29 JAN 10

★SCAN★
YOUR ASSIGNMENT

- HW Q & A
- Atwood's Machine

4 **••7** Three astronauts, propelled by jet backpacks, push and guide a 120 kg asteroid toward a processing dock, exerting the forces shown in Fig. 5-32, with $F_1 = 32$ N, $F_2 = 55$ N, $F_3 = 41$ N, $\theta_1 = 30°$, and $\theta_3 = 60°$. What is the asteroid's acceleration (a) in unit-vector notation and as (b) a magnitude and (c) a direction relative to the positive direction of the x axis? GO

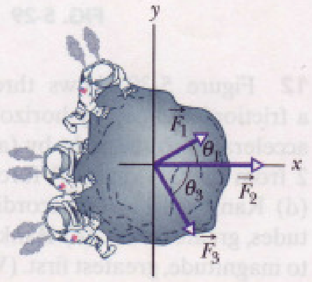


FIG. 5-32 Problem 7.

$m = 120\text{kg}$

$a = F/m$

$\vec{a} = 0.860 \, \text{m/s}^2 \, \hat{i} - 0.163 \, \text{m/s}^2 \, \hat{j}$

$\|\vec{a}\| = 0.875 \, \text{m/s}^2$

$\theta = \tan^{-1} \left| \frac{-19.507}{103.213} \right|$

$= 10.703°$ below the $+\hat{x}$ axis

	$\hat{x}$	$\hat{y}$
F_1	$+32\cos 30°$ N	$+32\sin 30°$ N
F_2	$+55$N	0
F_3	$+41\cos 60°$ N	$-41\sin 60°$ N
	$+103.213$N	-19.507N

9

•13 (a) An 11.0 kg salami is supported by a cord that runs to a spring scale, which is supported by a cord hung from the ceiling (Fig. 5-35*a*). What is the reading on the scale, which is marked in weight units? (b) In Fig. 5-35*b* the salami is supported by a cord that runs around a pulley and to a scale. The opposite end of the scale is attached by a cord to a wall. What is the reading on the scale? (c) In Fig. 5-35*c* the wall has been replaced with a second 11.0 kg salami, and the assembly is stationary. What is the reading on the scale? SSM

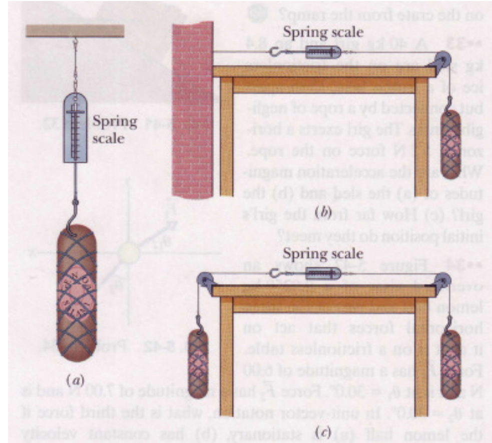


FIG. 5-35 Problem 13.

$W = mg$

$= (11\,kg)(9.8\,m/s^2)$

$= 108\,N$

$m = 4\,kg$

	$\hat{x}$	$\hat{y}$
F_1	$-11\,N$	0
F_2	0	$-17\,N$
F_3	$+3\,N$	0
F_4	$+14\cos 30^\circ\,N$	$+14\sin 30^\circ\,N$
F_5	0	$+5\,N$
	$+4.124\,N$	$-5\,N$

$a = F/m$

$\vec{a} = +1.031\,m/s^2\,\hat{i} - 1.25\,m/s^2\,\hat{j}$

70 **78** In the overhead view of Fig. 5-64, five forces pull on a box of mass $m = 4.0$ kg. The force magnitudes are $F_1 = 11$ N, $F_2 = 17$ N, $F_3 = 3.0$ N, $F_4 = 14$ N, and $F_5 = 5.0$ N, and angle θ_4 is 30°. Find the box's acceleration (a) in unit-vector notation and as (b) a magnitude and (c) an angle relative to the positive direction of the x axis.

