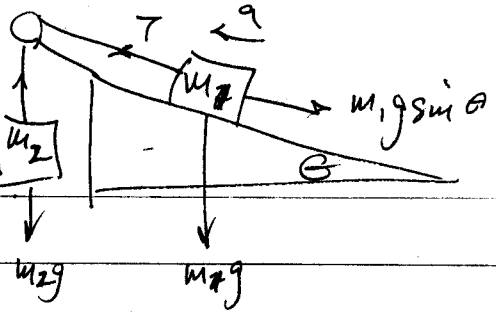
Phys A - week 4 - Giancoli Ch 4 - Dynamics

#5, 21, 26, 36, 40, 66, 67, 72, 75

See solutions to (✓) problems in earlier HW assignments for Phys B.

6.4 #66



$\Sigma F_2 = m_2 a$ $\quad$ $\Sigma F_1 = m_1 a$

$m_2 g - T = m_2 a$ $\quad$ $T - m_1 g \sin\theta = m_1 a$

$g - \frac{T}{m_2} = a$ $\quad$ $\frac{T}{m_1} - g\sin\theta = a$

② Solve for a by eliminating T, or vice versa

$a = g - \frac{T}{m_2} = \frac{T}{m_1} - g\sin\theta$

$m_2 g - T = \frac{m_2}{m_1} T - m_2 g \sin\theta$

$m_2 g(1 + \sin\theta) = T\left(\frac{m_2}{m_1} + 1\right) = T\left(\frac{m_2 + m_1}{m_1}\right)$

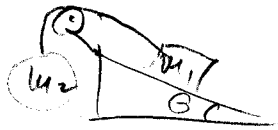
$\frac{m_2 m_1 g(1+\sin\theta)}{(m_2 + m_1)} = T$

(not needed yet, but interesting and potentially useful)

$T = m_2 g - m_2 a = m_1 a + m_1 g \sin\theta$

$g(m_2 - m_1 \sin\theta) = a(m_1 + m_2)$

$a = \frac{g(m_2 - m_1 \sin\theta)}{m_1 + m_2}$ /



6.4 #67 In the previous problem, if $m_1 = m_2 = 1.00$ kg and $\Theta = 30°$, (a) find a. $\sin 30° = 1/2$

(b) If $m_1 = 1.00$ kg and system is at rest, find m_2

(c) Calculate tension in cord for (a) & (b)

from #66:

(a) $\frac{a}{g} = \frac{m_2 - m_1 \sin\Theta}{m_1 + m_2} = \frac{1 - \frac{1}{2}}{2} = \frac{\frac{1}{2}}{2} = \frac{1}{4} = \frac{a}{g}$ /

$a = \frac{1}{4} g \approx \frac{1}{4} 10 \frac{m}{s^2} = \frac{5}{2} \approx 2{,}5 \frac{m}{s^2} = a$ /

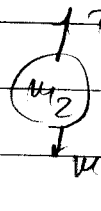
(b) $a = 0$: $m_2 = m_1 \sin\Theta = 1 \cdot \frac{1}{2} = \frac{1}{2}$ kg if $m_1 = 1$ kg

If $m_2 = 1$ then

$m_1 = \frac{m_2}{\sin\Theta} = \frac{1}{1/2} = 2$ kg /

No acceleration when hanging mass = $\frac{1}{2}$ sliding mass

(c) If system is at rest (b), then



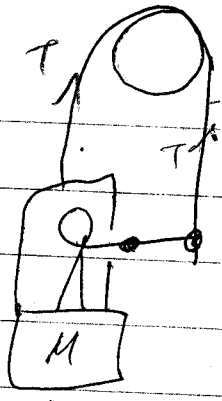
$T = m_2 g = \frac{1}{2}$ kg $\cdot 10 \frac{m}{s^2} = 5$ N /

If $m_1 = m_2 = 1$ kg (a), then (see #66)

$T = \frac{m_1 m_2 g (1 + \sin\Theta)}{m_1 + m_2} = \frac{1 \cdot 1 \cdot g (1 + \frac{1}{2})\,\text{kg}^2}{2\,\text{kg}} = \frac{3}{4} g\,(\text{kg}^2)$

$T \approx \frac{3}{4} 10 \frac{m}{s^2} \cdot \text{kg} = 3 \cdot \frac{5}{2} = \frac{15}{2} = 7{,}5$ N /

C.H # 36

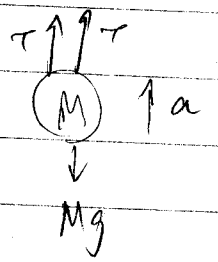


Window washer pulls herself up.

(a) How hard must she pull to raise herself slowly at constant speed? $T =$ ____

(b) If she increases T by 10%, what will her acceleration be?

$M = 58\ kg$



$$\Sigma F = Ma$$

$$2T - Mg = Ma \qquad a = \frac{2T}{M} - g$$

$$T = \frac{M(a+g)}{2}$$

(a) At constant speed, $a = 0$ so

$$T_0 = \frac{M(0+g)}{2} = \frac{gM}{2} \approx \frac{10\ m/s^2 \times 58\ kg}{2} = 260\ N$$

She has to pull only half her weight of 580 N

(b) If $T' = 1.1T_0 = 1.1\frac{gM}{2}$ then

$$a' = \frac{2T'}{M} - g = \frac{2}{M}\left(1.1\frac{gM}{2}\right) = 1.1g - g = 0.1g$$

$$\approx 1\ m/s^2$$