P5.28 (a) Isolate either mass:

$$T + mg = ma = 0$$
$$|T| = |mg|$$

The scale reads the tension T, so

$$T = mg = (5.00\text{ kg})(9.80\text{ m/s}^2) = \boxed{49.0\text{ N}}$$

(b) The solution to part (a) is also the solution to (b).

(c) Isolate the pulley:

$$\vec{\mathbf{T}}_2 + 2\vec{\mathbf{T}}_1 = 0$$
$$T_2 = 2|T_1| = 2mg = \boxed{98.0\text{ N}}$$

(d) $\sum \vec{\mathbf{F}} = \vec{\mathbf{n}} + \vec{\mathbf{T}} + m\vec{\mathbf{g}} = 0$

Take the component along the incline,

$$n_x + T_x + mg_x = 0$$

or $\quad 0 + T - mg\sin 30.0° = 0$

$$T = mg\sin 30.0° = \frac{mg}{2} = \frac{(5.00\text{ kg})(9.80\text{ m/s}^2)}{2} = \boxed{24.5\text{ N}}$$

***P5.29** (a) The resultant external force acting on this system, consisting of all three blocks having a total mass of 6.0 kg, is 42 N directed horizontally toward the right. Thus, the acceleration produced is

$$a = \frac{\sum F}{m} = \frac{42\text{ N}}{6.0\text{ kg}} = \boxed{7.0\text{ m/s}^2\text{ horizontally to the right}}$$

(b) Draw a free-body diagram of the 3.0-kg block and apply Newton's second law to the horizontal forces acting on this block:

$\sum F_x = ma_x$:

$$42\text{ N} - T = (3.0\text{ kg})(7.0\text{ m/s}^2) \quad \rightarrow \quad T = \boxed{21\text{ N}}$$

(c) The force accelerating the 2.0-kg block is the force exerted on it by the 1.0-kg block. Therefore, this force is given by

$$F = ma = (2.0\text{ kg})(7.0\text{ m/s}^2) = 14\text{ N}$$

or $\quad \vec{\mathbf{F}} = \boxed{14\text{ N horizontally to the right}}$

P5.33 From equilibrium of the sack:

$$T_3 = F_g \qquad [1]$$

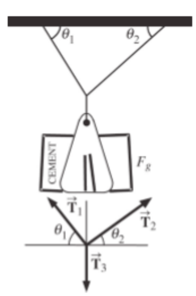
From $\sum F_y = 0$ for the knot:

$$T_1\sin\theta_1 + T_2\sin\theta_2 = F_g \qquad [2]$$

From $\sum F_x = 0$ for the knot:

$$T_1\cos\theta_1 = T_2\cos\theta_2 \qquad [3]$$

Eliminate T_2 by using $T_2 = T_1\cos\theta_1/\cos\theta_2$ and solve for T_1:



ANS. FIG. P5.33

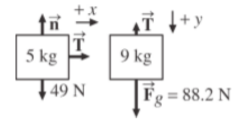
$$T_1 = \frac{F_g\cos\theta_2}{(\sin\theta_1\cos\theta_2 + \cos\theta_1\sin\theta_2)} = \frac{F_g\cos\theta_2}{\sin(\theta_1+\theta_2)}$$

$$T_3 = F_g = \boxed{325\text{ N}}$$

$$T_1 = F_g\left(\frac{\cos 40.0°}{\sin 100.0°}\right) = \boxed{253\text{ N}}$$

$$T_2 = T_1\left(\frac{\cos\theta_1}{\cos\theta_2}\right) = (253\text{ N})\left(\frac{\cos 60.0°}{\cos 40.0°}\right) = \boxed{165\text{ N}}$$

P5.40 (a) The forces on the objects are shown in ANS. FIG. P5.40.



ANS. FIG. P5.40

(b) and (c) First, consider m_1, the block moving along the horizontal. The only force in the direction of movement is T. Thus,

$$\sum F_x = ma$$

or $\quad T = (5.00\text{ kg})a \qquad [1]$

Next consider m_2, the block that moves vertically. The forces on it are the tension T and its weight, 88.2 N.

We have $\sum F_y = ma$:

$$88.2\text{ N} - T = (9.00\text{ kg})a \qquad [2]$$

Note that both blocks must have the same magnitude of acceleration. Equations [1] and [2] can be added to give 88.2 N = (14.0 kg)a. Then

$$\boxed{a = 6.30\text{ m/s}^2\text{ and }T = 31.5\text{ N}}$$

P5.41 (a) and (b) The slope of the graph of upward velocity versus time is the acceleration of the person's body. At both time 0 and time 0.5 s, this slope is (18 cm/s)/0.6 s = 30 cm/s^2.

