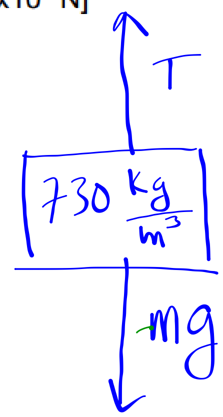
4. A block of wood of density 730.0 kg/m^3 has dimensions 1.20 m by 0.400 m by 0.700 m. What is the tension in a string if it is lifted by a string by an astronaut standing on the moon (where gravity is 1.63 m/sec^2)? [4.00x10^2 N]



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

$T - mg = 0$

$T = mg$

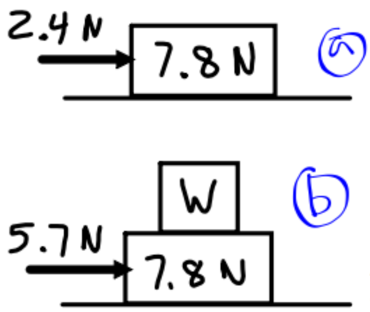
$T = (245)(1.63)$
$= 399\text{ N}$

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

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

$m = 245\text{ kg}$

EXAMPLE 1

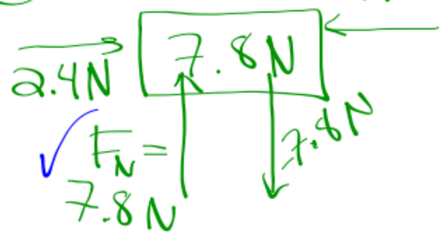


(a) For the 7.8 N object to move across the surface by itself at $\boxed{\text{constant speed}}$ a 2.4 N force must be applied. $\to a = 0$

(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)

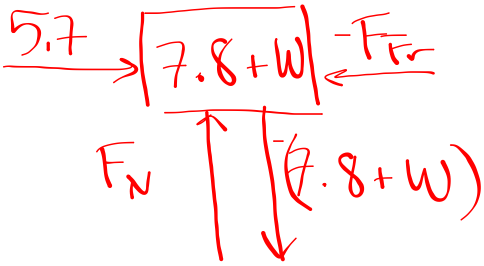
$F_{Fr} = 2.4\,N$ ✓



$F_{Fr} = \mu F_N$

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

$\boxed{\mu = 0.31}$



$F_{Fr} = 5.7$

$F_N = \boxed{7.8 + W}$

$F_{Fr} = \mu F_N$

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

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

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

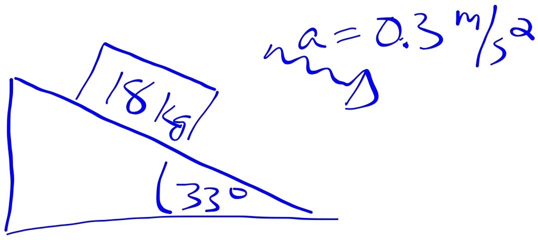
37. An 18.0-kg box is released on a 33.0° incline and accelerates down the incline at 0.300 m/s^2. Find the friction force impeding its motion. How large is the coefficient of friction?

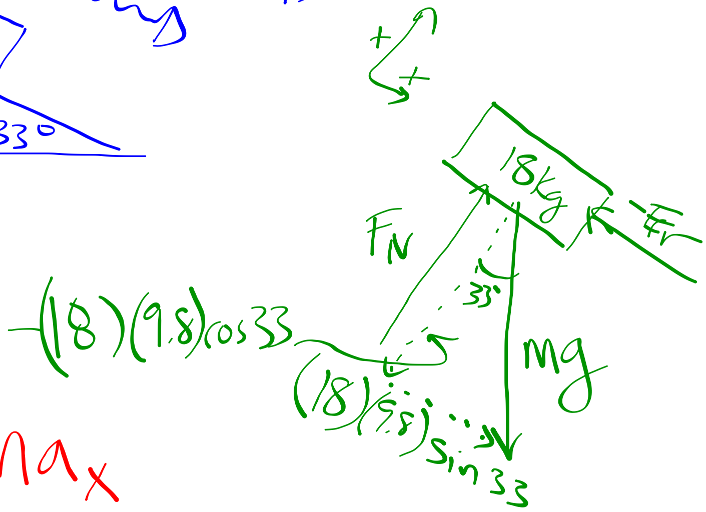
$5.7 = \mu(7.8 + W)$

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

$W = 10.6\,N$

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?





$$\Sigma F_x = ma_x$$

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

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

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

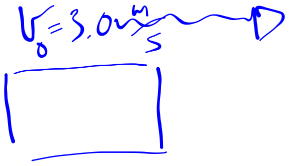
$$F_N + (-18)(9.8)(\cos 33) = 0$$

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

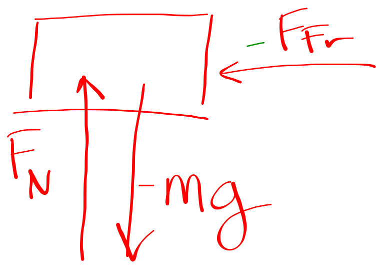
$$90.7 = \mu 148$$

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

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?



