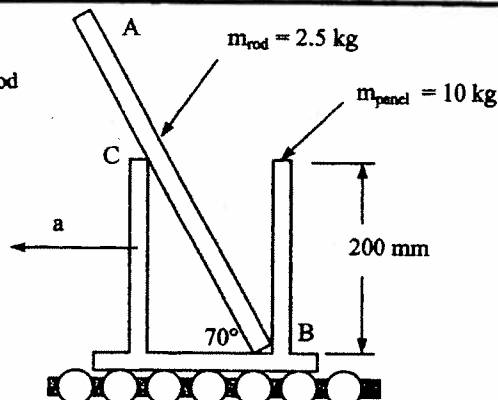


Ex 4/1

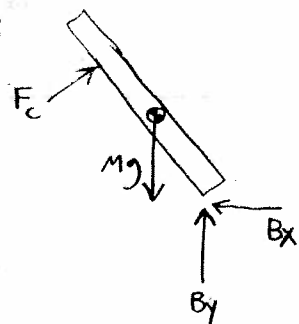
Example 4/1

A conveyor system is fitted with vertical panels, and a 0.5 m rod AB of mass 2.5 kg is lodged between the panels as shown. Assume all the surfaces are smooth. Given that the acceleration of the panels and the rod is 1.5 m/s^2 to the left, determine the forces on the rod.

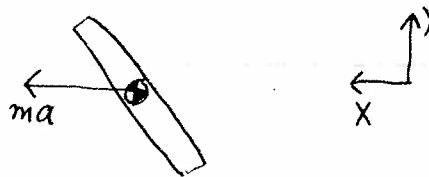


Strategy: CLM_{rate}
 CAM_{rate}

FBD:



KD



UNK	Eqn
B_x	1
B_y	2
F_c	3

CLM_{rate} (sys = rod) (dir = \hat{x})

$$\frac{d}{dt}(m\vec{v}_x) = \sum \vec{F}_x$$

$$ma_x = B_x - F_c \sin 70^\circ \quad (1)$$

CLM_{rate} (sys = rod) (dir = \hat{y})

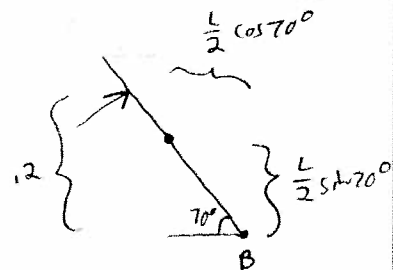
$$\frac{d}{dt}(m\vec{v}_y) = \sum \vec{F}_y$$

$$mgy^{\uparrow 0} = B_y - mg + F_c \cos 70^\circ \quad (2)$$

CAM_{rate} (sys = rod, dir = $\hat{\phi}$, about pt B) translation

$$\frac{d}{dt}(\vec{L}_{sys,B}) = \sum \vec{M}_B$$

$$ma \left(\frac{L}{2} \sin 70^\circ \right) = mg \left(\frac{L}{2} \cos 70^\circ \right) - F_c \left(\frac{L}{2} \sin 70^\circ \right) \quad (3)$$

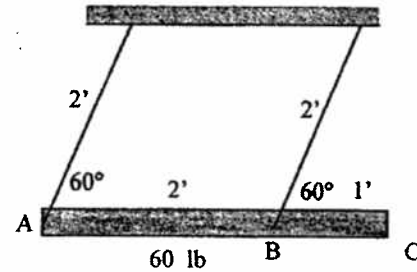


Ex 4/2

Example 4/2

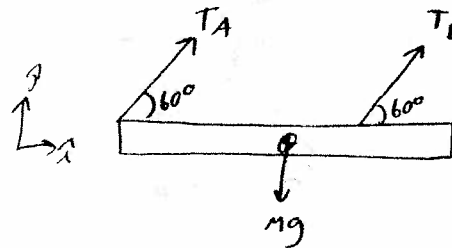
The uniform 60 lb log is supported by two cables and used as a battering ram. If the log is released from rest in the position shown, determine the tension in each cable immediately after release.

Note: Save all your calculations until after you have derived the necessary equations.



