13. $F_{net} = ma$, ☞ $m = \dfrac{F_{net}}{a} = \dfrac{4.0\text{ N}}{10\text{ m/s}^2} = \boxed{0.40\text{ kg}}$.

14. In the horizontal direction, $F_{net} = +30.0\text{ N} + (-35.0\text{ N}) = -5.0\text{ N}$.

$F_{net} = ma$, ☞ $a = \dfrac{F_{net}}{m} = \dfrac{-5.0\text{ N}}{5.0\text{ kg}} = \boxed{-1.0\text{ m/s}^2}$.

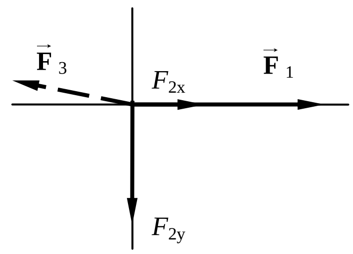
The negative sign indicates that the acceleration is in the $-x$-axis.

18. $\vec{\mathbf{F}}_1 = (5.5\text{ N})[(\cos 30°)\,\hat{\mathbf{x}} - (\sin 30°)\,\hat{\mathbf{y}}] = (4.76\text{ N})\,\hat{\mathbf{x}} + (-2.75\text{ N})\,\hat{\mathbf{y}}$,

$\vec{\mathbf{F}}_2 = (3.5\text{ N})[(\cos 37°)\,\hat{\mathbf{x}} + (\sin 37°)\,\hat{\mathbf{y}}] = (2.80\text{ N})\,\hat{\mathbf{x}} + (2.11\text{ N})\,\hat{\mathbf{y}}$.

$\Sigma\vec{\mathbf{F}} = \vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2 + \vec{\mathbf{F}}_3 = 0$, ☞ $\vec{\mathbf{F}}_3 = -(\vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2) = \boxed{(-7.6\text{ N})\,\hat{\mathbf{x}} + (0.64\text{ N})\,\hat{\mathbf{y}}}$.

22. (a) For the net force to be zero, the unknown (3rd force) must be in $\boxed{\text{(2) the second quadrant}}$. The x-component of the unknown force must be due west and the y-component of the unknown force must be due north.



(b) From $\Sigma\vec{\mathbf{F}} = \vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2 + \vec{\mathbf{F}}_3 = 0$,

$\vec{\mathbf{F}}_3 = 0 - (\vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2) = -\vec{\mathbf{F}}_1 - \vec{\mathbf{F}}_2$

$= [-(150\text{ lb}) - (30.0\text{ lb})]\,\hat{\mathbf{x}} - (-40.0\text{ lb})\,\hat{\mathbf{y}} = (-180\text{ N})\,\hat{\mathbf{x}} + (40.0\text{ N})\,\hat{\mathbf{y}}$,

or $F_3 = \sqrt{(-180\text{ N})^2 + (40.0\text{ N})^2} = \boxed{184\text{ N}}$, $\theta = \tan^{-1}\left(\dfrac{40.0\text{ N}}{-180\text{ N}}\right) = \boxed{12.5°\text{ above the }-x\text{-axis}}$.

39. The friction force is opposite the horizontal force. $a = \dfrac{F_{net}}{m} = \dfrac{300\text{ N} - 120\text{ N}}{75\text{ kg}} = \boxed{2.40\text{ m/s}^2}$.

45. First find the acceleration from dynamics. The acceleration is in the horizontal direction.

$\Sigma F_x = -(1.30 \times 10^4\text{ N})\cos 30° = -1.126 \times 10^4\text{ N}$.

$\Sigma F_x = ma$, ☞ $a = \dfrac{\Sigma F_x}{m} = \dfrac{-1.126 \times 10^4\text{ N}}{2000\text{ kg}} = -5.629\text{ m/s}^2$.

$v_o = 45.0$ m/s0, $v = 0$ (stop), $a = -5.629\text{ m/s}^2$.

$v^2 = v_o^2 + 2a(x - x_o)$, ☞ $x - x_o = \dfrac{v^2 - v_o^2}{2a} = \dfrac{0^2 - (45.0\text{ m/s})^2}{2(-5.629\text{ m/s}^2)} = 180\text{ m} < 200\text{m}$.