$\mu = 0.30$



$$\Sigma F_x = ma_x$$

$$-F_{Fr} = ma_x$$

$$F_{Fr} = \boxed{\mu F_N}$$

$$-\mu F_N = ma_x$$

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

$$F_N + -mg = 0$$

$$F_N = \boxed{mg}$$

$$\frac{-\mu(\cancel{m}g)}{\cancel{m}} = \frac{\cancel{m}a_x}{\cancel{m}}$$

$$a_x = -\mu g = -(0.3)(9.8)$$

$$a_x = -2.94$$

How far = displacement = $x - x_0$

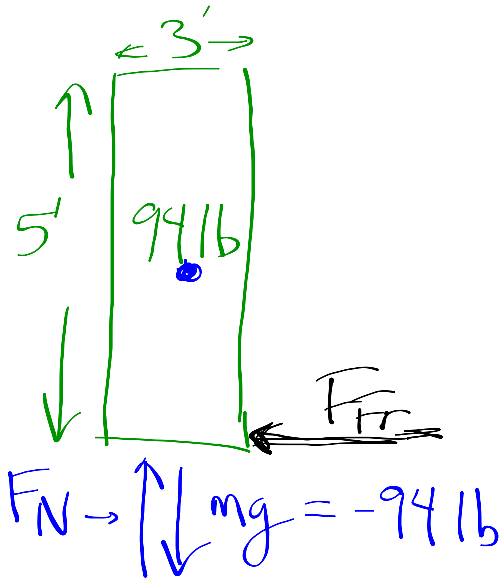
$x_0 = 0$
$x = x$
$v_0 = 3.0\,m/s$
$v = 0\,m/s$
$a = -2.94\,m/s^2$
$t = ?$

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

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

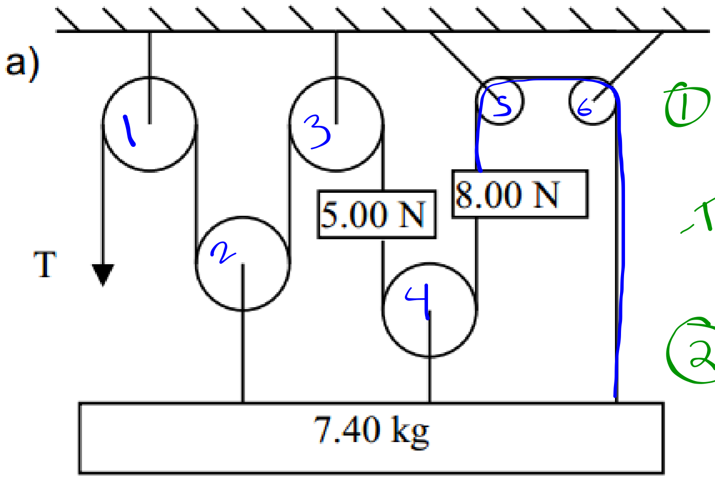
$$x = 1.53\,m$$

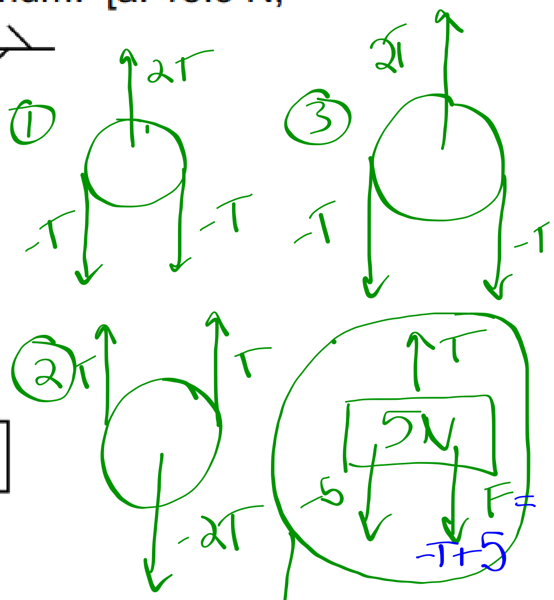
26. A 94 lb crate, 3.0-feet wide and 5.0 feet high, cruises serenely across a frictionless icy surface. When it strikes a frictional region, it tips over. What is the minimum μ that will tip it? (Think rotation). [.60]



