2 + 2a_y(y - y_0)$$

EXECUTE: $v_{0y} = \sqrt{-2a_y(y - y_0)} = \sqrt{-2(-9.80 \text{ m/s}^2)(1.2 \text{ m})} = 4.85 \text{ m/s}$

(b) SET UP: Now consider the acceleration phase, from when he starts to jump until when his feet leave the ground. Use a coordinate system where the $+y$-axis is upward and the origin is at his position when he starts his jump.

EXECUTE: Calculate the average acceleration:

$$(a_{av})_y = \frac{v_y - v_{0y}}{t} = \frac{4.85 \text{ m/s} - 0}{0.300 \text{ s}} = 16.2 \text{ m/s}^2$$

(c) SET UP: Finally, find the average upward force that the ground must exert on him to produce this average upward acceleration. (Don't forget about the downward force of gravity.) The forces are sketched in Figure 4.39.

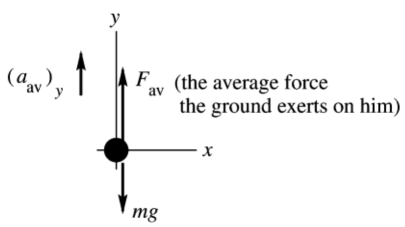


Figure 4.39

EXECUTE:

$$m = w/g = \frac{890 \text{ N}}{9.80 \text{ m/s}^2} = 90.8 \text{ kg}$$

$$\sum F_y = ma_y$$

$$F_{av} - mg = m(a_{av})_y$$

$$F_{av} = m(g + (a_{av})_y)$$

$$F_{av} = 90.8 \text{ kg}(9.80 \text{ m/s}^2 + 16.2 \text{ m/s}^2)$$

$$F_{av} = 2360 \text{ N}$$

This is the average force exerted on him by the ground. But by Newton's third law, the average force he exerts on the ground is equal and opposite, so is 2360 N, downward. The net force on him is equal to *ma*, so $F_{net} = ma = (90.8 \text{ kg})(16.2 \text{ m/s}^2) = 1470 \text{ N}$ upward.

EVALUATE: In order for him to accelerate upward, the ground must exert an upward force greater than his weight.