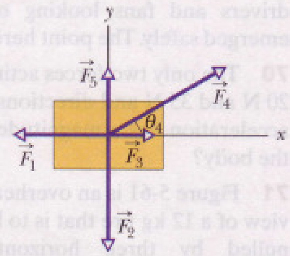


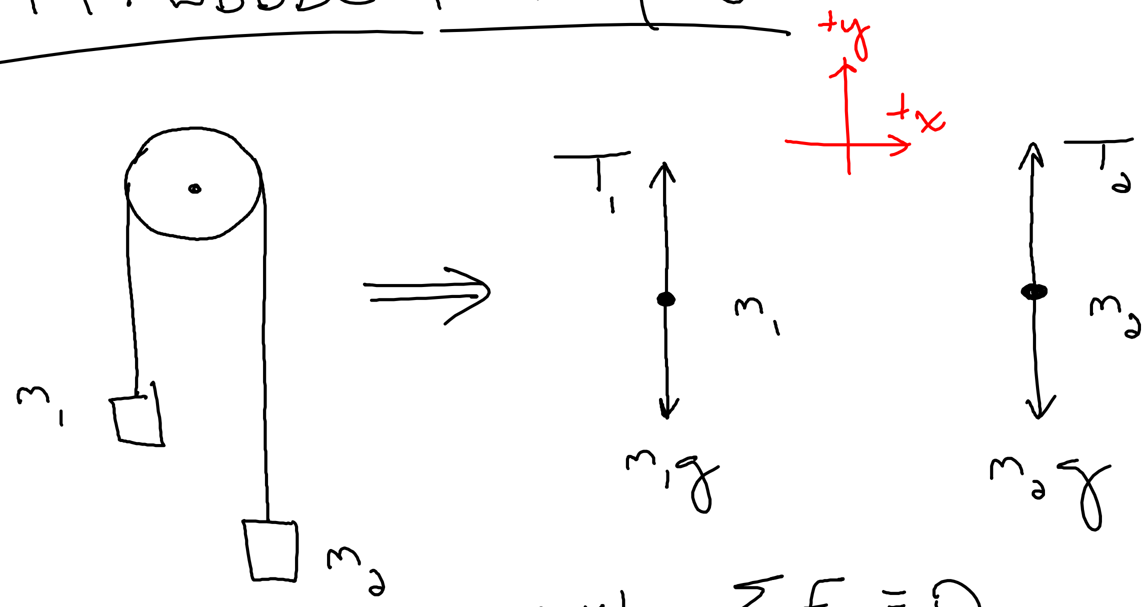
FIG. 5-64 Problem 78.

$\|\vec{a}\| = 1.620\,m/s^2$

$\theta = \tan^{-1}\left|\frac{-1.25}{+1.031}\right|$

$= 50.484^\circ$ below $+\hat{x}$

Atwood's Machine



at equilibrium

mass 1

$$\sum F_x = 0$$

$$m_1 a_x = 0 \Rightarrow a_x = 0$$

$$\sum F_y = T_1 - m_1 g$$

$$m_1 a_y = T_1 - m_1 g \quad (m_1 a_y = 0)$$

$$0 = T_1 - m_1 g$$

$$T_1 = m_1 g$$

mass 2

$$\sum F_x = 0$$

$$\sum F_y = T_2 - m_2 g$$

$$m_2 a_y = T_2 - m_2 g \quad (m_2 a_y = 0)$$

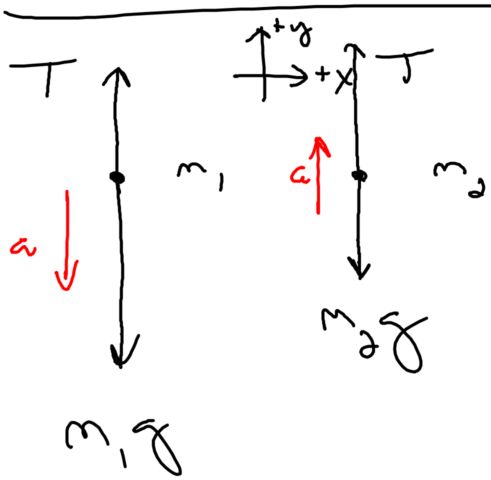
$$T_2 = m_2 g$$

Since $m_1 = m_2 \Rightarrow m_1 = m_2 = m$

$$T_1 = mg \quad \& \quad T_2 = mg$$

$T_1 = T_2$

Trial	Mass 1	Mass 2	$\|\vec{a}\|$
1	1.05 kg	1 kg	0.108 m/s^2
2	1.2 kg	1 kg	0.783 m/s^2
3	1.4 kg	1 kg	1.578 m/s^2



mass 1

$$\Sigma F_y = T - m_1 g$$

$$-m_1 a = T - m_1 g$$

$$T = m_1 g - m_1 a$$

mass 2

$$\Sigma F_y = T - m_2 g$$

$$+m_2 a = T - m_2 g$$

$$T = m_2 g + m_2 a$$

because $T = T \Rightarrow m_1 g - m_1 a = m_2 g + m_2 a$

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

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

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

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

$$a_1 = \left(\frac{1.05\,kg - 1\,kg}{1.05\,kg + 1\,kg}\right)\left(9.8\,m/s^2\right) = 0.239\,m/s^2$$

