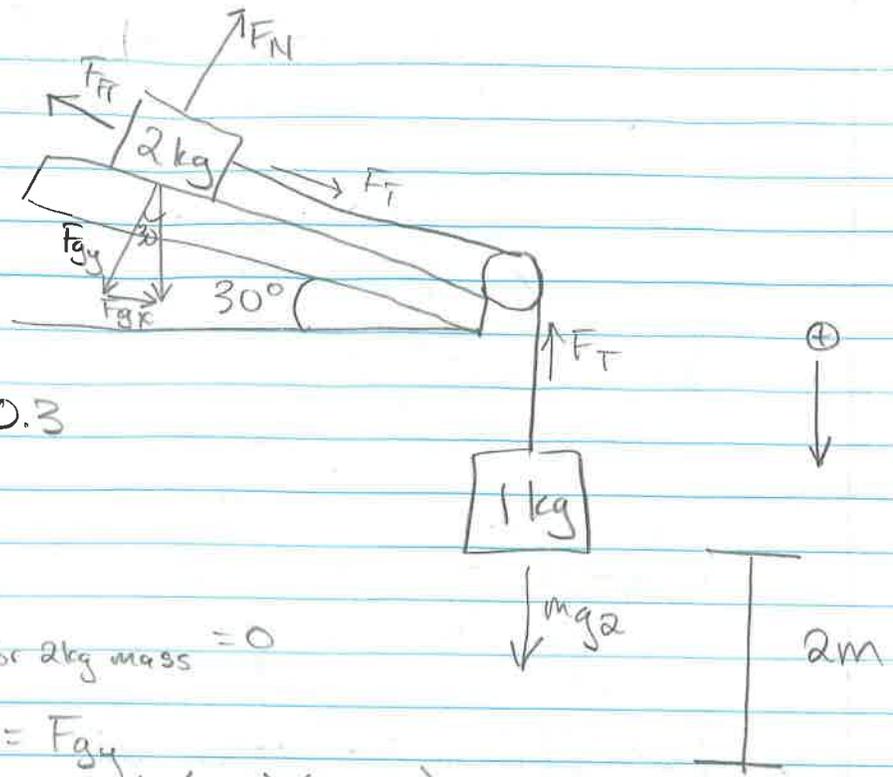


Problem Set #6

3)



$\mu = 0.3$

a) $\sum F_y \text{ for } 2 \text{ kg mass} = 0$

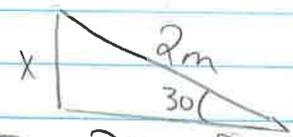
$F_N = F_{gy}$
 $F_N = \cos(30)(2 \text{ kg})(10 \frac{\text{m}}{\text{s}^2})$
 $F_N = 17.32 \text{ N}$

$F_{FFr} = \mu F_N$
 $F_{FFr} = (0.3)(17.32 \text{ N})$
 $F_{FFr} = 5.196 \text{ N}$

$W_{FFr} = F_{FFr} \cdot d$
 $W_{FFr} = (5.196 \text{ N})(2 \text{ m})$

$W_{FFr} = \text{heat}_E \text{ liberated} = 10.4 \text{ J}$

b)



$\sin(30) = \frac{x}{2 \text{ m}}$
 $x = 1 \text{ m}$

$\Delta PE = -PE_0 + PE_f$
 $\Delta PE = [(2 \text{ kg})(10 \frac{\text{m}}{\text{s}^2})(1 \text{ m}) + (1 \text{ kg})(10 \frac{\text{m}}{\text{s}^2})(2 \text{ m})] + 0 \text{ J}$
 $\Delta PE = -40 \text{ J}$

c) conservation of energy will be used

$\Delta PE_0 = \Delta KE_f + \Delta TE$
 $40 \text{ J} = \frac{1}{2}(2 \text{ kg} + 1 \text{ kg})(v)^2 + 10.4$