$\boxed{\text{Lois is saved}}$.

54. (a) For Jane: $T = ma = (50 \text{ kg})(0.92 \text{ m/s}^2) = 46 \text{ N}$.

The force on John is also 46 N (Newton's 3rd law).

$a_{John} = \dfrac{46 \text{ N}}{60 \text{ kg}} = \boxed{0.77 \text{ m/s}^2 \text{ toward Jane}}$.

(b) $x_{John} = \frac{1}{2} a_{John}\, t^2$, $x_{Jane} = \frac{1}{2} a_{Jane}\, t^2$.

So $\dfrac{x_{Jane}}{x_{John}} = \dfrac{a_{Jane}}{a_{John}} = \dfrac{0.92}{0.767} = 1.2$.

Also $x_{John} + x_{Jane} = 10 \text{ m}$, or $x_{John} + 1.2\, x_{John} = 10 \text{ m}$.

Therefore $x_{John} = \boxed{4.5 \text{ m from John's original position}}$.

55. (a) The answer is $\boxed{\text{(4) the pull of the rope on the girl}}$. The pull of the rope on the girl is the reaction of the pull of the girl on the rope.

(b) $\Sigma F_y = T - w = T - mg = ma$,

so $T = m(a + g) = (25.0 \text{ kg})(0.75 \text{ m/s}^2 + 9.80 \text{ m/s}^2) = \boxed{264 \text{ N}}$.

65. (a) $\vec{\mathbf{F}}_1 = (400 \text{ N})\,\hat{\mathbf{x}}$, $\vec{\mathbf{F}}_2 = (-300 \text{ N})\,\hat{\mathbf{x}}$,

$\vec{\mathbf{F}}_3 = (50 \text{ N})[(\cos 60°)\,\hat{\mathbf{x}} + (\sin 60°)\,\hat{\mathbf{y}}] = (25.0 \text{ N})\,\hat{\mathbf{x}} + (43.3 \text{ N})\,\hat{\mathbf{y}}$.

$\Sigma\vec{\mathbf{F}} = \vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2 + \vec{\mathbf{F}}_3 = (125 \text{ N})\,\hat{\mathbf{x}} + (43.3 \text{ N})\,\hat{\mathbf{y}}$.

So $\vec{\mathbf{a}} = \dfrac{\Sigma\vec{\mathbf{F}}}{m} = \dfrac{(125 \text{ N})\,\hat{\mathbf{x}} + (43.3 \text{ N})\,\hat{\mathbf{y}}}{75 \text{ kg}} = (1.67 \text{ m/s}^2)\,\hat{\mathbf{x}} + (0.577 \text{ m/s}^2)\,\hat{\mathbf{y}}$.

$a = \sqrt{(1.67 \text{ m/s}^2)^2 + (0.577 \text{ m/s}^2)^2} = \boxed{1.7 \text{ m/s}^2}$,

$\theta = \tan^{-1}\left(\dfrac{0.577}{1.67}\right) = \boxed{19° \text{ north of east}}$.

(b) Now the wind and current force is opposite that of Part (a).

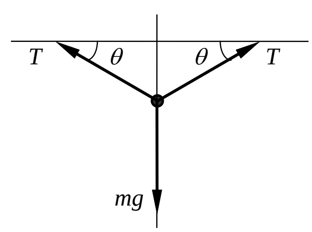
$\vec{\mathbf{F}}_3 = -[(25.0 \text{ N})\,\hat{\mathbf{x}} + (43.3 \text{ N})\,\hat{\mathbf{y}}]$. $\Sigma\vec{\mathbf{F}} = \vec{\mathbf{F}}_1 + \vec{\mathbf{F}}_2 + \vec{\mathbf{F}}_3 = (75 \text{ N})\,\hat{\mathbf{x}} + (-43.3 \text{ N})\,\hat{\mathbf{y}}$.

$\vec{\mathbf{a}} = (1.00 \text{ m/s}^2)\,\hat{\mathbf{x}} + (-0.577 \text{ m/s}^2)\,\hat{\mathbf{y}}$.

