1.

a. Use string to make a loop and hang one of the known masses in the loop and then hang this loop onto the meterstick at the 0cm mark. Place the meterstick on the fulcrum and slide it horizontally until it reaches a position where it balances without rotating around the fulcrum. Measure the distance, *x*, in centimeters between the 0cm mark of the meterstick and the position of the fulcrum along the meterstick.

b. one known mass, the fulcrum, and string

c. $(m_{known})(g)(x) = (m_{meterstick})(g)(50 - x)$

$m_{meterstick} = \frac{m_{known} \cdot x}{50 - x}$

2.

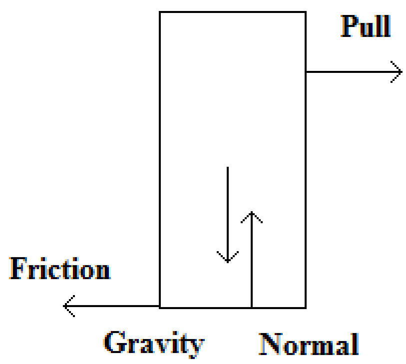
a. $\tau = (L)(4m)(g)(\sin 90°) + (L)(m)(g)(\sin 270°) = 3mgL$

b. $I = (4m)(L^2) + (m)(L^2) = 5mL^2$

$\alpha = \frac{\tau}{I} = \frac{3mgL}{5mL^2} = \frac{3g}{5L}$

3.

a.



b. F_N = 100N

$F_{friction}$ = -(0.4)(100) = -40N

F_{pull} = 40N

c. $\tau_{pull} = \tau_{gravity}$

$(R\perp)(F_{pull}) = (R\perp)(F_{gravity})$

$(\frac{5}{3})(F_{pull}) = (0.5)(100)$

F_{pull} = 30N

d. It increases because a wider box makes ($R\perp$) for the force of gravity greater. F_{pull} must then be greater to compensate.

4.

a. Take the bottom of the thread as the point of rotation.

$0 = \tau_{gravity} + \tau_{axle}$

$0 = (½L)(Mg)(\sin 90°) + (L)(F_{axle})(\sin 270°)$

$F_{axle} = ½Mg$

b. $\alpha = \frac{\tau}{I} = \frac{-½L \cdot Mg}{\frac{1}{3}ML^2} = \frac{-3g}{2L}$

c. $a = R \cdot \alpha = (½L)(\frac{-3g}{2L}) = \frac{-3g}{4}$

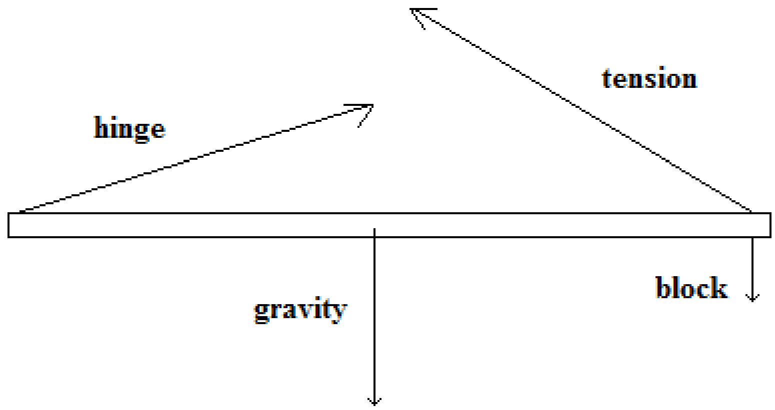
d. $F_{gravity} + F_{axle} = Ma$

$-Mg + F_{axle} = (M)(\frac{-3g}{4})$

$F_{axle} = \frac{Mg}{4}$

5.

a.



b. $0 = \tau_{gravity} + \tau_{block} + \tau_{tension}$

$0 = (0.30)(20)(\sin 270°) + (0.60)(5)(\sin 270°) + (0.60)(F_{tension})(\sin 150°)$

$F_{tension} = 30\text{N}$

c. The hinge must push to the right to oppose the horizontal tension in the cord. It must also pull upwards to provide the clockwise torque opposing the torque of gravity on the bar (taking the right end of the bar as the point of rotation).

d. $\tau = \tau_{gravity} + \tau_{block} = (0.30)(20)(\sin 270°) + (0.60)(5)(\sin 270°) = -9$ mN

$I = I_{bar} + I_{block} = \frac{1}{3}(2)(0.6^2) + (0.5)(0.6^2) = 0.42 \text{ kg}\cdot\text{m}^2$

$\alpha = \frac{\tau}{I} = \frac{-9}{0.42} = -21.43 \text{rad/s}^2$

6.

a. $I = I_{mgr} + I_{boy} = ½(100)(2.4^2) + (35)(2^2) = 248 kg·m^2$

b. $\alpha = \frac{\tau}{I} = \frac{144}{248} = 0.58 rad/s^2$

c. $\Delta\theta = ½\alpha\Delta t^2 = 29 rad$

d. $29 / 2\pi = 4.615$ rotations