

12 DEC 11

• Day 54 •

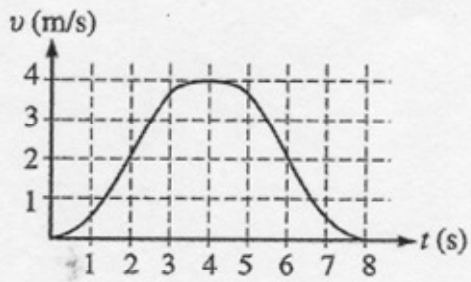
★ SCAN YOUR ASSIGNMENT ★
★ PICK UP QUIZZES AFTER SCHOOL ★

- HW ✓ + Q&A with WARM-UP
- New Agenda
- Free body diagrams: examples
- Atwood's Machine
 - Derivation of acceleration equation
 - Experiment
- Homework Assignment

★ end of page

Warm-up

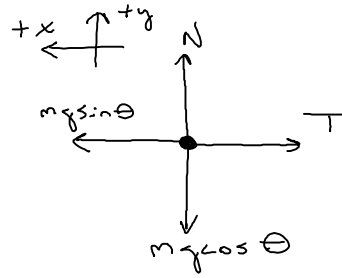
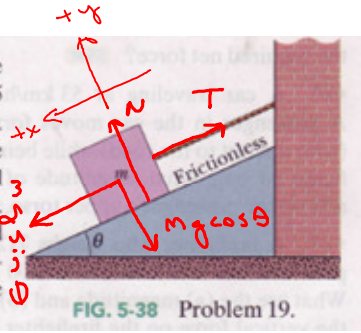
warm-up



13. The velocity v of an elevator moving upward between adjacent floors is shown as a function of time t in the graph above. At which of the following times is the force exerted by the elevator floor on a passenger the least?

- (A) 1 s
- (B) 3 s
- (C) 4 s
- (D) 5 s
- (E) 6 s

•19 In Fig. 5-38, let the mass of the block be 8.5 kg and the angle θ be 30° . Find (a) the tension in the cord and (b) the normal force acting on the block. (c) If the cord is cut, find the magnitude of the resulting acceleration of the block.



$$\theta = 30^\circ$$

$$m = 8.5 \text{ kg}$$

$$(a) \quad \Sigma F_x = mg \sin \theta - T$$

$$0 = mg \sin \theta - T$$

$$T = mg \sin \theta = 8.5 \text{ kg} \cdot 9.8 \text{ m/s}^2 \cdot \sin 30^\circ$$

$$= \boxed{41.65 \text{ N}}$$

$$(b) \quad \Sigma F_y = N - mg \cos \theta$$

$$0 = N - mg \cos \theta \Rightarrow N = mg \cos \theta$$

$$= 8.5 \text{ kg} \cdot 9.8 \text{ m/s}^2 \cdot \cos 30^\circ$$

$$= \boxed{72.14 \text{ N}}$$

the weight is 83.3 N

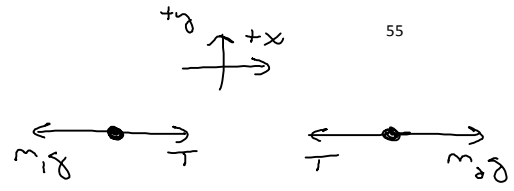
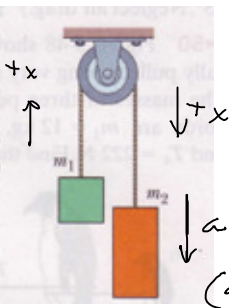
$$(c) \quad \Sigma F_x = mg \sin \theta - T$$

$$a_x = mg \sin \theta - T$$

$$a_x = g \sin \theta = 9.8 \text{ m/s}^2 \cdot \sin 30^\circ = \boxed{4.9 \text{ m/s}^2}$$

★ end of page

••55 Figure 5-53 shows two blocks connected by a cord (of negligible mass) that passes over a frictionless pulley (also of negligible mass). The arrangement is known as *Atwood's machine*. One block has mass $m_1 = 1.30$ kg; the other has mass $m_2 = 2.80$ kg. What are (a) the magnitude of the blocks' acceleration and (b) the tension in the cord?



