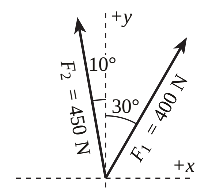
PHY 2130 Homework solutions
Assignment 3

4.12 (a) Choose the positive y-axis in the forward direction. We resolve the forces into their components as



Force	x-component	y-component
400 N	200 N	346 N
450 N	–78.1 N	443 N
Resultant	$\Sigma F_x = 122$ N	$\Sigma F_y = 790$ N

The magnitude and direction of the resultant force is

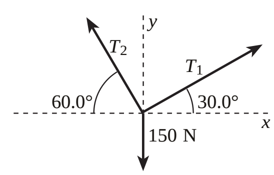
$$\left|\Sigma \mathbf{F}\right| = \sqrt{\left(\Sigma F_x\right)^2 + \left(F_y\right)^2} = 799 \text{ N}, \ \theta = \tan^{-1}\left(\frac{\Sigma F_x}{\Sigma F_y}\right) = 8.77° \text{ to right of } y\text{-axis.}$$

Thus, $\boxed{\Sigma \mathbf{F} = 799 \text{ N at } 8.77° \text{ to the right of the forward direction}}$.

(b) The acceleration is in the same direction as $\Sigma \mathbf{F}$ and is given by

$$a = \frac{\left|\Sigma \mathbf{F}\right|}{m} = \frac{799 \text{ N}}{3000 \text{ kg}} = \boxed{0.266 \text{ m/s}^2}.$$

4.17 From $\Sigma F_x = 0$, $T_1 \cos 30.0° - T_2 \cos 60.0° = 0$,



or $\quad T_2 = (1.73) T_1$. (1)

Then $\Sigma F_y = 0$ becomes

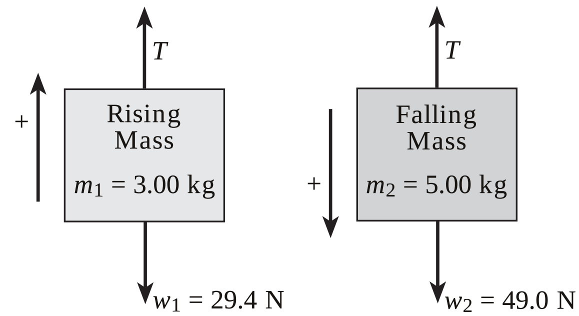
$$T_1 \sin 30.0° + (1.73 \ T_1) \sin 60.0° - 150 \text{ N} = 0,$$

which gives $T_1 = \boxed{75.0 \text{ N in the right side cable}}$.

Finally, Equation (1) above gives $T_2 = \boxed{130 \text{ N in the left side cable}}$.

4.34 First, consider the 3.00-kg rising mass. The forces on it are the tension, ***T***, and its weight, 29.4 N. With the upward direction as positive, the second law becomes

$$T - 29.4\text{ N} = (3.00\text{ kg})a. \qquad (1)$$



The forces on the falling 5.00-kg mass are its weight and ***T***, and its acceleration has the same magnitude as that of the rising mass. Choosing the positive direction down for this mass, gives

$$49\text{ N} - T = (5.00\text{ kg})a. \qquad (2)$$

Equations (1) and (2) can be solved simultaneously to give

(a) the tension as $T = \boxed{36.8\text{ N}}$,

(b) and the acceleration as $a = \boxed{2.45\text{ m/s}^2}$.

(c) Consider the 3.00-kg mass. We have

$$\Delta y = v_{iy}t + \frac{1}{2}a_y t^2 = 0 + \frac{1}{2}(2.45\text{ m/s}^2)(1.00\text{ s})^2 = \boxed{1.23\text{ m}}.$$

4.35 When the block is on the verge of moving, the static friction force has a magnitude $f_s = (f_s)_{max} = \mu_s n$.

Since equilibrium still exists and the applied force is 75 N, we have

$$\Sigma F_x = 75\text{ N} - f_s = 0 \text{ or } (f_s)_{max} = 75\text{ N}.$$

In this case, the normal force is just the weight of the crate, or $n = mg$. Thus, the coefficient of static friction is

$$\mu_s = \frac{(f_s)_{max}}{n} = \frac{(f_s)_{max}}{mg} = \frac{75\text{ N}}{(20\text{ kg})(9.80\text{ m/s}^2)} = \boxed{0.38}.$$

After motion exists, the friction force is that of kinetic friction, $f_k = \mu_k n$.

Since the crate moves with constant velocity when the applied force is 60 N, we find that $\Sigma F_x = 60\text{ N} - f_k = 0$ or $f_k = 60\text{ N}$. Therefore, the coefficient of kinetic friction is

$$\mu_k = \frac{f_k}{n} = \frac{f_k}{mg} = \frac{60\text{ N}}{(20\text{ kg})(9.80\text{ m/s}^2)} = \boxed{0.31}.$$

4.38 (a) $a_x = \dfrac{v_f - v_i}{t} = \dfrac{6.00\text{ m/s} - 12.0\text{ m/s}}{5.00\text{ s}} = \boxed{-1.20\text{ m/s}^2}$.

(b) From Newton's second law, $\Sigma F_x = -f_k = ma_x$, or $f_k = -ma_x$.

The normal force exerted on the puck by the ice is $n = mg$, so the coefficient of friction is

$$\mu_k = \frac{f_k}{n} = \frac{-m(-1.20\text{ m/s}^2)}{m(9.80\text{ m/s}^2)} = \boxed{0.122}.$$

(c) $\Delta x = \bar{v}t = \left(\dfrac{v_f + v_i}{2}\right)t = \left(\dfrac{12.0\text{ m/s} + 6.00\text{ m/s}}{2}\right)(5.00\text{ s}) = \boxed{45.0\text{ m}}$.