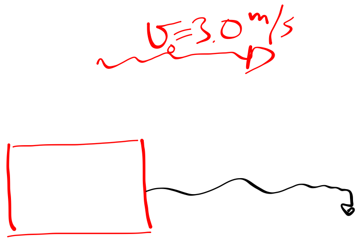
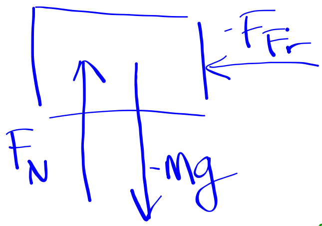
$\mu = 0.3$

draw



FBD



$$\Sigma F_x = ma_x$$

$$-F_{Fr} = ma_x$$

$$F_{Fr} = \boxed{-ma_x}$$

Friction: $F_{Fr} = \mu F_N$

$$\Sigma F_y = m\cancel{a_y}^{\,0}$$

$$F_N + {}^-mg = 0$$

$$F_N = \boxed{mg}$$

$$\frac{-ma_x}{-m} = \frac{\mu mg}{-m}$$

$$a_x = -\mu g$$

$$a_x = -(.3)(9.8)$$

$$= \boxed{-2.94}\ m/s$$

how far? = displacement = $\Delta x = x - x_0$

$x_0 = 0$
$x = x$
$v_0 = 3.0\ m/s$
$v = 0$
$a = -2.94\ m/s$
$t = ?$

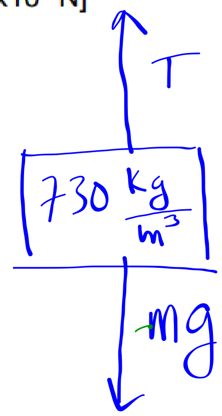
$$v^2 = v_0^2 + 2a(x - x_0)$$

$$0 = 3^2 + 2(-2.94)x$$

$$-9 = -5.88x$$

$$x = 1.53\ m$$

4. A block of wood of density 730.0 kg/m^3 has dimensions 1.20 m by 0.400 m by 0.700 m. What is the tension in a string if it is lifted by a string by an astronaut standing on the moon (where gravity is 1.63 m/sec^2)? [4.00x10^2 N]



$$\Sigma F_y = \cancel{ma_y} = 0$$

$$T - mg = 0$$

$$T = mg$$

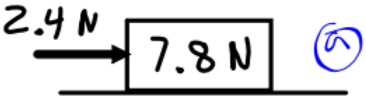
$$T = (245)(1.63)$$
$$= 399\ N$$

$$D = \frac{m}{V}$$

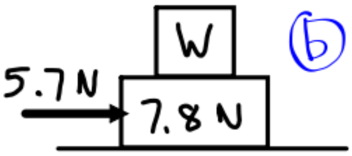
$$730 = \frac{m}{(1.2 \cdot .4 \cdot .7)}$$

$$m = 245\ kg$$

EXAMPLE 1



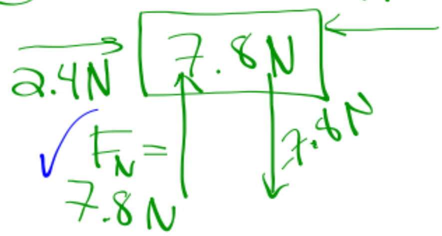
(a) For the 7.8 N object to move across the surface by itself at constant speed a 2.4 N force must be applied. $\rightarrow a = 0$



(b) If the 2.4 N force must be increased to 5.7 N when an object with weight W is placed on the 7.8 N object, what is W? Assume the two blocks move at constant velocity.

(a)