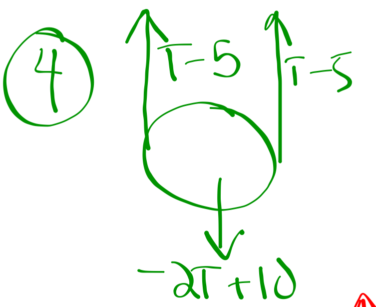
6. Find the tensions necessary for equilibrium. [a: 15.9 N;

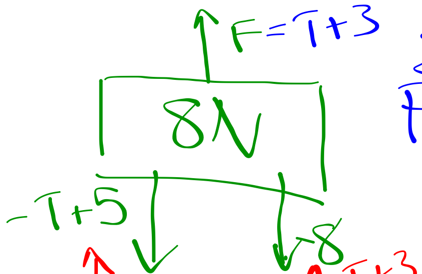
a)



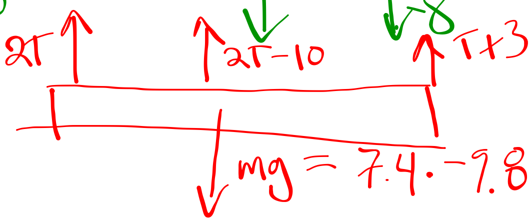


$$\Sigma F = 0$$
$$T - 5 + F = 0$$
$$F = -T + 5$$



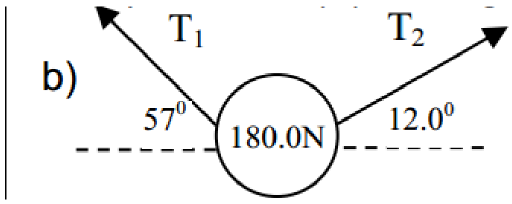


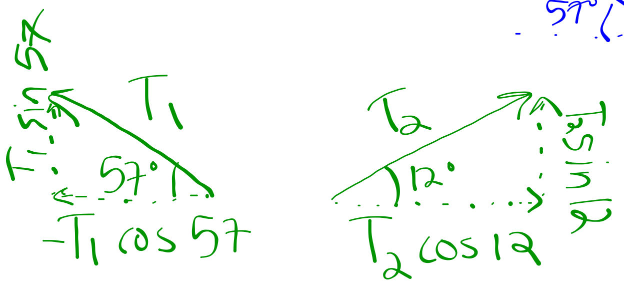
$$\Sigma F = 0$$
$$F + (-T+5) + {}^{-}8 = 0$$
$$F = T + 3$$

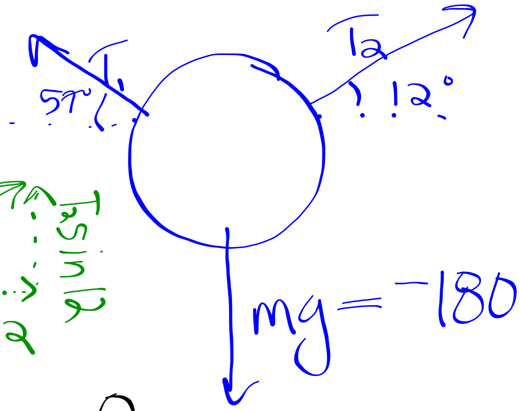


$$mg = 7.4 \cdot -9.8 = {}^{-}72.52\text{ N}$$

$$\Sigma F = 0$$
$$2T + 2T + {}^{-}10 + T + 3 + {}^{-}72.52 = 0$$
$$5T = 79.52$$
$$T = 15.91\text{ N}$$