$v_{\text{system}} = 4.44 \frac{\text{m}}{\text{s}}$

$$d) v_{avg} = \frac{v_0 + v_f}{2} \quad v_{avg} = \frac{0 + 4.44 \frac{m}{s}}{2}$$

$$\boxed{v_{avg} = 2.22 \frac{m}{s}}$$

$$\Delta x = (v_{avg})(t)$$

$$2m = (2.22 \frac{m}{s})(t)$$

$$\boxed{t = .90 s}$$

$$v_f^2 = v_0^2 + 2ax$$

$$\vec{v}_f = v_0 + at$$

$$4.44 \frac{m}{s} = 0 + (a)(.90 s)$$

$$\boxed{a = 4.93 \frac{m}{s^2}}$$

$$e) \sum F_{1kg \text{ mass}} = ma_{1kg \text{ mass}}$$

$$mg - F_T = ma$$

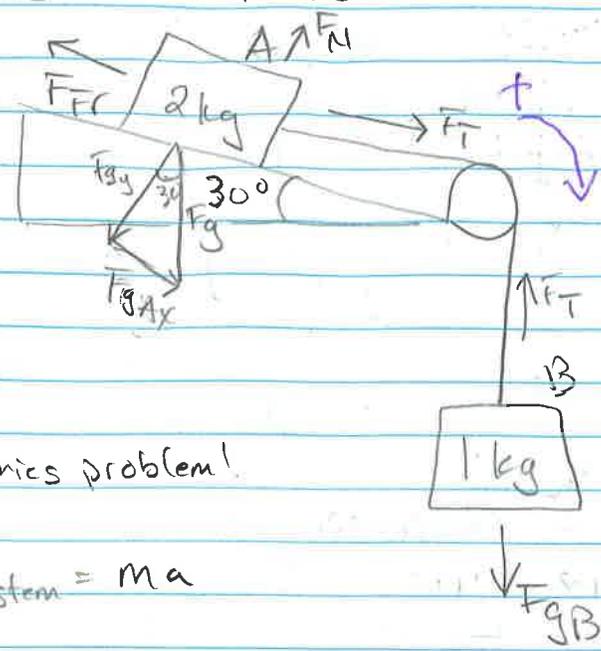
$$(1 \text{ kg})(10 \frac{m}{s^2}) - F_T = (1 \text{ kg})(4.93 \frac{m}{s^2})$$

$$\boxed{F_T = 5.07 \text{ N}}$$

Problem Set #6

4)

$\mu = 0.3$



*dynamics problem!

$$\sum F_{\text{system}} = ma$$

$$F_{gB} + F_{gAy} - F_{fr} = ma$$

$$(1 \text{ kg})(10 \frac{\text{m}}{\text{s}^2}) + (\sin 30)(2 \text{ kg})(10 \frac{\text{m}}{\text{s}^2}) - (0.3)F_N = (1+2 \text{ kg})(a)$$

$$\sum F_{yA} = 0$$

$$F_{gAy} = F_N$$

$$\cos(30)(2 \text{ kg})(10 \frac{\text{m}}{\text{s}^2}) = F_N$$

$$*F_N = 17.32$$

$\sum F = ma$

$$10 \text{ N} + 10 \text{ N} - (0.3)(17.32 \text{ N}) = (3 \text{ kg})(a)$$

$$a = 4.93 \frac{\text{m}}{\text{s}^2}$$

$$\sum F_B = F_{gB} - F_T = ma$$

$$(1 \text{ kg})(10 \frac{\text{m}}{\text{s}^2}) - F_T = (1 \text{ kg})(4.93 \frac{\text{m}}{\text{s}^2})$$