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

$$= \frac{2.8 \text{ kg} - 1.3 \text{ kg}}{2.8 \text{ kg} + 1.3 \text{ kg}} (9.8 \text{ m/s}^2)$$

$$= 3.585 \text{ m/s}^2$$

I assume you are able to derive this equation.

(b) find the Tension

use either equation:

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

$$m_2 a = m_2 g - T$$

$$T = m_2 g - m_2 a$$

$$= m_2 (g - a)$$

$$= 2.8 \text{ kg} (9.8 \text{ m/s}^2 - 3.585 \text{ m/s}^2)$$

$$= 17.402 \text{ N}$$

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

$$m_1 a = T - m_1 g$$

$$T = m_1 g + m_1 a$$

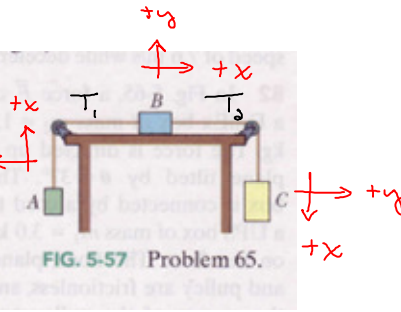
$$= m_1 (g + a)$$

$$= 1.3 \text{ kg} (9.8 \text{ m/s}^2 + 3.585 \text{ m/s}^2)$$

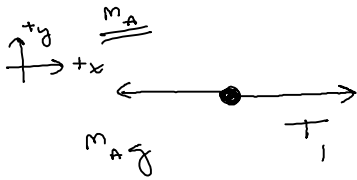
$$= 17.401 \text{ N}$$

★ end of page

•••65 Figure 5-57 shows three blocks attached by cords that loop over frictionless pulleys. Block B lies on a frictionless table; the masses are $m_A = 6.00$ kg, $m_B = 8.00$ kg, and $m_C = 10.0$ kg. When the blocks are released, what is the tension in the cord at the right?

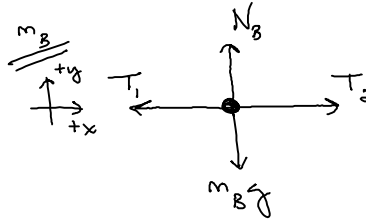


find T_2



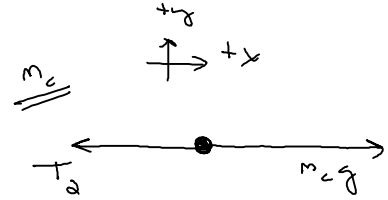
$$\sum F_x = T_1 - m_A g$$

$$m_A a_x = T_1 - m_A g$$



$$\sum F_x = T_2 - T_1$$

$$m_B a_x = T_2 - T_1$$



$$\sum F_x = m_C g - T_2$$

$$m_C a_x = m_C g - T_2$$

let $a = a_x$
since $a_y = 0$

$$m_A a = T_1 - m_A g$$

$$m_B a = T_2 - T_1$$

$$+ m_C a = m_C g - T_2$$

$$(m_A + m_B + m_C) a = m_C g - m_A g$$

$$\therefore a = \frac{m_C - m_A}{m_A + m_B + m_C} g = \frac{10 \text{ kg} - 6 \text{ kg}}{6 \text{ kg} + 8 \text{ kg} + 10 \text{ kg}} \cdot 9.8 \text{ m/s}^2$$