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

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

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

$$\sum F_y = \cancel{ma_y}^{0}$$

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

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

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

$$0.95 T_1 = 180$$

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

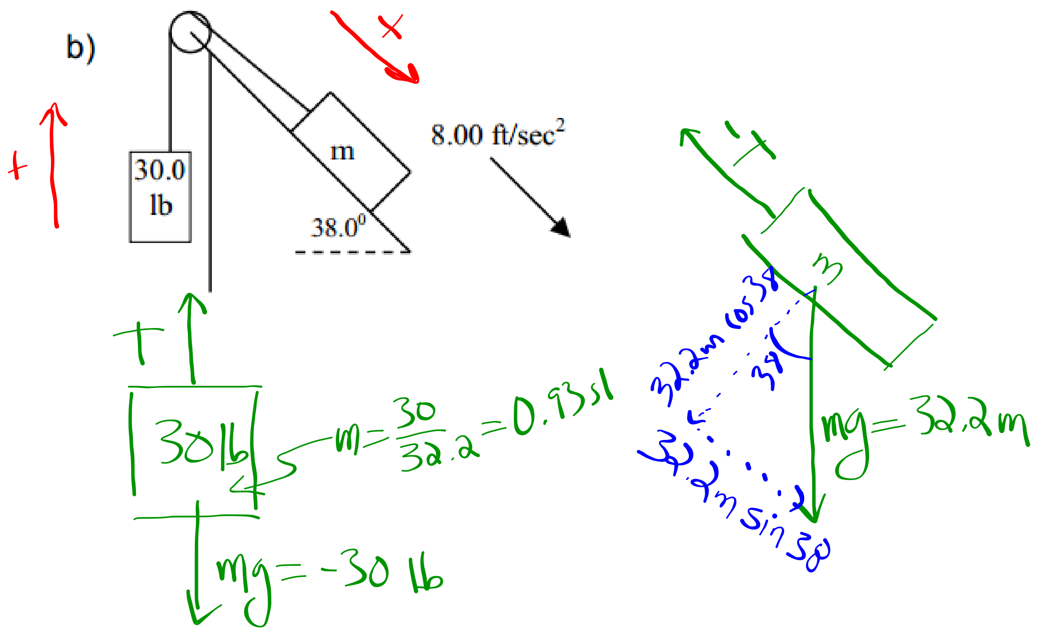
$$-T_1 \cos 57 + T_2 \cos 12 = 0$$

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

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

[~~a: a = 960 m/sec²~~; b: m = 3.2 slugs]

b)