$$F_T = 5.07 \text{ N}$$

$$x_f = y_0 + v_0 t + \frac{1}{2} a t^2$$

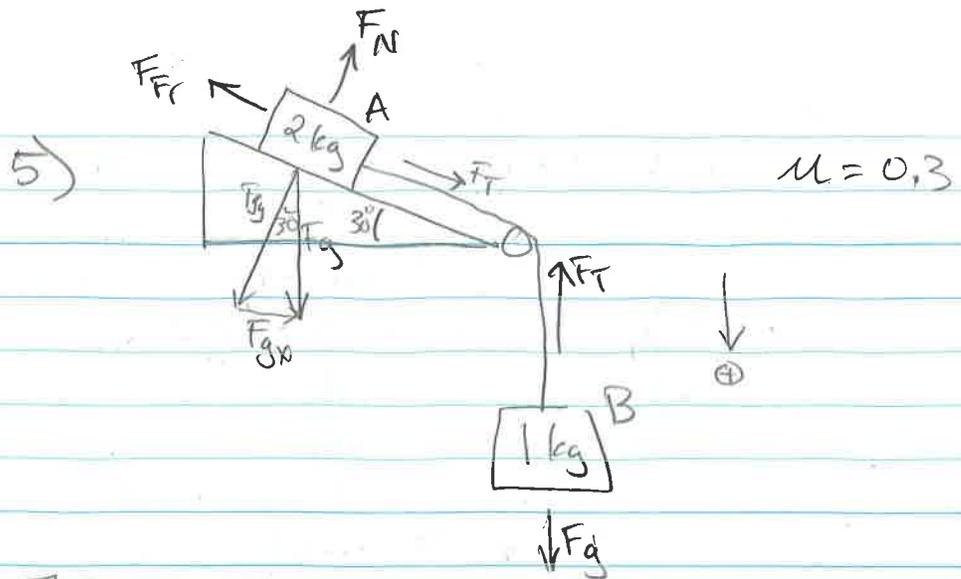
$$0 \text{ m} = 2 \text{ m} + \frac{1}{2} (-4.93 \frac{\text{m}}{\text{s}^2})(t^2)$$

$$t = .9 \text{ s}$$

$$v = a(t)$$

$$v_f = (4.93 \frac{\text{m}}{\text{s}^2})(.9 \text{ s})$$

$$v_f = 4.4 \frac{\text{m}}{\text{s}}$$



$$\sum F_{yA} = 0 = F_{gy} - F_N$$

$$F_N = \cos(30) (2 \text{ kg}) (10 \frac{\text{m}}{\text{s}^2})$$

$$\star F_N = 17.3 \text{ N}$$

$$\sum F_{xA} = F_T + F_{gx} - F_{FFr} = ma \quad \left\{ \begin{array}{l} \sum F_B = F_g - F_T = ma \\ (1 \text{ kg}) (10 \frac{\text{m}}{\text{s}^2}) - F_T = (1 \text{ kg}) (a) \end{array} \right.$$

$$F_T + (\sin 30) (2 \text{ kg}) (10 \frac{\text{m}}{\text{s}^2}) - (0.3) (17.3 \text{ N}) = a (2 \text{ kg})$$

$$F_T + 4.81 = (2 \text{ kg}) (a)$$

$$a = \frac{F_T + 4.81}{2 \text{ kg}}$$

$$(1 \text{ kg}) (10 \frac{\text{m}}{\text{s}^2}) - F_T = (1 \text{ kg}) (a)$$

$$10 \frac{\text{kg} \cdot \text{m}}{\text{s}^2} - F_T = \frac{F_T + 4.81}{2 \text{ kg}}$$

$$20 - 2F_T = F_T + 4.81$$

$$20 = 3F_T + 4.81$$

$$3F_T = 15.19 \text{ N}$$

$$F_T = 5.06 \text{ N}$$

$$a = \frac{(5.06 \text{ N}) + 4.81}{2 \text{ kg}}$$

$$a = 4.94 \frac{\text{m}}{\text{s}^2}$$

$$2 \text{ m} = 0 \text{ m} + \frac{1}{2} (4.94 \frac{\text{m}}{\text{s}^2}) t^2$$