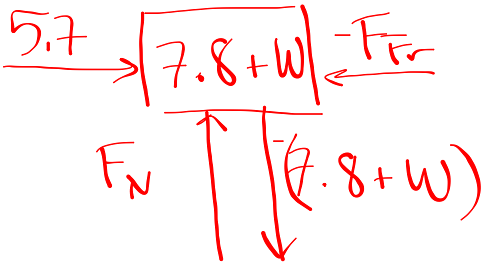
$F_{Fr} = -2.4N$ ✓



$F_{Fr} = \mu F_N$

$\mu = \frac{F_{Fr}}{F_N} = \frac{2.4}{7.8}$

$\boxed{\mu = 0.31}$



$\sum F_x = \cancel{ma_x}^{\,0}$

$5.7 + {}^-F_{Fr} = 0$

$F_{Fr} = \boxed{5.7}$

$F_{Fr} = 5.7$

$F_N = \boxed{7.8 + W}$

$F_{Fr} = \mu F_N$

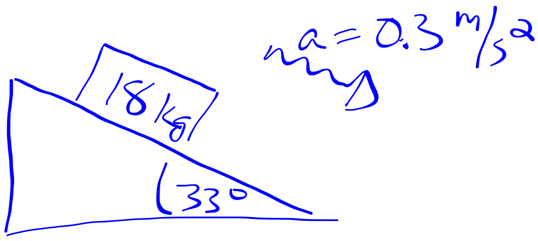
37. An 18.0-kg box is released on a 33.0° incline and accelerates down the incline at 0.300 m/s^2. Find the friction force impeding its motion. How large is the coefficient of friction?

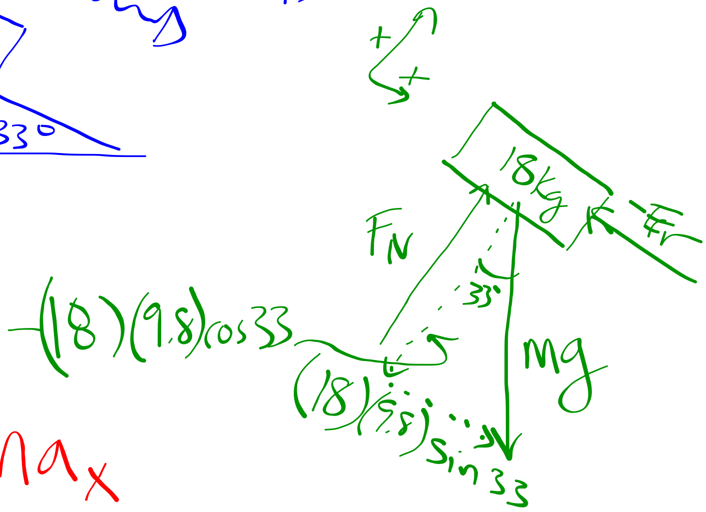
$5.7 = \mu(7.8 + W)$

$5.7 = (0.31)(7.8 + W)$

$W = 10.6\,N$

37. An 18.0-kg box is released on a 33.0° incline and accelerates down the incline at 0.300 m/s^2. Find the friction force impeding its motion. How large is the coefficient of friction?





$$\Sigma F_x = ma_x$$

$$(18)(9.8)(\sin 33) + {}^{-}F_{Fr} = (18)(0.3)$$

$$\boxed{F_{Fr} = 90.7\ N}$$

$$\Sigma F_y = \cancel{ma_y} = 0$$

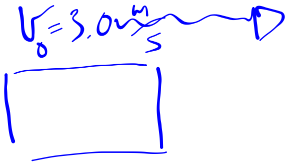
$$F_N + (-18)(9.8)(\cos 33) = 0$$

$$F_N = 148\ N \qquad F_{Fr} = \mu F_N$$

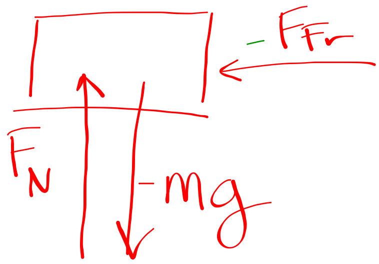
$$90.7 = \mu 148$$

$$\boxed{\mu = 0.61}$$

31. A box is given a push so that it slides across the floor. How far will it go, given that the coefficient of kinetic friction is 0.30 and the push imparts an initial speed of 3.0 m/s?