$$T - 30 = (0.93)(8)$$

$$T = 37.44 \text{ lb}$$

$$-T + 32.2 m \sin 38 = m(8)$$

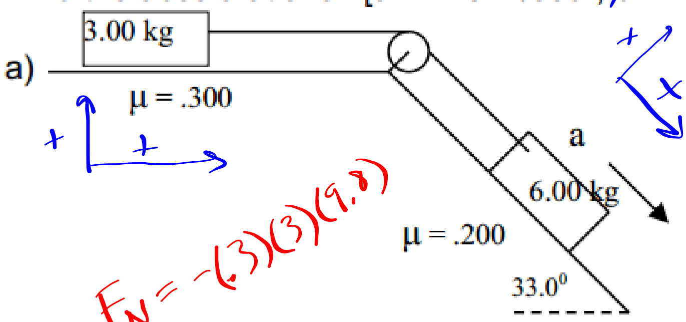
$$-37.44 + 32.2 m \sin 38 = m(8)$$

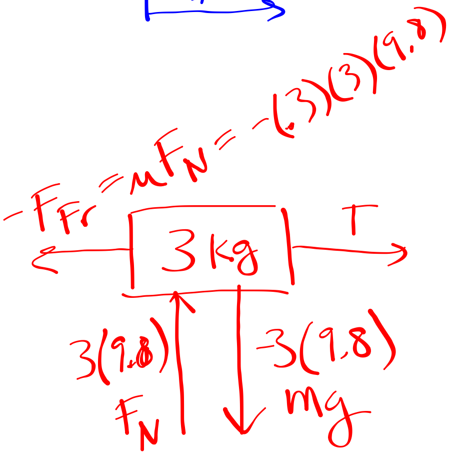
$$19.82 m - 8m = 37.44$$

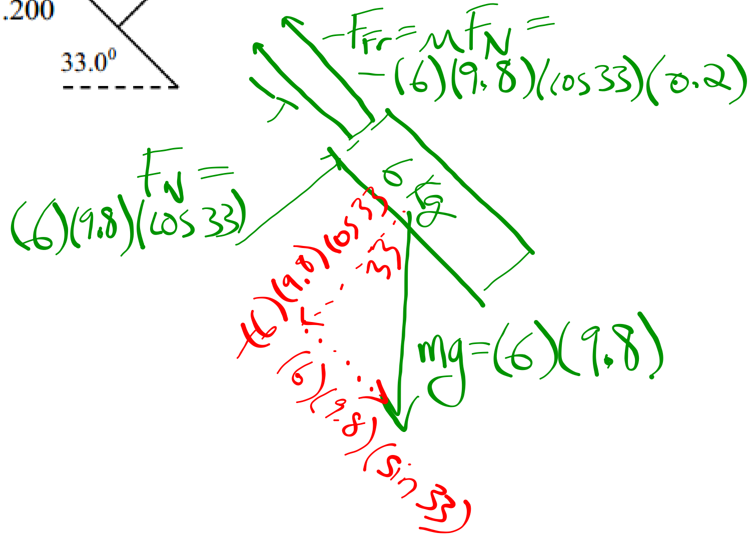
$$11.82 m = 37.44$$

$$m = 3.17 \text{ sl}$$

27. Find the accelerations. [a: 1.48 m/sec^2; ~~b: 14.37 ft/sec^2~~]







$$-F_{Fr} + T = (3)a$$

$$\boxed{T} = 3a + 8.82$$

$$-T + {}^{-}9.86 + 32.02 = 6a$$

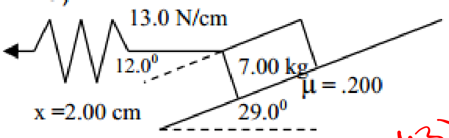
$$\boxed{T} = 22.16 - 6a$$

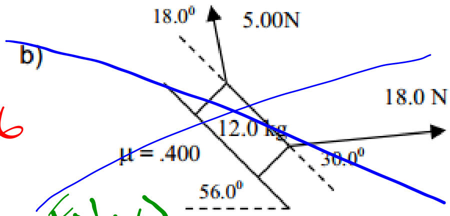
$$3a + 8.82 = 22.16 - 6a$$

$$9a = 13.34$$

$$\boxed{a = 1.48\ m/s^2}$$

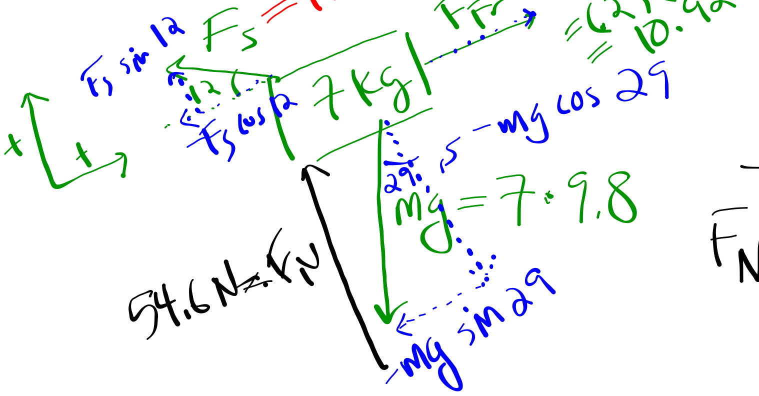
28. For the masses shown, what are the masses' final velocities and how long does it take each mass to slide down the inclines if both masses start from rest and both inclines are 48.0 meters in length? [a: 25.6 m/sec, 3.75 sec; ~~b: 26.3 m/sec, 3.65 sec~~]