$$t = .9 \text{ s}$$

$$v_f = a(t)$$

$$v_f = (4.94 \frac{\text{m}}{\text{s}^2}) (.9 \text{ s})$$

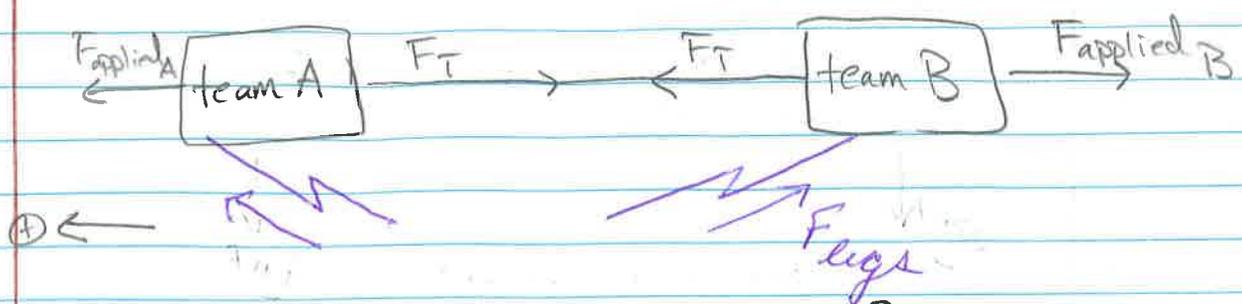
$$v_f = 4.44 \frac{\text{m}}{\text{s}}$$

I like #1 the best

Problem Set #6

6) dynamics problem

$$\sum F = ma$$



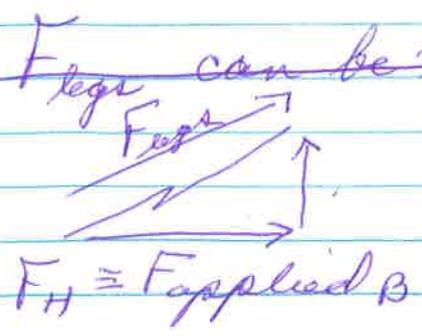
In this system, the forces we will focus on are F_T and $F_{Applied}$ by both team A and team B. No matter how hard a team pulls, tension will act equally on each team, so F_T is basically irrelevant. The only forces left are force applied. The team that applies the most force on the system will cause the system to accelerate in that direction, causing a team to win. If Team A applies more force, the system will accelerate to the left and Team A will win.

$$\sum F = ma$$

$$F_{Applied A} - F_{Applied B} + F_T - F_T = ma$$

$$F_{Applied A} - F_{Applied B} = ma$$

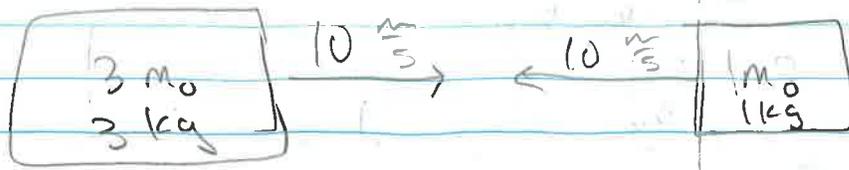
The the force applied of the feet of one team is greater than the force applied by the other team's feet, then that team will win.