$a = \sqrt{(1.00 \text{ m/s}^2)^2 + (-0.577 \text{ m/s}^2)^2} = \boxed{1.2 \text{ m/s}^2}$.

$\theta = \tan^{-1}\left(\dfrac{-0.577}{1.00}\right) = \boxed{30° \text{ south of east}}$.

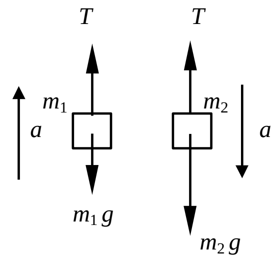
73. (a) The angle the rope makes with the horizontal, θ, depends on both the tree separation and sag. $\Sigma F_y = 2T \sin\theta - mg = 0$, ☞ $T = \dfrac{mg}{2 \sin\theta}$.



So the tension depends on $\boxed{\text{(3) both the tree separation and sag}}$.

(b) $\theta = \tan^{-1}\left(\dfrac{0.20 \text{ m}}{5.0 \text{ m}}\right) = 2.29°$. $T = \dfrac{(5.0 \text{ kg})(9.80 \text{ m/s}^2)}{2 \sin 2.29°} = \boxed{6.1 \times 10^2 \text{ N}}$.

$\boxed{80}$. (a) Since the two objects accelerate together, they have the same acceleration, a. Also according to Newton's third law, the tension on m_1 (up) is the same as the tension on m_2 (up).



For m_1: $\Sigma F_1 = T - m_1 g = m_1 a.$ (1)

For m_2: $\Sigma F_2 = m_2 g - T = m_2 a.$ (2)

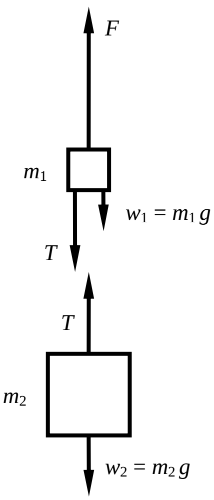
Equation (1) + Equation (2) gives $(m_2 - m_1)g = (m_1 + m_2)a$,

so $a = \dfrac{(m_2 - m_1)g}{m_1 + m_2} = \dfrac{(0.80 \text{ kg} - 0.55 \text{ kg})(9.80 \text{ m/s}^2)}{0.55 \text{ kg} + 0.80 \text{ kg}} = \boxed{1.8 \text{ m/s}^2}$.

(b) From Equation (1), $T = m_1(a + g) = (0.55 \text{ kg})(1.8 \text{ m/s}^2 + 9.80 \text{ m/s}^2) = \boxed{6.4 \text{ N}}$.

83. (a) According to Newton's 3rd law, the tension force at the ends of the string are the same because the string is massless. Since m_2 is accelerating up, $T > w_2$. Since F is responsible for accelerating both m_1 and m_2 upward, $F > T$. Therefore the answer is

$\boxed{(1)\ T > w_2 \text{ and } T < F}$.



(b) For m_1: $\Sigma F_1 = F - T - m_1 \text{g} = m_1 a$ (1)

For m_2: $\Sigma F_2 = T - m_2 \text{g} = m_2 a$ (2)

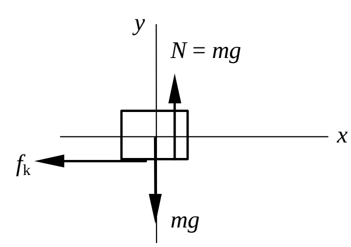
Equation (1) + Equation (2) gives

$F - m_1 g - m_2 g = m_1 a + m_2 a = (m_1 + m_2)a.$

$F = (m_1 + m_2)(a + g) = (50.0 \text{ kg} + 100 \text{ kg})(1.50 \text{ m/s}^2 + 9.80 \text{ m/s}^2) = \boxed{1.70 \times 10^3 \text{ N}}$.

(c) From Equation (2), $T = m_2(a + g) = (100 \text{ kg})(1.50 \text{ m/s}^2 + 9.80 \text{ m/s}^2) = \boxed{1.13 \times 10^3 \text{ N}}$.