$F_s = kx = (13)(2) = 26$

$F_{Fr} = \mu F_N = (.2)(54.6) = 10.92$



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

$-mg\cos 29 + F_s \sin 12 + F_N = 0$

$F_N = mg\cos 29 - F_s \sin 12$

$= (7)(9.8)\cos 29 - 26 \sin 12$

$= 54.6\text{ N}$

$\Sigma F_x = m a_x$

$-F_s\cos 12 + F_{Fr} + -mg\sin 29 = ma$

$$\frac{-26\cos 12 + 10.92 + -(7)(9.8)(\sin 29)}{7} = a$$

$a = -6.82\ m/s^2$

$x_0 = 0$
$x = -48$
$v_0 = 0$
$v = -25.58\ m/s$
$a = -6.82$
$t = 3.75s$

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

$-48 = \frac{1}{2}(-6.82)t^2$

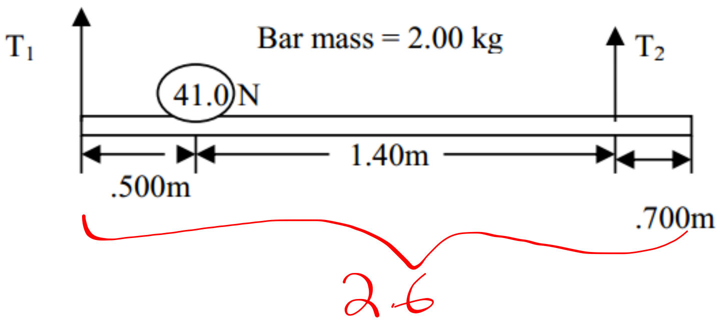
$t = 3.75s$

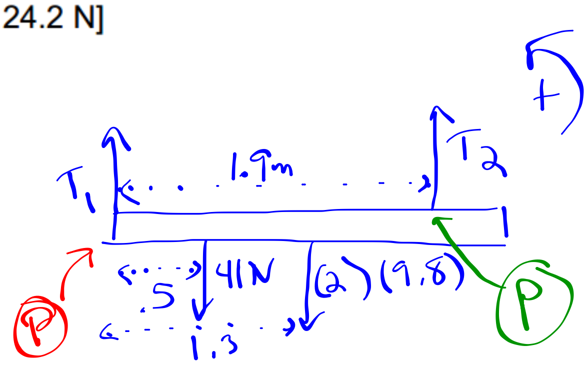
$v = \cancel{v_0} + at$

$v = (-6.82)(3.75)$

$v =$

9. Find the tensions in each string supporting the weight and the board. [T_1 = 36.4 N; T_2 = 24.2 N]





$$\Sigma\tau = 0$$

$$(T_1)(0) + {}^-(41)(.5) + T_2(1.9) + {}^-(2)(9.8)(1.3) = 0$$

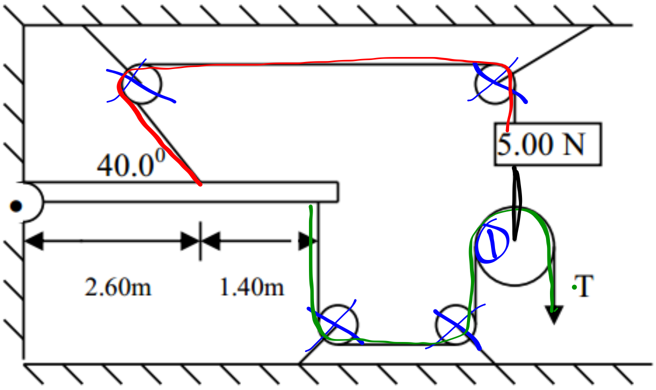
$$T_2 = 24.2\ N$$

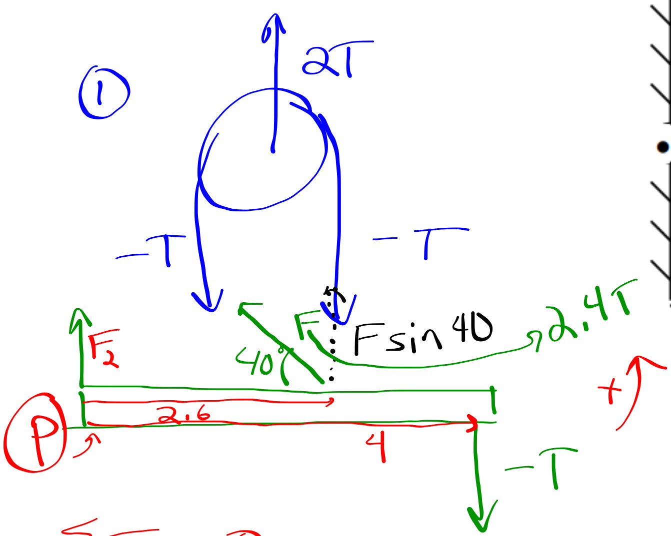
$$\Sigma\tau = 0$$

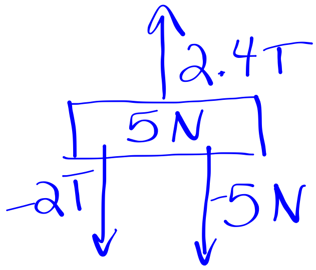
$$-(T_1)(1.9) + (41)(1.4) + (2)(9.8)(.6) + T_2(0) = 0$$

$$T_1 = 36.4N$$

8. Find the tension in the string. [12.7 N]







$\Sigma \tau = 0$

$\cancel{(F_2)(0)} + F(\sin 40)(2.6) + -T(4)$

$F = \frac{4T}{(\sin 40)(2.6)} = 2.4T$

$\Sigma F = 0$

$2.4T + -2T - 5 = 0$

$0.4T = +5$

$T = 12.5$