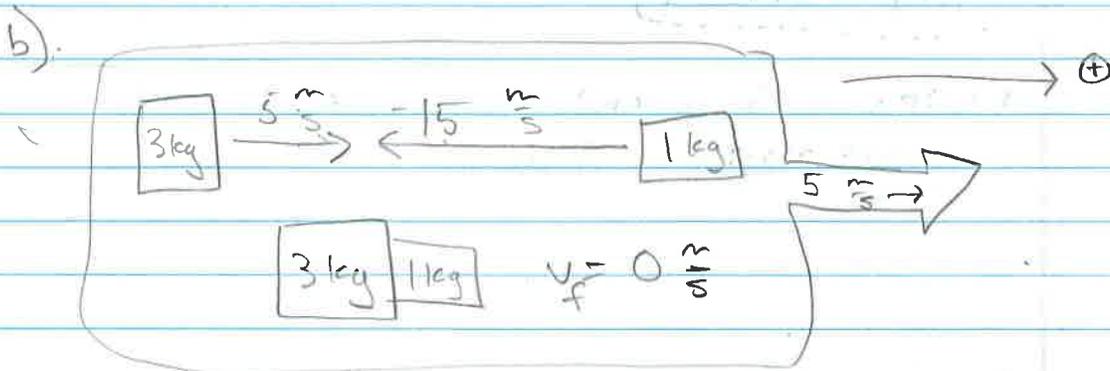
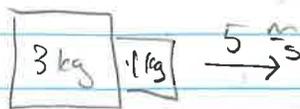
~~F_Feet~~ $\sum F_y = ma_y = 0$
vertical component of ~~norm~~ $F_{Feet} = mg$

Problem Set #6

⇒ $v_0 = 10 \frac{m}{s}$



a) $p_0 = p_f$
 $(3 \text{ kg})(10 \frac{m}{s}) - (1 \text{ kg})(10 \frac{m}{s}) = (4 \text{ kg})(v_f)$
 $v_f = 5 \frac{m}{s} \rightarrow$



c) $p_{\text{left}} = (3 \text{ kg})(5 \frac{m}{s})$
 $p_{\text{left}} = 15 \text{ kg} \frac{m}{s}$
 $p_{\text{right}} = (1 \text{ kg})(-15 \frac{m}{s})$
 $p_{\text{right}} = -15 \text{ kg} \frac{m}{s}$

$p_{\text{system}} = (15 \text{ kg} \frac{m}{s} - 15 \text{ kg} \frac{m}{s})$
 $p_{\text{system}} = 0 \text{ kg} \frac{m}{s}$

d) The velocities in the C.O.M. reference are the same, but in opposite directions.

$v_{3 \text{ kg}} = -5 \frac{m}{s}$ $v_{1 \text{ kg}} = 15 \frac{m}{s}$

e) convert back to lab frame (add C.O.M. velocity to each.)

$v_{3 \text{ kg}} = -5 \frac{m}{s} + 5 \frac{m}{s} = 0 \frac{m}{s}$ $v_{3 \text{ kg}} = 0 \frac{m}{s}$
 $v_{1 \text{ kg}} = 15 \frac{m}{s} + 5 \frac{m}{s} = 20 \frac{m}{s}$ $v_{1 \text{ kg}} = 20 \frac{m}{s}$

$$f) P_0 = (3 \text{ kg})(10 \frac{\text{m}}{\text{s}}) + (1 \text{ kg})(-10 \frac{\text{m}}{\text{s}})$$
$$P_0 = 20 \text{ kg} \cdot \frac{\text{m}}{\text{s}}$$

$$P_f = (3 \text{ kg})(0 \frac{\text{m}}{\text{s}}) + (1 \text{ kg})(20 \frac{\text{m}}{\text{s}})$$
$$P_f = 20 \text{ kg} \cdot \frac{\text{m}}{\text{s}}$$

$$g) KE_0 = \frac{1}{2}(3 \text{ kg})(10 \frac{\text{m}}{\text{s}})^2 + \frac{1}{2}(1 \text{ kg})(10 \frac{\text{m}}{\text{s}})^2$$
$$KE_0 = 200 \text{ J}$$

$$KE_f = \frac{1}{2}(3 \text{ kg})(0 \frac{\text{m}}{\text{s}})^2 + \frac{1}{2}(1 \text{ kg})(20 \frac{\text{m}}{\text{s}})^2$$
$$KE_f = 200 \text{ J}$$

h) Yes, both p and energy were conserved in the elastic collision.