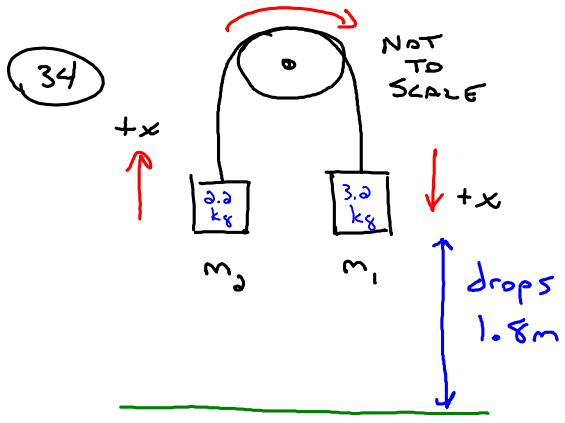
$$= 1.633 \text{ m/s}^2$$

find T_2 : $m_C a = m_C g - T_2 \Rightarrow T_2 = m_C g - m_C a$

$$= m_C (g - a) = 10 \text{ kg} (9.8 \text{ m/s}^2 - 1.633 \text{ m/s}^2)$$

$$= \boxed{81.67 \text{ N}}$$

★ end of page



starts from rest.

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

* I assume you can derive this equation

$$= \frac{3.2\text{kg} - 2.2\text{kg}}{3.2\text{kg} + 2.2\text{kg}} \cdot 9.8\text{m/s}^2$$

$$= 1.815\text{m/s}^2$$

m_1 hit the ground after falling 1.8m

$\therefore m_2$ hits the ground after rising 1.8m

find v after rising 1.8m with $a = 1.815\text{m/s}^2$ (from rest)

$$y = \frac{v^2 - v_0^2}{2a} \Rightarrow v = \sqrt{2ay} = \sqrt{2(1.815\text{m/s}^2)(1.8\text{m})} = 2.556\text{m/s}$$

\Rightarrow then, it becomes a free-fall / projectile motion problem

$y \left\{ \begin{array}{l} \bullet v = 0 \\ \bullet v_0 = 2.556\text{m/s} \end{array} \right.$

$$y = \frac{v^2 - v_0^2}{2a} = \frac{- (2.556\text{m/s})^2}{2(-9.8\text{m/s}^2)} = 0.333\text{m}$$

max height is $1.8\text{m} + 1.8\text{m} + 0.333\text{m} = \boxed{3.933\text{m}}$

↑ initial height
 ↑ height it rises
 ↑ height it is projected

* end of page

••54 In Fig. 5-52, three ballot boxes are connected by cords, one of which wraps over a pulley having negligible friction on its axle and negligible mass. The three masses are $m_A = 30.0$ kg, $m_B = 40.0$ kg, and $m_C = 10.0$ kg. When the assembly is released from rest, (a) what is the tension in the cord connecting B and C, and (b) how far does A move in the first 0.250 s (assuming it does not reach the pulley)?

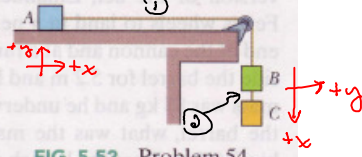
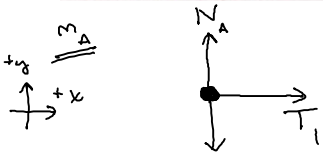


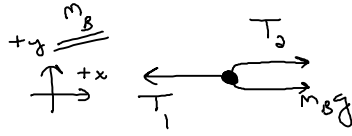
FIG. 5-52 Problem 54.

let $a = a_x$
 $F = F_x$
 all of the "action" is in \hat{x}



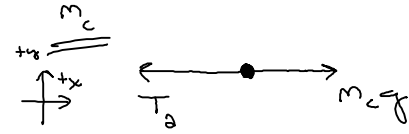
$$\Sigma F = T_1 - m_A g$$

$$m_A a = T_1$$



$$\Sigma F = T_2 + m_B g - T_1$$

$$m_B a = T_2 + m_B g - T_1$$



$$\Sigma F = m_C g - T_2$$

$$m_C a = m_C g - T_2$$

$$m_A a = T_1$$

$$m_B a = T_2 + m_B g - T_1$$

$$+ m_C a = m_C g - T_2$$

$$(m_A + m_B + m_C) a = (m_B + m_C) g$$

$$a = \frac{m_B + m_C}{m_A + m_B + m_C} g = \frac{40 \text{ kg} + 10 \text{ kg}}{30 \text{ kg} + 40 \text{ kg} + 10 \text{ kg}} \cdot 9.8 \text{ m/s}^2$$