$\boxed{100}$. (a) First find acceleration from dynamics and use μ_k from Table 4.1.



$\Sigma F_x = -f_k = -\mu_k mg = ma$, ☞ $\mu_k = -\dfrac{a}{g}$.

So $a = -\mu_k g = -0.85(9.80 \text{ m/s}^2) = -8.33 \text{ m/s}^2$,

and $v_o = 90 \text{ km/h} = 25 \text{ m/s}$, $v = 0$. (Take $x_o = 0$.)

$v^2 = v_o^2 + 2a(x - x_o)$, ☞ $x = \dfrac{v^2 - v_o^2}{2a} = \dfrac{0 - (25 \text{ m/s})^2}{2(-8.33 \text{ m/s}^2)} = \boxed{38 \text{ m}}$.

(b) $a = -0.60(9.80 \text{ m/s}^2) = -5.88 \text{ m/s}^2$. So $x = \dfrac{0 - (25 \text{ m/s})^2}{2(-5.88 \text{ m/s}^2)} = \boxed{53 \text{ m}}$.

101. Use the result of 4.100(a), $\mu_k = -\dfrac{a}{g}$.

$a = \dfrac{0 - (5.0 \text{ m/s})^2}{2(20 \text{ m})} = -0.625 \text{ m/s}^2$, so $\mu_k = -\dfrac{-0.625 \text{ m/s}^2}{9.80 \text{ m/s}^2} = \boxed{0.064}$.

111. Use the diagram in Exercise 4.110 but with f_k replacing f_s.

For m_1: $\Sigma F_1 = T_1 - m_1 g = m_1 a$, (1)

For m_3: $\Sigma F_3 = T_2 - T_1 - f_k = m_3 a$, (2), where $f_k = \mu_k N_3 = \mu_k m_3 g$.

For m_2: $\Sigma F_2 = m_2 g - T_2 = m_2 a$, (3)

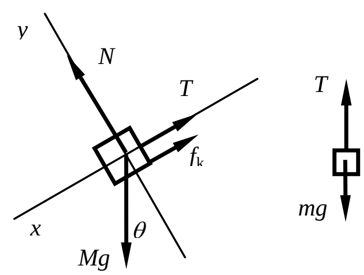
Equation (1) + Equation (2) + Equation (3) gives $(m_2 - m_1 - \mu_k m_3)g = (m_1 + m_2 + m_3)a$,

so $a = \dfrac{(m_2 - m_1 - \mu_k m_3)g}{m_1 + m_2 + m_3}$.

(a) For constant speed, $a = 0$. So $m_3 = \dfrac{m_2 - m_1}{\mu_k} = \dfrac{0.250\text{ kg} - 0.150\text{ kg}}{0.560} = \boxed{0.179\text{ kg}}$.

(b) $a = \dfrac{0.250\text{ kg} - 0.150\text{ kg} - (0.560)(0.100\text{ kg})}{0.150\text{ kg} + 0.250\text{ kg} + 0.100\text{ kg}}(9.80\text{ m/s}^2) = \boxed{0.862\text{ m/s}^2}$.

$\boxed{117}$. (a) If m is accelerating upward, M is accelerating down the incline.



For M: $\Sigma F_y = N - Mg\cos\theta = 0$,

so $N = Mg\cos\theta = (5.00\text{ kg})(9.80\text{ m/s}^2)\cos 30° = 42.4\text{ N}$.

$f_k = \mu_k N = (0.100)(42.4\text{ N}) = 4.24\text{ N}$.

$\Sigma F_x = Mg\sin\theta - T - f_k = Ma$, so

$T = Mg\sin\theta - f_k - Ma$

$= (5.00\text{ kg})(9.80\text{ m/s}^2)\sin 30° - 4.24\text{ N} - (5.00\text{ kg})(2.00\text{ m/s}^2)$

$= \boxed{10.3\text{ N}}$.

(b) For m: $\Sigma F_x = T - mg = ma$, ☞ $m = \dfrac{T}{g + a} = \dfrac{10.3\text{ N}}{9.80\text{ m/s}^2 + 2.00\text{ m/s}^2} = \boxed{0.954\text{ kg}}$.