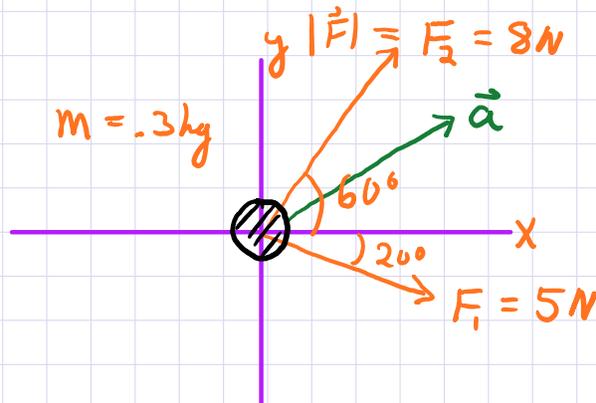
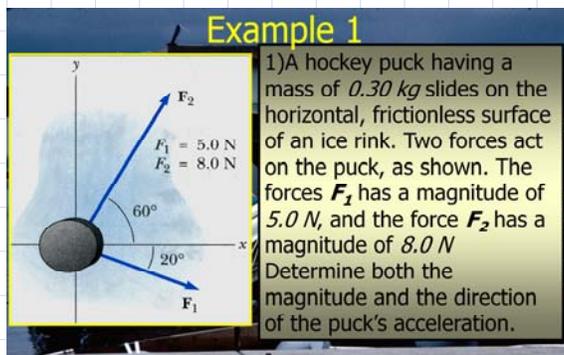


Example 1

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$$\sum \vec{F}_x = m a_x$$

$$F_1 \cos(20^\circ) + F_2 \cos(60^\circ) = m a_x$$

$$a_x = \frac{F_1 \cos(20^\circ) + F_2 \cos(60^\circ)}{m} = \frac{(5N) \cos(20^\circ) + (8N) \cos(60^\circ)}{.3 \text{ kg}}$$

$$a_x = 28.99 \text{ m/s}^2 \approx 29 \text{ m/s}^2$$

$$\sum \vec{F}_y = m a_y$$

$$-F_1 \sin(20^\circ) + F_2 \sin(60^\circ) = m a_y$$

$$a_y = \frac{-F_1 \sin(20^\circ) + F_2 \sin(60^\circ)}{m} = \frac{-(5N) \sin(20^\circ) + (8N) \sin(60^\circ)}{.3 \text{ kg}}$$

$$a_y = 17.4 \text{ m/s}^2$$

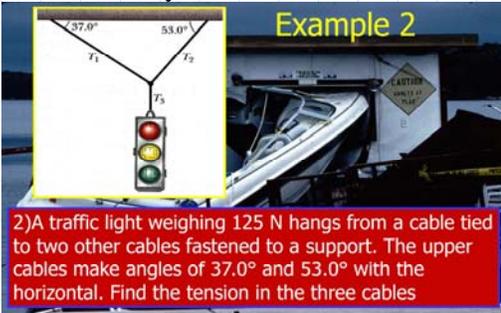
$$|\vec{a}| = \sqrt{a_x^2 + a_y^2} = \sqrt{(29 \text{ m/s}^2)^2 + (17.4 \text{ m/s}^2)^2} = 33.82 \text{ m/s}^2$$

$$\theta = \tan^{-1}\left(\frac{a_y}{a_x}\right) = \tan^{-1}\left(\frac{17.4 \text{ m/s}^2}{29 \text{ m/s}^2}\right) = 30.96^\circ \approx 31^\circ$$

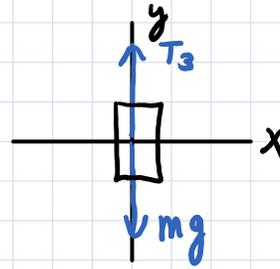
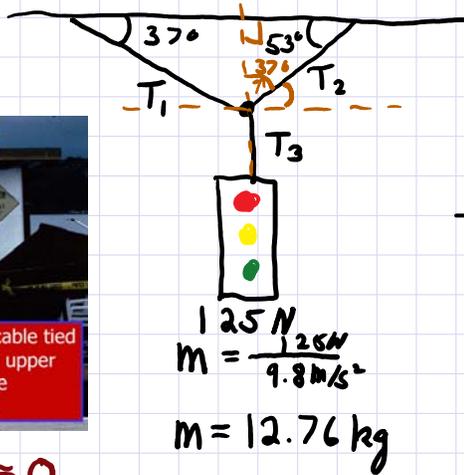
Example 2

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$W = mg$



2) A traffic light weighing 125 N hangs from a cable tied to two other cables fastened to a support. The upper cables make angles of 37.0° and 53.0° with the horizontal. Find the tension in the three cables