$$= 6.125 \text{ m/s}^2$$

find T_2 : $m_C a = m_C g - T_2 \Rightarrow T_2 = m_C g - m_C a = m_C (g - a)$

$$= 10 \text{ kg} (9.8 \text{ m/s}^2 - 6.125 \text{ m/s}^2)$$

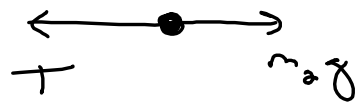
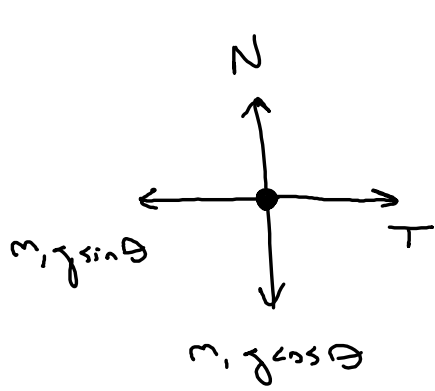
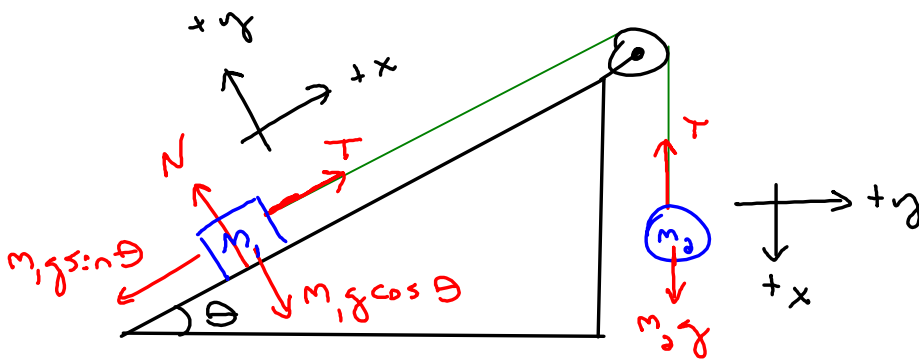
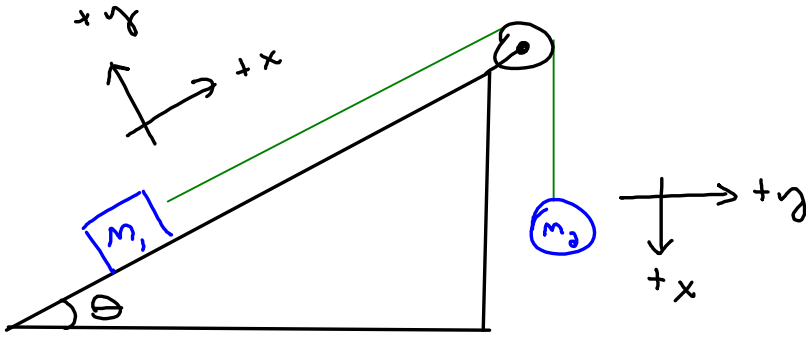
$$= \boxed{36.75 \text{ N}}$$