$\mu = 0.30$



$$\Sigma F_x = ma_x$$
$$-F_{Fr} = ma_x$$
$$F_{Fr} = \boxed{\mu F_N}$$
$$-\mu F_N = ma_x$$
$$\frac{-\mu(\cancel{m}g)}{\cancel{m}} = \frac{\cancel{m}a_x}{\cancel{m}}$$
$$a_x = -\mu g = -(0.3)(9.8)$$
$$a_x = -2.94$$

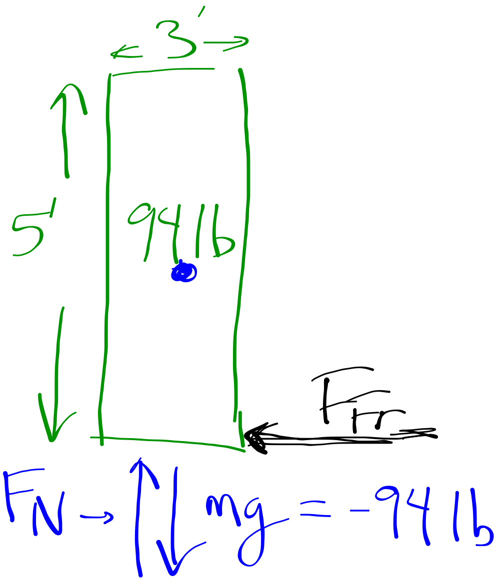
$$\Sigma F_y = m\cancel{a_y}^{\,0}$$
$$F_N + {-mg} = 0$$
$$F_N = \boxed{mg}$$

How far = displacement = $x - x_0$

$x_0 = 0$
$x = x$
$v_0 = 3.0\ m/s$
$v = 0\ m/s$
$a = -2.94\ m/s^2$
$t = ?$

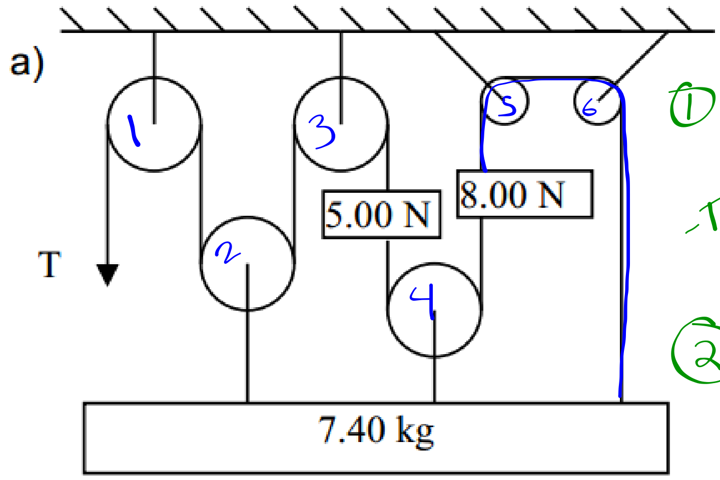
$$v^2 = v_0^2 + 2a(x - x_0)$$
$$0 = 3^2 + 2(-2.94)\,x$$
$$x = 1.53\,m$$

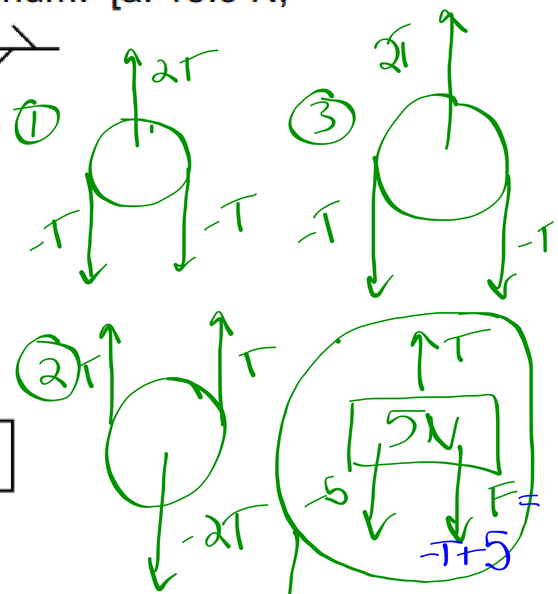
26. A 94 lb crate, 3.0-feet wide and 5.0 feet high, cruises serenely across a frictionless icy surface. When it strikes a frictional region, it tips over. What is the minimum μ that will tip it? (Think rotation). [.60]



6. Find the tensions necessary for equilibrium. [a: 15.9 N;

a)