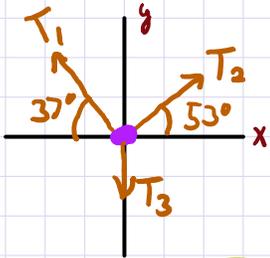


$$\sum F_y = 0$$

$$T_3 - mg = 0$$

$$T_3 = mg$$

$$T_3 = 125 N$$



$$\sum F_x = 0$$

$$+T_2 \cos(53^\circ) - T_1 \cos(37^\circ) = 0$$

$$T_2 \cos(53^\circ) = T_1 \cos(37^\circ)$$

$$T_2 = T_1 \frac{\cos(37^\circ)}{\cos(53^\circ)} = (75.23 N) \frac{\cos(37^\circ)}{\cos(53^\circ)} = 99.83 N$$

$$\sum F_y = 0$$

$$+T_1 \sin(37^\circ) + T_2 \sin(53^\circ) - T_3 = 0$$

$$T_1 \sin(37^\circ) + T_1 \frac{\cos(37^\circ)}{\cos(53^\circ)} \sin(53^\circ) = T_3$$

$$T_1 \left[\sin(37^\circ) + \frac{\cos(37^\circ)}{\cos(53^\circ)} \sin(53^\circ) \right] = T_3$$

$$T_1 = \frac{T_3}{\sin(37^\circ) + \frac{\cos(37^\circ)}{\cos(53^\circ)} \sin(53^\circ)}$$

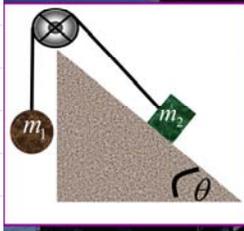
$$T_1 = \frac{125 N}{\sin(37^\circ) + \frac{\cos(37^\circ)}{\cos(53^\circ)} \sin(53^\circ)}$$

$$T_1 = 75.23 N$$

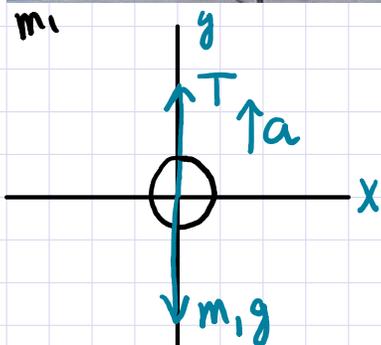
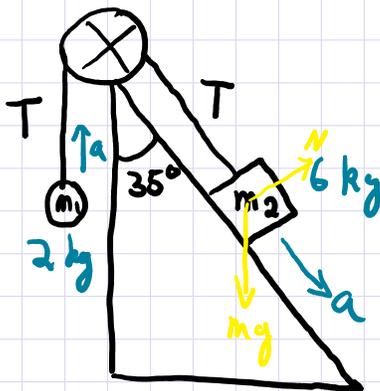
Example 3

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Example 3



3) Two masses are connected by a light string that passes over a frictionless pulley. If the incline is frictionless and if $m_1 = 2.00 \text{ kg}$ and $m_2 = 6.00 \text{ kg}$ and $\theta = 55.0^\circ$, find a) the acceleration of the masses, b) the tension in the string, and c) the speed of each mass 2.0 s after being released from rest.



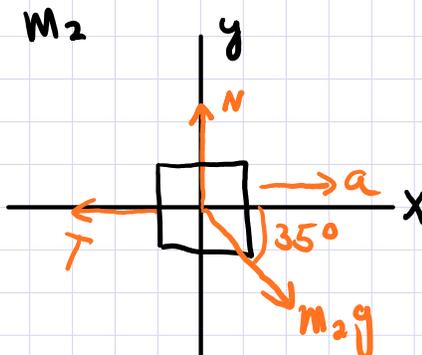
$$\sum F_y = ma_y$$

$$T - m_1 g = m_1 a$$

$$T = m_1 g + m_1 a = m_1 (g + a)$$

$$T = (2 \text{ kg}) (9.8 \text{ m/s}^2 + 3.57 \text{ m/s}^2)$$

$$T = 26.74 \text{ N}$$



$$\sum F_x = ma_x$$

$$m_2 g \cos(35^\circ) - T = m_2 a$$

$$m_2 g \cos(35^\circ) - (m_1 g + m_1 a) = m_2 a$$

$$m_2 g \cos(35^\circ) - m_1 g - m_1 a = m_2 a$$

$$m_1 a + m_2 a = m_2 g \cos(35^\circ) - m_1 g$$

$$a (m_1 + m_2) = m_2 g \cos(35^\circ) - m_1 g$$

$$a = \frac{m_2 g \cos(35^\circ) - m_1 g}{m_1 + m_2} = g \frac{(m_2 \cos(35^\circ) - m_1)}{m_1 + m_2}$$

$$a = (9.8 \text{ m/s}^2) \frac{(6 \text{ kg}) \cos(35^\circ) - (2 \text{ kg})}{8 \text{ kg}}$$

$$a = 3.57 \text{ m/s}^2$$

$$v = v_0 + a t$$

$$v = (3.57 \text{ m/s}^2) (2 \text{ s})$$

$$\sum F_y = 0$$

$$N - m_2 g \sin(35^\circ) = 0$$

$$N = m_2 g \sin(35^\circ)$$

$$v = 7.14 \text{ m/s}$$