(b) $\Delta t = 0.25 \text{ s}$, $v_0 = 0$, $a = 6.125 \text{ m/s}^2$

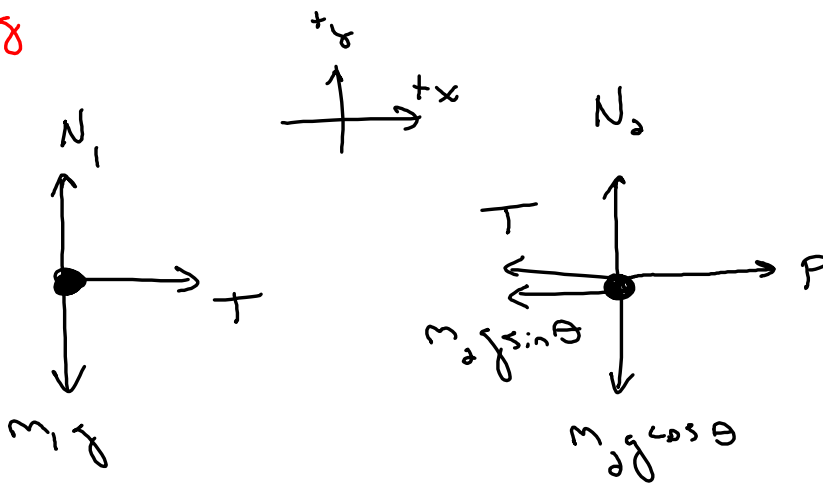
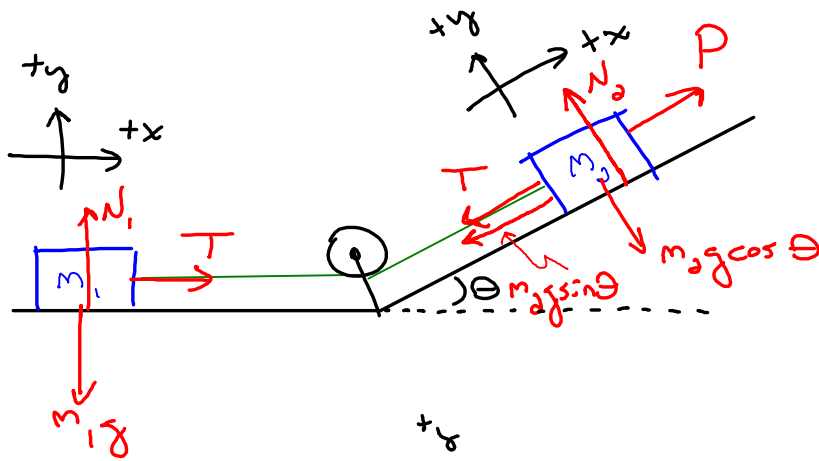
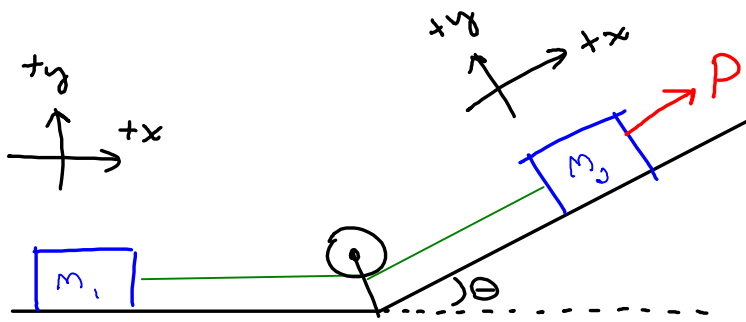
$$x = v_0 t + \frac{1}{2} a t^2 = \frac{1}{2} (6.125 \text{ m/s}^2) (0.25 \text{ s})^2 = \boxed{0.191 \text{ m}}$$