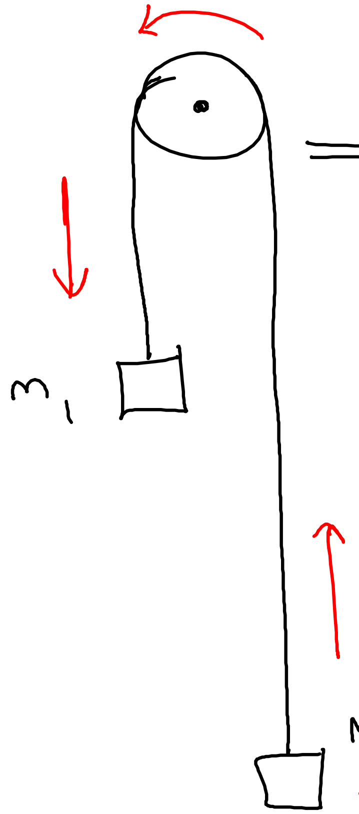
$$a_2 = \left(\frac{1.2\,kg - 1\,kg}{1.2\,kg + 1\,kg}\right)\left(9.8\,m/s^2\right) = 0.891\,m/s^2$$

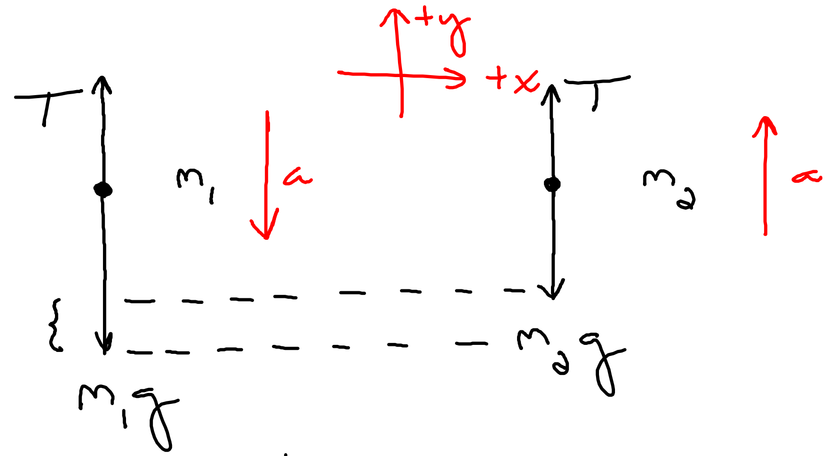
$$a_3 = \left(\frac{1.4\,kg - 1\,kg}{1.4\,kg + 1\,kg}\right)\left(9.8\,m/s^2\right) = 1.633\,m/s^2$$

ATWOOD'S MACHINE

TRIAL	MASS 1	MASS 2	a
1	1.2 kg	1 kg	0.8577 m/s^2
2	1.4 kg	1 kg	1.685 m/s^2
3	1.6 kg	1 kg	2.254 m/s^2

experimentally determined





for mass 1

$$\sum F_x = 0 \Rightarrow a_x = 0$$

$$\sum F_y = T - m_1 g$$

$$-m_1 a = T - m_1 g$$

$$\boxed{T = m_1 g - m_1 a}$$

for mass 2

$$\sum F_y = T - m_2 g$$

$$+m_2 a = T - m_2 g$$

$$\boxed{T = m_2 g + m_2 a}$$

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

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

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

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

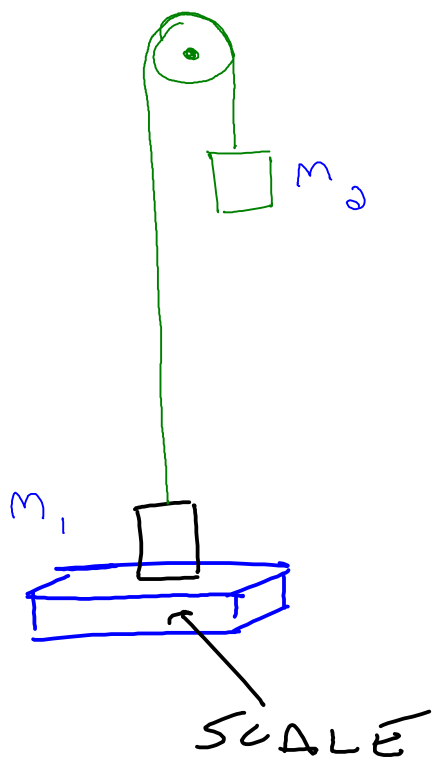
$$a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) g$$

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

$$a = \frac{m_1 - m_2}{m_1 + m_2} g$$

Trial	a
1	$0.8909 \, m/s^2$
2	$1.633 \, m/s^2$
3	$2.2615 \, m/s^2$

theoretical values


m 2
m 1
SCALE

Ch 5

problems

#'s 13 14 15 20 55

(9) (10) (11) (16) (47)

already assigned