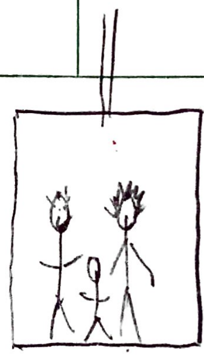
6.37

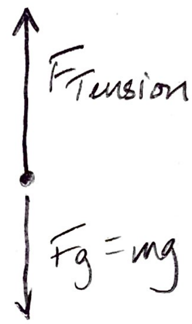


elevator + people
$m = 1.7e3$ kg

$a = 1.20\ m/s^2 \uparrow$ from rest ($v=0$)
for $\Delta t = 1.50\,s$

a) Find Tension in cable.

Free-body



$$\Sigma F = ma$$
$$F_{Tension} - F_g = ma$$
$$F_{Tension} - mg = ma$$
$$F_{Tension} = m(a+g)$$
$$F_{Tension} = 1.7e3(1.2+9.8)$$
$$= \boxed{1.87e4\,N}$$

Note that the Tension to just hold the elevator motionless would be $F_T - mg = 0$, $F_T = mg$
$= \underline{1.67e4\,N}$

To accelerate the elevator upwards the cable has to apply a greater tension.

b) During constant velocity, $a=0$, so $F_{Tension} = mg$, as noted here.

c) Elevator decelerates for 3.00s at $0.600\ m/s^2$. $F_{Tension}$ during this time is:

$$\Sigma F = ma$$
$$F_{Tension} - mg = ma$$
$$F_{Tension} - (1.7e3)(9.8) = (1.7e3)(-0.6)$$
$$F_{Tension}\ \boxed{1.56e4\,N}$$

Negative because elevator is slowing down while elevator is going up.

d) How high is it at the end of the problem, & how fast is it moving?

(See next page)

6.37 (cont'd)

t=0 to 1.50s

$\Delta y = v_i t + \frac{1}{2}at^2$ (t=0 to 1.5s)

$= 0t + \frac{1}{2}(1.2)(1.50)^2 = \underline{1.35\,m}$

$v_f = v_i + at$

$= 0 + (1.2)(1.5s) = \underline{1.8\,m/s}$

Δt=8.50s

$\Delta y = v\Delta t$

$= (1.8\,m/s)(8.5) = \underline{15.3\,m}$

$v_{constant} = 1.8\,m/s$

Δt=3.00s

$\Delta y = v_i t + \frac{1}{2}at^2$

$\Delta y = (1.8)(3) + \frac{1}{2}(-0.60)(3)^2$

$= \underline{2.7\,m}$

$v_f = v_i + at$

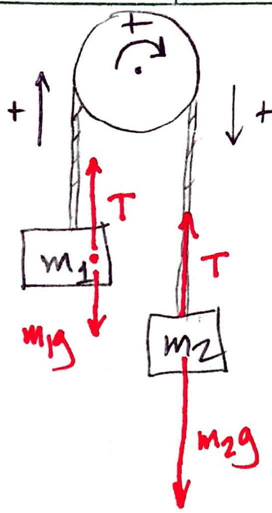
$= 1.8 + (-0.6)(3)$

$= \boxed{0\,m/s}$

$\Delta y_{total} = 1.35 + 15.3 + 2.7\,m$

$= \boxed{19.4\,m}$

6.42



Assume motion consistent with clockwise rotation is positive

a)

Left side	Right side
$\Sigma F_1 = m_1 a$	$\Sigma F_2 = m_2 a$
$F_T - F_g = m_1 a$	$m_2 g - F_T = m_2 a$
$F_T = m_1 a + m_1 g$	$m_2 g - (m_1 a + m_1 g) = m_2 a$
	Collect terms.

$$m_2 a + m_1 a = m_2 g - m_1 g$$

$$\boxed{a = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g}$$

b) $F_{Tension\ in\ string} = ?$ Use equations from above!

$$F_T = m_1 a + m_1 g$$

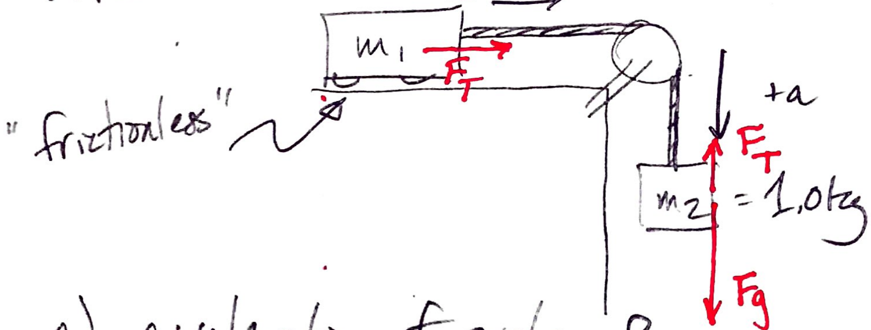
$$= \boxed{m_1 g\left(1 + \frac{m_2 - m_1}{m_1 + m_2}\right)}$$

c) If $m_1 = 2$ & $m_2 = 4$?

$$a = \left(\frac{4-2}{2+4}\right) 9.8 = \boxed{3.27\ m/s^2}$$

$$T = (2 \cdot 9.8)\left(1 + \frac{4-2}{2+4}\right) = \boxed{26.1\ N}$$

6.43



a) acceleration of system?

Complete, formal, 2-body strategy

$\Sigma F_1 = m_1 a$

$F_T = m_1 a$

$\Sigma F_2 = m_2 a$

$F_g - F_T = m_2 a$

$m_2 g - m_1 a = m_2 a$

$a = \dfrac{m_2 g}{m_1 + m_2}$

$= \dfrac{1g}{4+1} = \boxed{1.96\ m/s^2}$

Shortcut (advanced users only!)

$\Sigma F_{1+2} = m_{1+2}\, a$

$m_2 g = (m_1 + m_2)\, a$

$a = \dfrac{m_2 g}{m_1 + m_2} = \boxed{1.96\ m/s^2}$

b) Tension in rope? Use

$F_T = m_1 a$

$= (4.0\ kg)(1.96\ m/s^2)$

$= \boxed{7.84\ N}$

c) v after traveling 1,0 m?

$v_f^2 = v_i^2 + 2a\Delta x$

$v_f = \sqrt{0^2 + 2(1.96\ m/s^2)(1.0\ m)}$

$= \boxed{1.98\ m/s}$