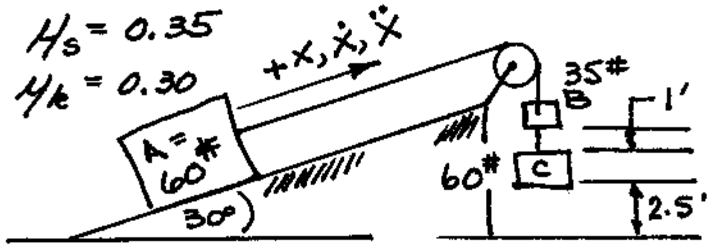
SYSTEM INITIALLY AT REST
$t = 0, \quad x_0 = 0, \quad \dot{x} = v_0 = 0, \quad \ddot{x} = \dot{v}_0 = a_0 = 0$



BLOCK B comes to rest on BLOCK C

a) ? $V_{A\,max}$

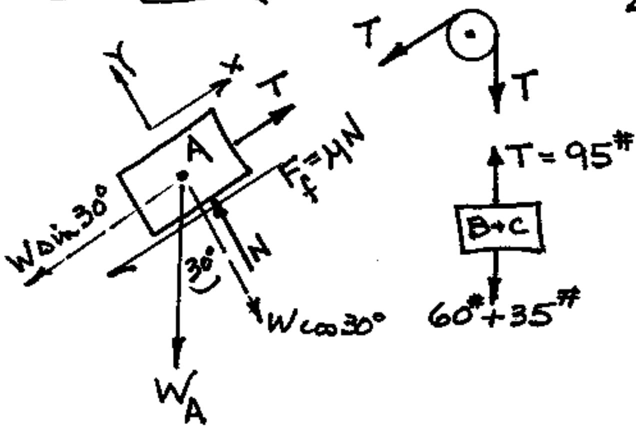
b.) ? ΔX_A before stopping $\therefore V_A = 0$

G. MILANO

DEPENDENT SYSTEM
- EACH MASS REQUIRES A F.B.D.
- EACH F.B.D. PRODUCES EQUATION(S)
- DEPENDENCY = Solve SIMULTANEOUSLY.

First — SOLVE BY STATICS (IMPENDING MOTION) to determine what's going to happen.

BY PARTS



BLOCK A

$\Sigma F_y = 0 = N - W \cos 30°$

$N = 60^{\#} \cos 30°$

$= 51.96^{lb.}$

$F_f = \mu_s N = 0.35\,(51.96^{lb})$

$= 18.186^{lb.}$

$\Sigma F_x = 0 = -W \sin 30° + T - F_f$

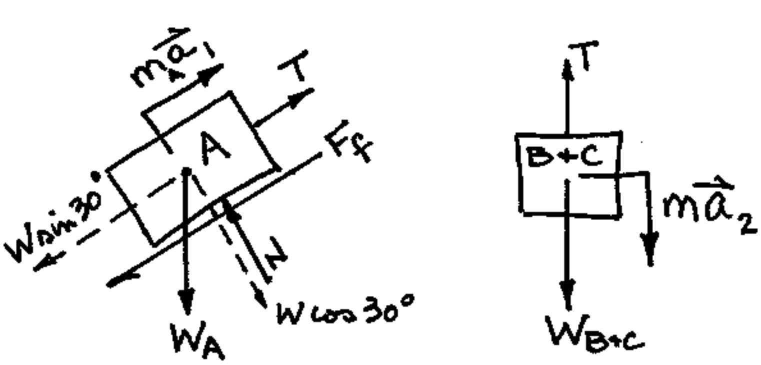
$\therefore T = 60^{\#} \sin 30° + 18.186$

$T = 48.186^{lb} < 95^{lb.}$ OF BLOCKS B+C

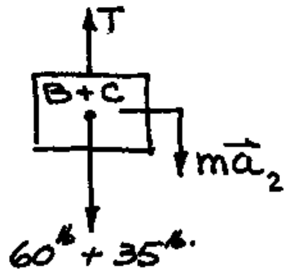
So, BLOCK A IS DEFINITELY ON THE MOVE UP THE INCLINE.

next — A, B + C will all move together until C hits the floor.

