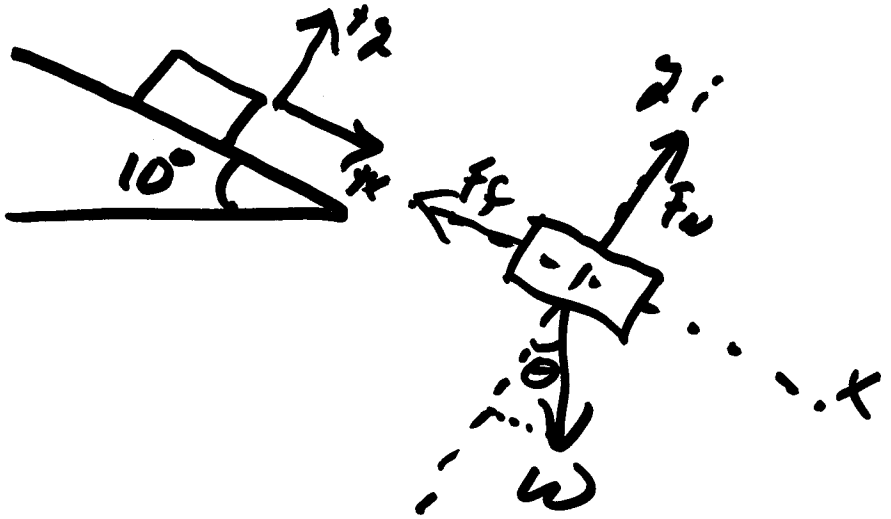
H.W #4 Due today

Read 5.1 - 5.3

H.W #5 available

group problem #5 solutions available on class web page

ex) An 82 kg box sits on a surface that makes an angle of 10° with the horizontal. If box does not move, what is the force of static friction?



y: $F_N - w\cos\theta = 0$

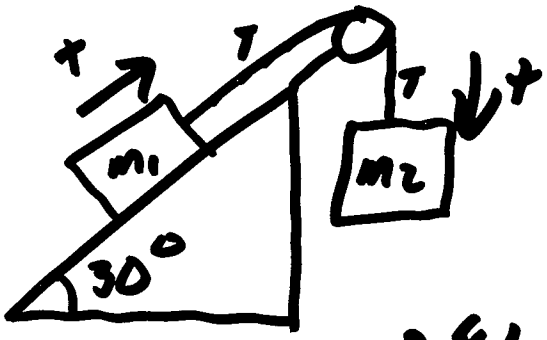
x: $w\sin\theta - F_f = 0$

$$F_f = w\sin\theta = mg\sin\theta$$
$$= (82\text{kg})(9.8\text{m/s}^2)\sin 10^\circ$$
$$= \boxed{140\text{ N}}$$

Interactive Question

An object is held in place by friction on an inclined plane. The angle of the inclination is increased until the object starts moving. If the surface is kept at this angle, the object

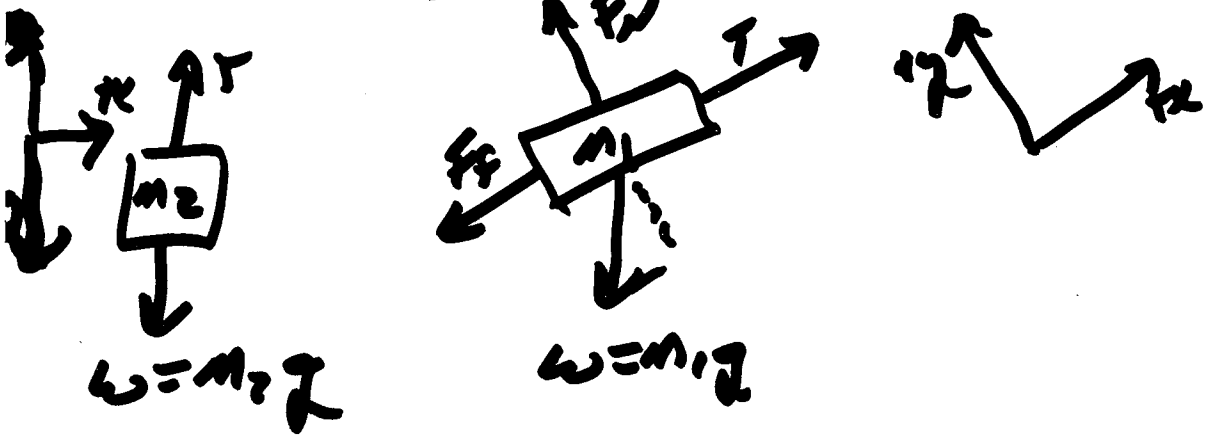
A) slows down.
B) moves at uniform speed.
C) speeds up.
D) none of the above.