Strategy: CLM_{rate}
CAM_{rate}

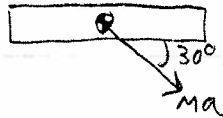
Soln: FBD sys = log



$$\hat{e}_n = \cos 60^\circ \hat{x} + \sin 60^\circ \hat{y}$$

$$\hat{e}_t = \sin 60^\circ \hat{x} - \cos 60^\circ \hat{y}$$

KD



b/c of the cables, motion must be \perp to cables

CLM_{rate} (sys = log, dir = \hat{e}_t)

$$\frac{d}{dt}(m\vec{v}_t) = \sum \vec{F}_t$$

$$ma = mg \sin 30^\circ \quad (1)$$

CLM_{rate} (sys = log, dir = \hat{e}_n)

$$\frac{d}{dt}(m\vec{v}_n) = \sum \vec{F}_n \quad \text{released from rest, so } \vec{v}_n = 0, \text{ so } a_n = \frac{v_n^2}{r} = 0$$

$$m(\vec{a} \cdot \hat{e}_n) = T_A + T_B - mg \cos 30^\circ \quad (2)$$

CAM_{rate} (sys = log, about cog, \hat{k}) translation

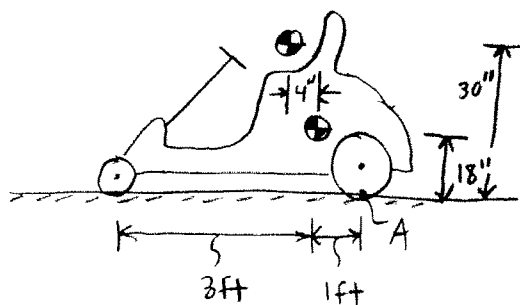
$$\frac{d}{dt}(\vec{L}_{\text{sys, cog}}) = \sum \vec{M}_{\text{cog}}$$

$$\text{taking about cog, so no ang momentum } \Rightarrow (T_A \sin 60^\circ)(1.5 \text{ ft}) + (T_B \sin 60^\circ)(1.5 \text{ ft}) \quad (3)$$

alternatively CAM_{rate} (sys = log, about pt A, \hat{k}) translation

$$-(ma \sin 30^\circ)(1.5 \text{ ft}) = (T_B \sin 60^\circ)(2 \text{ ft}) - (mg)(1.5 \text{ ft}) \quad (3b)$$

Lawnmower Example



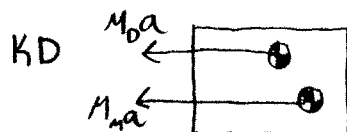
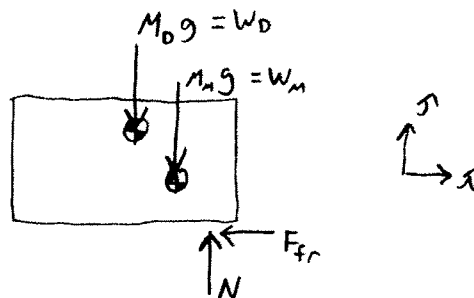
$$W_M = 280 \text{ lbf} \quad \therefore M_M = 8.696 \text{ slugs}$$

$$W_D = 180 \text{ lbf} \quad M_D = 5.59 \text{ slugs}$$

Find minimum μ st front wheel lift

Strategy: CLM_{rate}
CAM_{rate}

Solution: FBD sys = mower + driver



w/ same a as both

CAM_{rate} (about rear wheel contact point, \uparrow) translation

$$\frac{d}{dt} (L_{\text{sys}, A}) = \sum \vec{M}_A$$

27.019 a

$$(M_D a) \left(\frac{30}{12} \text{ ft} \right) + (M_M a) \left(\frac{18}{12} \text{ ft} \right) = (W_D) \left(\frac{16}{12} \text{ ft} \right) + (W_M) (1 \text{ ft})$$

$$\text{gets } a = 19.25 \text{ ft/s}^2$$

CLM_{rate} (in y dir)

$$\frac{d}{dt} (m \vec{v}_y) = \sum \vec{F}_y$$

$$0 = N - W_D - W_M \quad \therefore N = 460 \text{ lbf}$$

CLM_{rate} (in x dir)

$$\frac{d}{dt} (m \vec{v}_x) = \sum \vec{F}_x$$

$$(M_M + M_D) (-a) = -F_{fr}$$

$$\therefore F_{fr} = 275 \text{ lbf}$$

Finally, $F_{fr} = \mu N \quad \therefore \mu = 0.598$ using friction relation