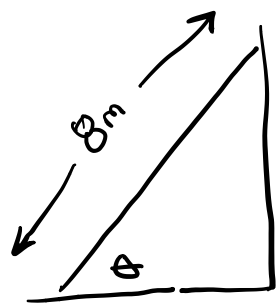
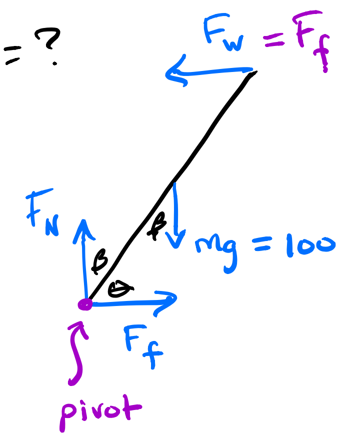
1) $X_{cm} = \sum \frac{rm}{m}$ in x direction only

$$X_{cm} = \frac{0(6) + 2(4) + 2(5)}{6+4+5} = \frac{18}{15} = \underline{1.2\ m}$$

2) $\theta = ?$




$\mu_s = 0.4$




$$F_{f_{max}} = \mu F_N$$
$$= 0.4(100)$$
$$= 40\ N$$

$\beta = 90 - \theta$

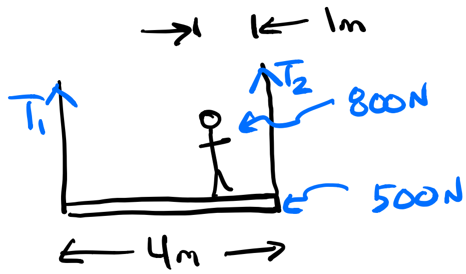
$\sum \tau = 0 = 4(100)\cos\theta - 8(40)\sin\theta = 0$
@ bottom

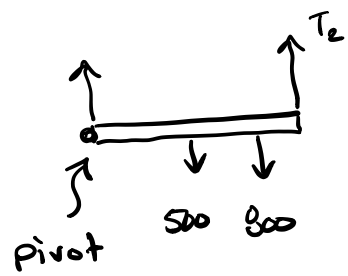
$$400\cos\theta = 320\sin\theta$$

$$\frac{400}{320} = \frac{\sin\theta}{\cos\theta} = \tan\theta$$

$$\tan^{-1}\left(\frac{400}{320}\right) = \theta = \underline{51.3°}$$

3)



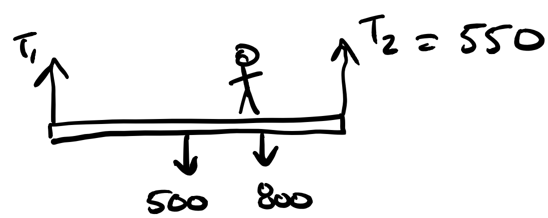




$$\Sigma \tau = 0 = 2(500)\sin 90 + 3(800)\sin 90 - 4T_2 \sin 90$$

$$1000 + 2400 = 4T_2$$

$$\frac{3400}{4} = T_2 = 850\text{ N}$$

4) SAME SET UP AS ABOVE, BUT MAN'S LOCATION IS UNKNOWN.



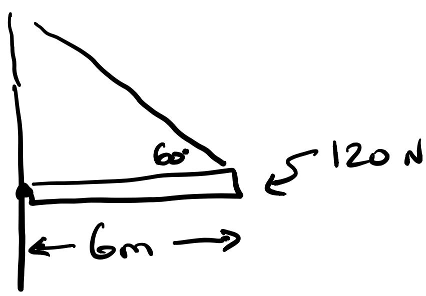

$$\Sigma \tau = 0 = 2(500) + r(800) - 4(550)$$

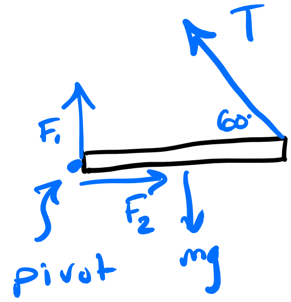
$$800r =$$

$$r = \frac{1200}{800} = 1.5\text{ m}$$ from pivot

$\therefore$ 2.5 m from right (the 550N)

5)