★ end of page

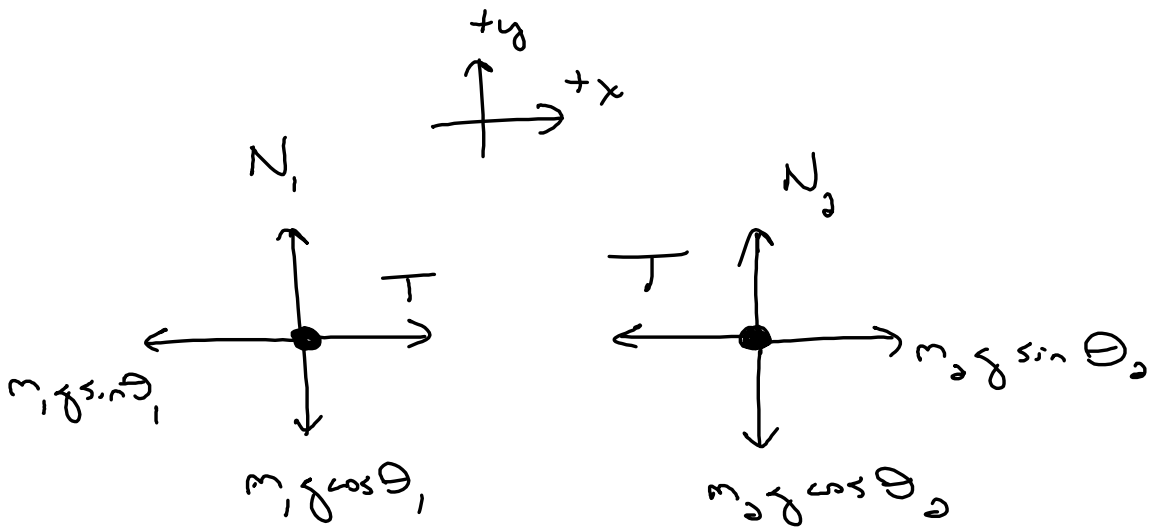
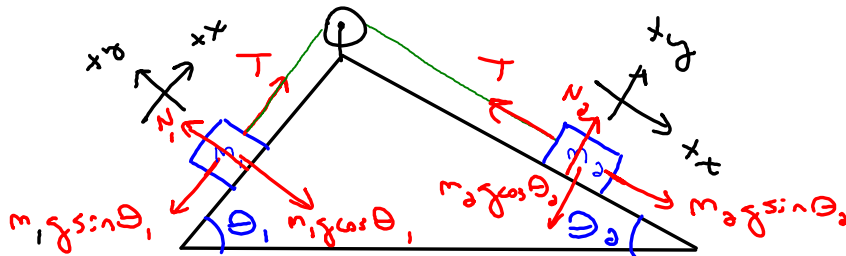
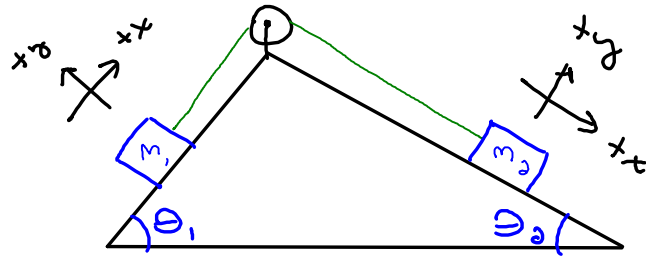
★ no friction ★



★ end of page

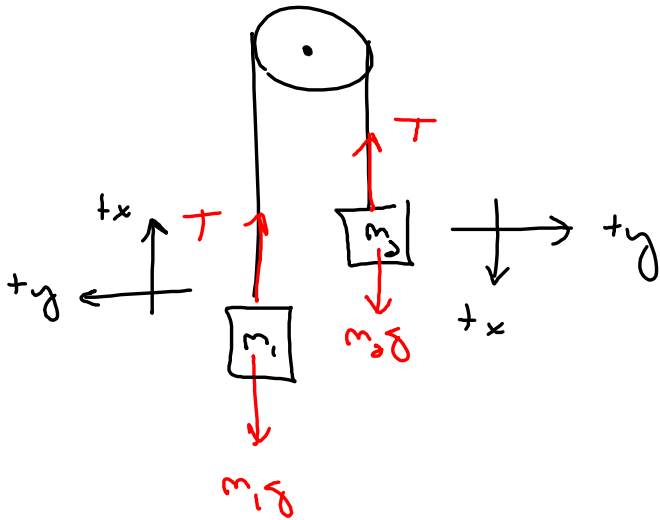


★ end of page



★ end of page

Atwood's Machine



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

★ end of page

★ Homework Assignment ★

NEW
HRW Chapter 5 PROBLEMS: 59, 82, 99, 101

Atwood's
machine HRW Chapter 5 PROBLEM: 55

Giencol: Chapter 4 PROBLEMS: 34

° READ! TAKE NOTES HRW 6-1 through 6-4

★ end of page