SOLVE BY DYNAMICS $\Sigma \vec{F} = m\vec{a}$ use $\mu_k = 0.30$ (SLIDING COEF.)



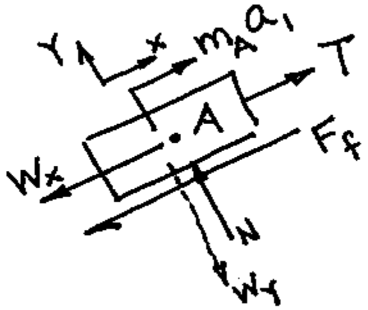
BLOCKS B + C WILL MOVE TOGETHER UNTIL BLOCK C STOPS WHEN IT LANDS ON THE FLOOR.



$$\sum \vec{F}_y = m\vec{a}_2 \quad \downarrow +$$

$$\left(-T + 95^{lb}\right) = \frac{W}{g} a_2 = \frac{95^{lb}}{386 \frac{in}{s^2}} a_2$$

$$T = 95^{lb} - \frac{95}{386} a_2 = 95\left[1 - \frac{a_2}{386}\right] \quad (1)$$



$\sum F_y = 0$ since $m\cancel{a_y}^{0}$ $\therefore N = W \cos 30°$

$$\therefore F_f = \mu_k N = 0.30\left(60^{lb} \cos 30°\right) = 15.59^{lb_f}$$

$$\sum F_x = m_A \vec{a}_1 \quad \xrightarrow{+}$$

$$\left(-W \sin 30° - F_f + T\right) = \frac{W_A}{g} a_1$$

$$-60^{lb} \sin 30° - 15.59^{lb} + T = \frac{60^{lb}}{386 \frac{in}{s^2}} a_1$$

$$T = \frac{60}{386} a_1 + \left(30^{lb} + 15.59^{lb}\right) = \frac{60}{386} a_1 + 45.6^{lb} \quad (2)$$

SET (1) = (2) where $\vec{a}_1 = \vec{a}_2 = \vec{a}_I$ since all blocks move together

$$95\left[1 - \frac{a_I}{386}\right] = \frac{60}{386} a_I + 45.6$$

$$95 - 45.6 = \frac{60}{386} a_I + \frac{95}{386} a_I = \frac{155}{386} a_I$$

$$\therefore \boxed{a_I = 123.02 \frac{in}{sec^2} = 10.25 \frac{ft}{sec^2}}$$

ALL BLOCKS MOVE 2.5 ft. UNTIL BLOCK C STOPS AT THE FLOOR.

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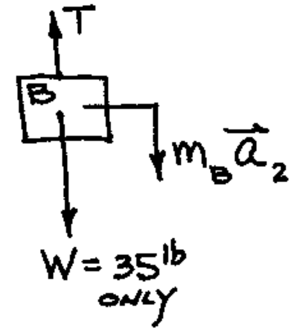
still in motion ... UNTIL BLOCK B LANDS ATOP BLOCK C.

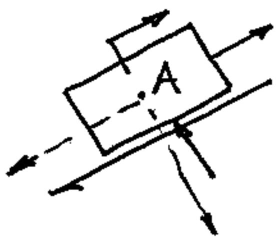
So — BLOCKS A + B WILL CONTINUE TO MOVE ANOTHER 1 ft. (SEE PICTURE)



$$\Sigma F_y = m_B \vec{a}_2 \quad \downarrow +$$

$$(-T + 35^{lb.}) = \frac{W}{g} a_2 = \frac{35^{lb.}}{386 \frac{in}{s^2}} a_2$$

$$T = 35 - \frac{35}{386} a_2 \qquad (3)$$



SAME FOR THIS BLOCK AS BEFORE

$$T = \frac{60}{386} a_1 + 45.6^{lb.} \qquad (2)$$

$$a_1 = a_2 = a_{II} \qquad \text{SET (3) = (2)}$$

$$35 - \frac{35}{386} a_{II} = \frac{60}{386} a_{II} + 45.6$$

$$35 - 45.6 = \left[\frac{60}{386} + \frac{35}{386}\right] a_{II}$$

$$-10.6 \left[\frac{386}{95}\right] = a_{II}$$

$$\boxed{\begin{aligned} a_{II} &= -43.07 \frac{in}{s^2} \\ &= -3.6 \frac{ft}{sec^2} \end{aligned}}$$

This means that BLOCKS A + B decelerate once BLOCK C comes to rest.