$m_1 = 1\,kg \quad m_2 = 2\,kg$

$\mu_k = 0.5$

Find a



① $+m_2 g - T = m_2 a$

② $y: F_N - m_1 g \cos\theta = 0$

③ $x: +T - F_f - m_1 g \sin\theta = m_1 a$

① $T = m_2 g - m_2 a$

③ $T = m_1 a + F_f + m_1 g \sin\theta$

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

↳ $\mu_k F_N$

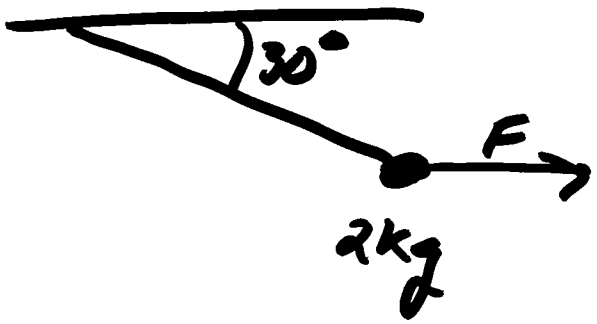
② $F_N = m_1 g \cos\theta$

$$m_2 g - m_2 a = m_1 a + \mu_k m_1 g \cos\theta + m_1 g \sin\theta$$

$$m_1 a + m_2 a = m_2 g - \mu_k m_1 g \cos\theta - m_1 g \sin\theta$$

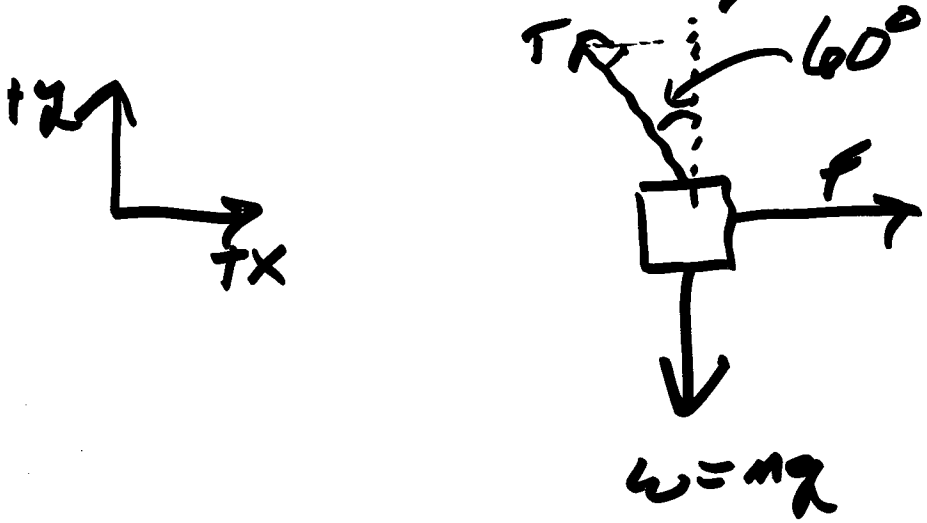
$$a = g\left(\frac{m_2 - \mu_k m_1 \cos\theta - m_1 \sin\theta}{m_1 + m_2}\right]$$