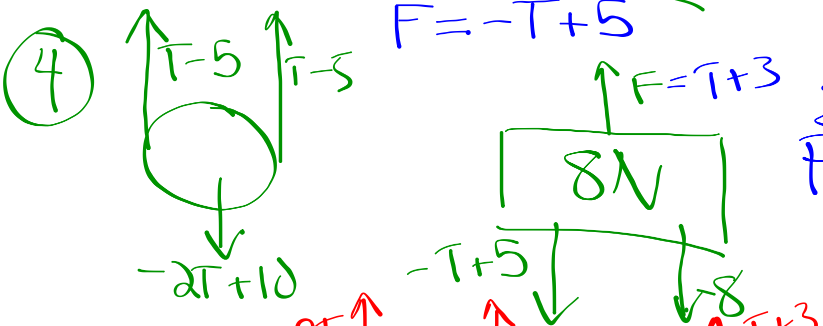


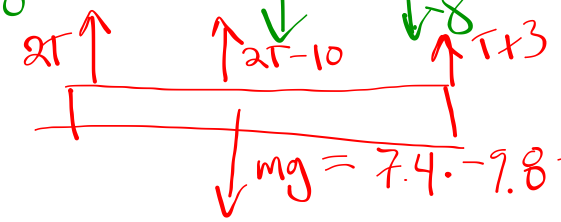


$$\Sigma F = 0$$

$$T - 5 + F = 0$$

$$F = -T + 5$$





$$\Sigma F = 0$$

$$F + (-T + 5) + {}^{-}8 = 0$$

$$F = T + 3$$

$$mg = 7.4 \cdot -9.8 = -72.52\ N$$

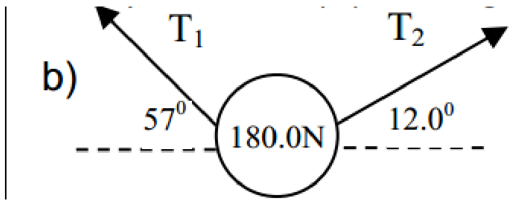
$$\Sigma F = 0$$

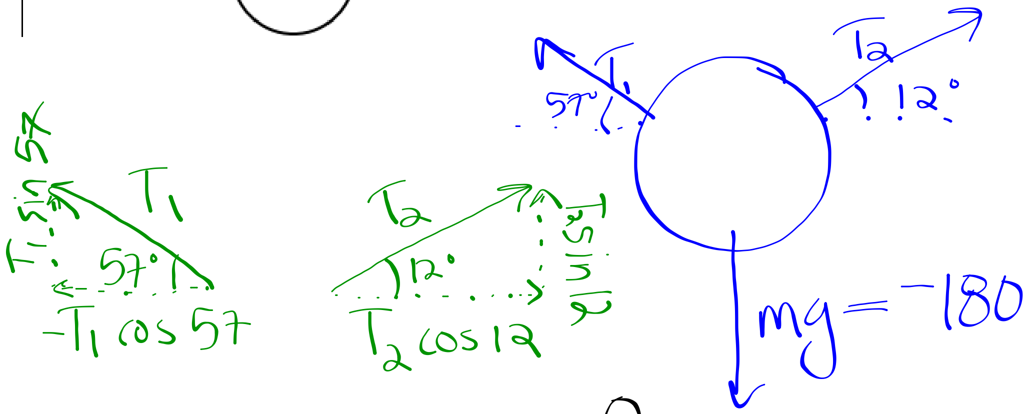
$$2T + 2T + {}^{-}10 + T + 3 + {}^{-}72.52 = 0$$

$$5T = 79.52$$

$$T = 15.91\ N$$

b)





$$\Sigma F_x = \cancel{m a_x}^{\,0}$$

$$-T_1 \cos 57 + T_2 \cos 12 = 0$$

$$\boxed{T_2 = \frac{T_1 \cos 57}{\cos 12}}$$

$$\Sigma F_y = \cancel{m a_y}^{\,0}$$

$$T_1 \sin 57 + T_2 \sin 12 + -180 = 0$$

$$T_1 \sin 57 + T_1 \frac{\cos 57}{\cos 12} \cdot \sin 12 = 180$$

$$\left(\sin 57 + \frac{\cos 57 \cdot \sin 12}{\cos 12}\right) T_1 = 180$$

$$0.95 T_1 = 180$$

$$T_1 = \boxed{188.6\,\text{N}}$$

$$-T_1 \cos 57 + T_2 \cos 12 = 0$$

$$-188.6 \cos 57 + T_2 \cos 12 = 0 \qquad T_2?$$

$$T_2 = \frac{188.6 \cdot \cos 57}{\cos 12} = \boxed{105\,\text{N}}$$