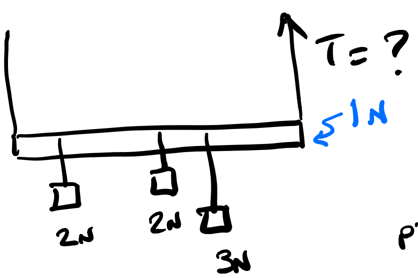



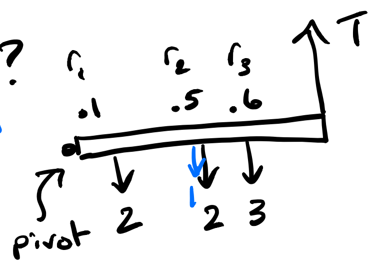

$$\sum \tau = 0 = 3(120) - 6(T)\sin 60$$

$$360 = 5.196(T)$$

$$\frac{360}{5.196} = T = 69.3\text{ N}$$

6)




$$\sum \tau = 0 = 0.1(2) + 0.5(1) + 0.5(2) + 0.6(3) - 1(T)$$

$$0 = 0.2 + 0.5 + 1 + 1.8 = T = 3.5\text{ N}$$

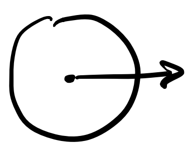
7) Since all moments of inertia are positive values, adding a mass could only increase the moment of inertia. E – not possible

8) TREAT THE EARTH AS A POINT MASS, THEN

$I = \sum mr^2$ $\therefore$ AS $r$ DECREASES, THEN SO MUST $I$.

A) DECREASES

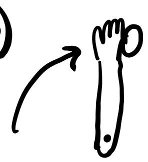
9)



$V_{cm} = V_{edge}$ if rolling w/o slipping

$$\omega = \frac{V}{R} = \frac{4}{0.1} = 40\ \frac{rad}{s}$$

10)

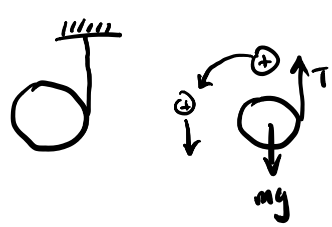


SINCE THE DIMENSIONS OF THE BALL ARE NOT GIVEN, TREAT BALL AS POINT MASS $\therefore$

$$I = mr^2 = 0.15(.32)^2$$

$$= 0.0154\ kg\text{-}m^2$$ "A"

11)



CAREFUL, $T \neq mg$

USE TORQUE

$\sum F_y = ma$ $\oplus\downarrow$

$mg - T = ma$

$T = mg - ma$

$\sum \tau = I\alpha$ (sub $\alpha = \frac{a}{r}$)

$rT\sin 90 = I\left(\frac{a}{r}\right)$

$\cancel{r}T = \left(\frac{1}{2}m\cancel{r^2}\right)\left(\frac{a}{\cancel{r}}\right)$

$T = \frac{1}{2}ma$

COMBINE

$\frac{1}{2}\cancel{m}a = \cancel{m}g - \cancel{m}a$

$\frac{3}{2}a = g$

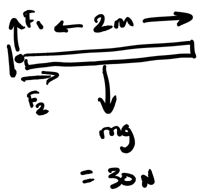
$a = \frac{2}{3}g = 6.67\ \frac{m}{s^2}$

12) HE CAN WALK DUE TO FRICTION W/ PLATFORM, SO BY NEWTON'S 3RD LAW, HE PUSH ON THE PLATFORM THE SAME AS THE PLATFORM ON HIM.

SINCE THE PLATFORM HAS LESS MASS, BUT THE SAME R VALUE, THE PLATFORM "ACCELERATES" MORE AND MOVES FURTHER. C

OR BY $L_1 = L_2$

$$\underset{boy}{mvr} = \underset{platform}{mvr}$$

13) 


$$\Sigma\tau = I\alpha$$
@ end

$$I_{rod @ end} = \frac{1}{3}ml^2$$

$$rF\sin 90 = \left(\frac{1}{3}ml^2\right)\alpha$$

$$1(30) = \frac{1}{3}(3 \cdot 2^2)\alpha$$

$$\frac{30}{4} = \alpha = 7.5 \ \frac{rad}{s^2}$$

14) $K = \frac{1}{2}I\omega^2$ $\quad \Delta\omega = \alpha t$ $\quad \alpha = \frac{\tau}{I}$

$$K = \frac{1}{2}(0.034)(25.88)^2 \qquad \Delta\omega = (3.24)8 \qquad \alpha = \frac{0.11}{0.034} = 3.24 \ \frac{rad}{s^2}$$

$$\omega_f = 25.88 \ \frac{rad}{s}$$

$$K = 11.38 \text{ J}$$

15) SINCE THE BALL IS MOVING THROUGH SPACE AND ROTATING, THE KINETIC ENERGY $= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$ $\therefore$ IT RELIES ON BOTH LINEAR AND ROTATIONAL SPEEDS. "C"