$$\boxed{a = 3.5\ m/s^2}$$



Find F

Find Tension in rope



$T_x = T \sin 60$

$T_y = T \cos 60$

$x: \; F - T\sin 60^\circ = 0$

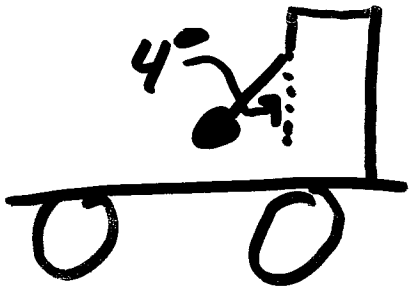
$y: \; T\cos 60^\circ - mg = 0$

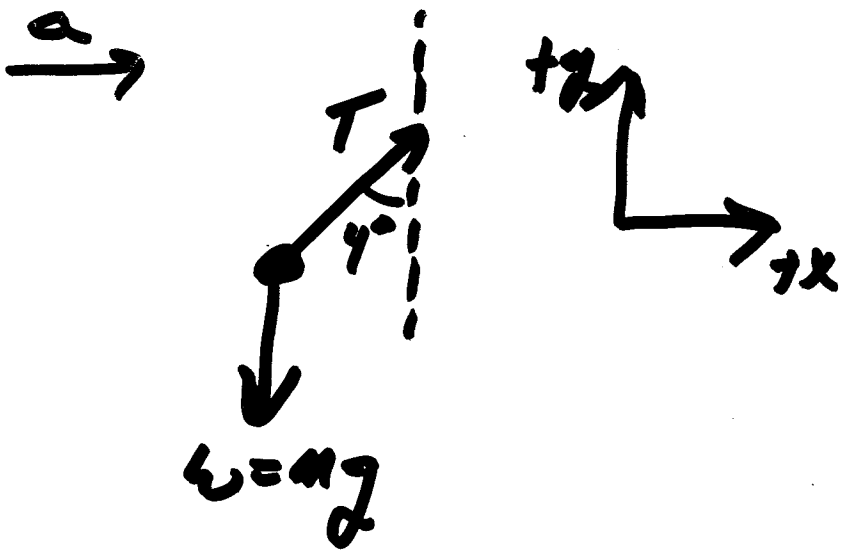
$$T = \frac{mg}{\cos 60^\circ} = \underline{39.2\,N}$$

$$F - (39.2\,N)(\sin 60^\circ) = 0$$

$$\boxed{F = 34\,N}$$

A 3kg mass hangs in a car which accelerates to right. The mass makes an angle of 4° with the vertical. Find the car's acceleration





$T_x = T\sin 4°$

$T_y = T\cos 4°$

$y: T\cos 4° - mg = 0$

$x: T\sin 4° = ma$

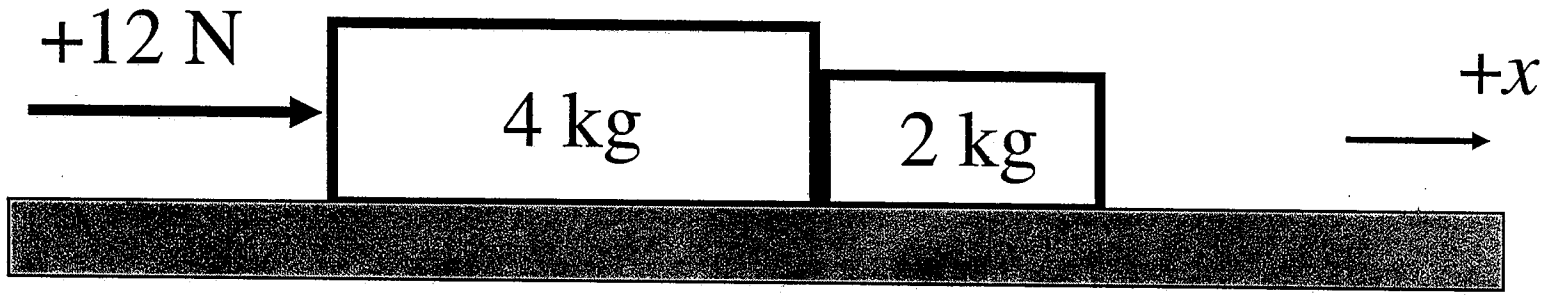
$$\frac{T\sin 4° = ma}{T\cos 4° = mg}$$

$$\tan 4° = \frac{a}{g} \qquad a = g\tan 4°$$

$$\boxed{a = .69\ m/s^2}$$

Interactive Question

A 4 kg block and a 2 kg block can move on a horizontal frictionless surface. The blocks are accelerated by a 12 N force in the positive x direction that pushes the larger block against the smaller one. Determine the force that the 2 kg block exerts on the 4 kg block.