To change from ACCELERATION to DECELERATION, BLOCK A reached V_{max} when BLOCK C stopped.

$\therefore X_A = 2.5 \text{ ft.}$ @ V_{max}

DERIVE $\quad A = \frac{dV}{dt} \quad \therefore \int A\, dt = \int dV$

BUT YOU NEED TO RELATE THIS TO DISTANCE

$V = \frac{dx}{dt} \quad \therefore dt = \frac{dx}{V}$ SUB. FOR dt

$$A\left(\frac{dx}{V}\right) = dV \qquad \text{where } A = a_I = 10.25 \frac{ft}{sec^2}$$

$$\int A\, dx = \int V\, dV$$

$$A(x_1 - x_0) = \left.\frac{V^2}{2}\right]_{V_0}^{V_1} = \frac{V_1^2}{2} - \frac{V_0^2}{2}$$

REMEMBER I.C.

@ $t = 0, \quad x_0 = 0$
$\quad V_0 = 0$

FIND V_{max} when $X_1 = 2.5$ ft.

$$\left(10.25 \frac{ft}{sec^2}\right)(2.5 \text{ ft.}) = \frac{1}{2} V_{max}^2$$

$$\boxed{V_{max} = 7.16 \frac{ft}{sec.}}$$

AFTER V_{max} —

BLOCK A DECELERATES where $A = a_{II} = -3.6 \frac{ft}{sec^2}$
and moves the additional 1 ft. UNTIL BLOCK B comes to rest.

$$\int_{X_1}^{X_2} A\,dx = \int_{V_1}^{V_2} V\,dV$$

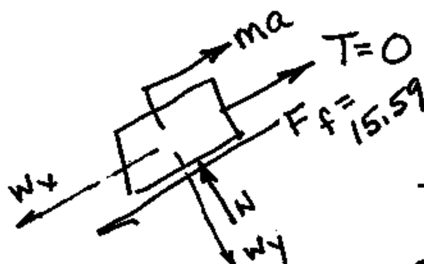
$$A \underbrace{(X_2 - X_1)}_{\Delta X = 1\,ft.} = \frac{1}{2}\left(V_2^2 - V_{max}^2\right) \qquad \text{where } A = a_{II} = -3.6 \frac{ft}{sec^2}$$

$$\left(-3.6 \frac{ft}{s^2}\right)(1\,ft) = \frac{1}{2}\left(V_2^2 - 7.16^2\right)$$

$$V_2^2 = 2(-3.6)(1) + 7.16^2$$

$$= 44.065 \qquad \therefore \boxed{V_2 = 6.64 \frac{ft}{sec.}}$$

BUT — how far has BLOCK A moved before it stops?
Think about this. BLOCKS B + C are both at rest.
THERE IS NO MORE T PULLING BLOCK A (ONLY MOMENTUM)



$\Sigma \vec{F} = m\vec{a}$ FIND a_{III}

$$-60 \sin 30° - 15.59 = \frac{60^{lb.}}{386 \frac{in}{s^2}} a_{III}$$

$$a_{III} = -293.3 \frac{in}{s^2}$$

$$= -24.44 \frac{ft}{sec^2}$$

$$A \underbrace{(X_3 - X_2)}_{\Delta X} = \frac{1}{2}\left(V_3^2 - V_2^2\right) \qquad \text{where } V_3 = 0$$

$$\Delta X = \frac{-\frac{1}{2}\left(6.64 \frac{ft}{sec.}\right)^2}{-24.44 \frac{ft}{s^2}} = 0.902\,ft$$

DON'T FORGET TO SQUARE

TOTAL DISTANCE OF BLOCK A = 2.5' + 1' + 0.902'

$$\boxed{\Delta X = 4.4\,ft.}$$

How much time?