For the person's body,

$\sum F_y = ma_y$:

$$+F_{\text{bar}} - (64.0\text{ kg})(9.80\text{ m/s}^2) = (64.0\text{ kg})(0.3\text{ m/s}^2)$$

Note that there is no floor touching the person to exert a normal force, and that he does not exert any extra force "on himself." Solving, $F_{\text{bar}} = \boxed{646\text{ N up}}$.

(c) a_y = slope of v_y versus t graph = 0 at t = 1.1 s. The person is moving with maximum speed and is momentarily in equilibrium:

$\sum F_y = ma_y$:

$$+F_{\text{bar}} - (64.0\text{ kg})(9.80\text{ m/s}^2) = 0$$

$$F_{\text{bar}} = \boxed{627\text{ N up}}$$

(d) a_y = slope of v_y versus t graph = (0 – 24 cm/s)/(1.7 s – 1.3 s) = –60 cm/s^2

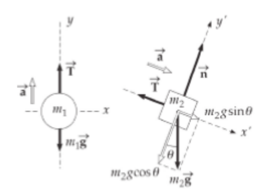
$\sum F_y = ma_y$:

$$+F_{\text{bar}} - (64.0\text{ kg})(9.80\text{ m/s}^2) = (64.0\text{ kg})(-0.6\text{ m/s}^2)$$

$$F_{\text{bar}} = \boxed{589\text{ N up}}$$

P5.42 $m_1 = 2.00$ kg, $m_2 = 6.00$ kg, $\theta = 55.0°$

(a) The forces on the objects are shown in ANS. FIG. P5.42.



ANS. FIG. P5.42

(b) $\sum F_x = m_2 g\sin\theta - T = m_2 a$ and

$$T - m_1 g = m_1 a$$

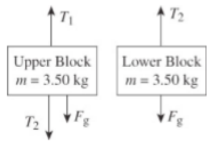
$$a = \frac{m_2 g\sin\theta - m_1 g}{m_1 + m_2} = \frac{(6.00\text{ kg})(9.80\text{ m/s}^2)\sin 55.0° - (2.00\text{ kg})(9.80\text{ m/s}^2)}{2.00\text{ kg} + 6.00\text{ kg}} = \boxed{3.57\text{ m/s}^2}$$

(c) $T = m_1(a+g) = (2.00\text{ kg})(3.57\text{ m/s}^2 + 9.80\text{ m/s}^2) = \boxed{26.7\text{ N}}$

(d) Since $v_i = 0$, $v_f = at = (3.57\text{ m/s}^2)(2.00\text{ s}) = \boxed{7.14\text{ m/s}}$.

P5.43 (a) Free-body diagrams of the two blocks are shown in ANS. FIG. P5.43. Note that each block experiences a downward gravitational force

$$F_g = (3.50 \text{ kg})(9.80 \text{ m/s}^2) = 34.3 \text{ N}$$



ANS. FIG. P5.43

Also, each has the same upward acceleration as the elevator, in this case $a_y = +1.60 \text{ m/s}^2$.

Applying Newton's second law to the lower block:

$$\sum F_y = ma_y \quad \Rightarrow \quad T_2 - F_g = ma_y$$

or

$$T_2 = F_g + ma_y = 34.3 \text{ N} + (3.50 \text{ kg})(1.60 \text{ m/s}^2) = \boxed{39.9 \text{ N}}$$

Next, applying Newton's second law to the upper block:

$$\sum F_y = ma_y \quad \Rightarrow \quad T_1 - T_2 - F_g = ma_y$$

or

$$T_1 = T_2 + F_g + ma_y = 39.9 \text{ N} + 34.3 \text{ N} + (3.50 \text{ kg})(1.60 \text{ m/s}^2)$$
$$= \boxed{79.8 \text{ N}}$$

(b) Note that the tension is greater in the upper string, and this string will break first as the acceleration of the system increases. Thus, we wish to find the value of a_y when $T_1 = 85.0$. Making use of the general relationships derived in (a) above gives:

$$T_1 = T_2 + F_g + ma_y = (F_g + ma_y) + F_g + ma_y = 2F_g + 2ma_y$$

or

$$a_y = \frac{T_1 - 2F_g}{2m} = \frac{85.0 \text{ N} - 2(34.3 \text{ N})}{2(3.50 \text{ kg})} = \boxed{2.34 \text{ m/s}^2}$$