A) zero
B) –4 N
C) +4 N
D) +8 N
E) -12 N

Ex) Tarzan has a mass of 100kg and is 100 m above the ground. A vine which can only hold 400 N without breaking is nearby. What is the <u>shortest</u> and <u>longest</u> time for Tarzan to reach ground?

$$w = mg = (9.8\,m/s^2)(100kg) = \underline{980N}$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$x - x_0 = \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2x}{a}} = \sqrt{\frac{2 \cdot 100m}{9.8 m/s^2}} = \boxed{4.5\,s}$$

$$-T + w = ma$$

$$T = w - ma$$

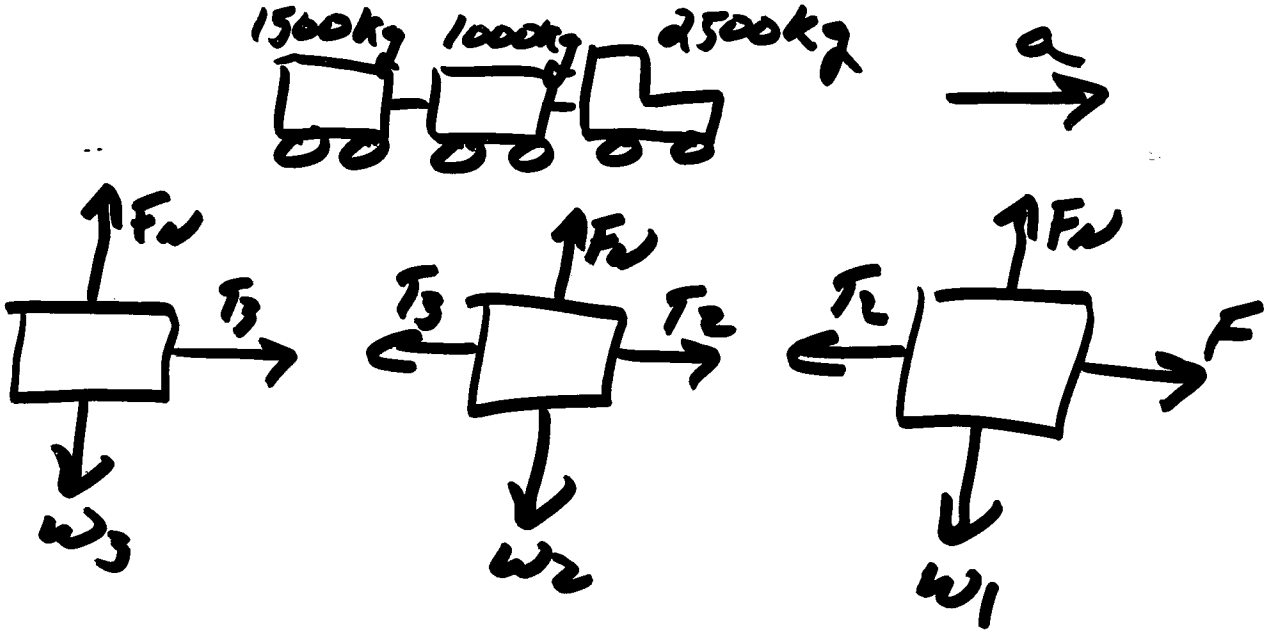
$$T = mg - ma$$

$$400N = mg - ma$$

$$\Rightarrow \underline{a = 5.8\,m/s^2}$$

$$t = \sqrt{\frac{2x}{5.8 m/s^2}} = \sqrt{\frac{2 \cdot 100m}{5.8 m/s^2}} = \boxed{5.9\,s}$$

(X) a tram is accelerating at 5.0 m/s² what is the tension between each of the cars?



$T_3 = m_3 a$

$T_3 = (1500kg)(5.0 m/s^2) = 7.5 \times 10^3 N$

$T_2 - T_3 = m_2 a$

$T_2 = m_2 a + T_3$

$T_2 = (1000kg)(5.0 m/s^2) + 7.5 \times 10^3 N$

$T_2 = 1.3 \times 10^4 N$