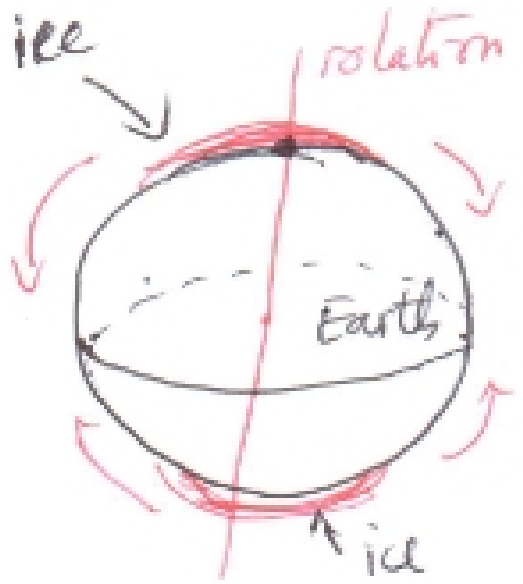
HW # 10 SOLUTION

problem 1 :

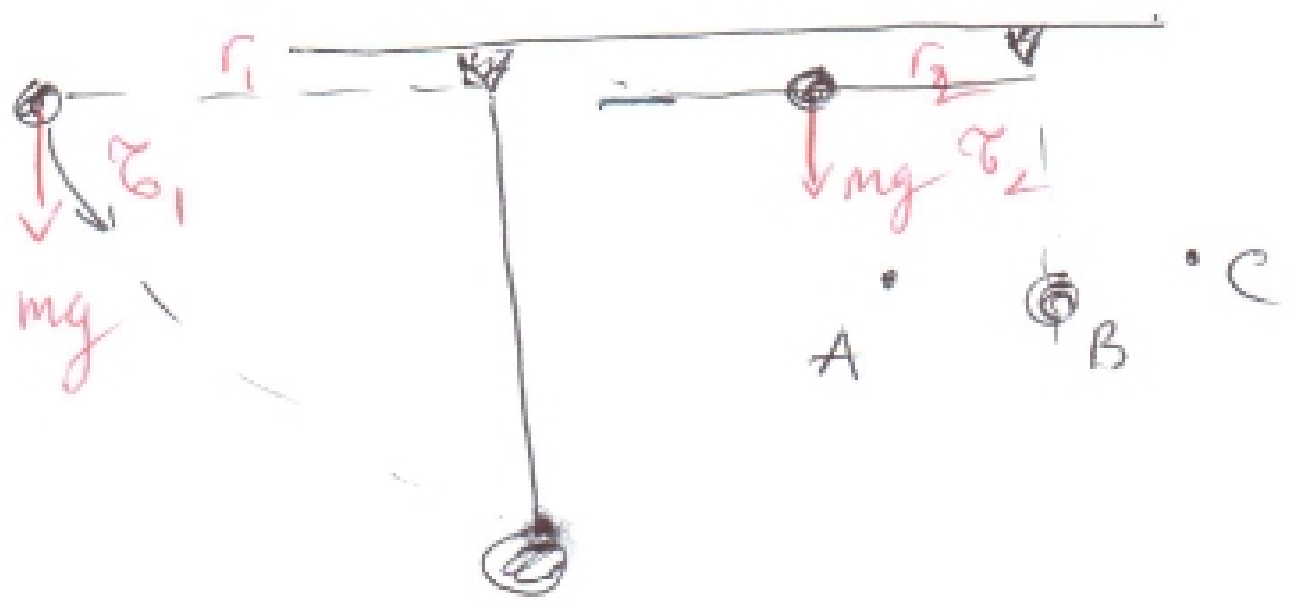


a) when ice sheets are melt, water will move from the north and south poles to the equator. As the result the moment of inertia increases;

b) $L = I\omega = \text{constant}$

Since I increases, ω must decrease or the day length will increase

problem 2 :



in two cases, the weight of the mass makes the rod rotates. Since the weights are the same and since

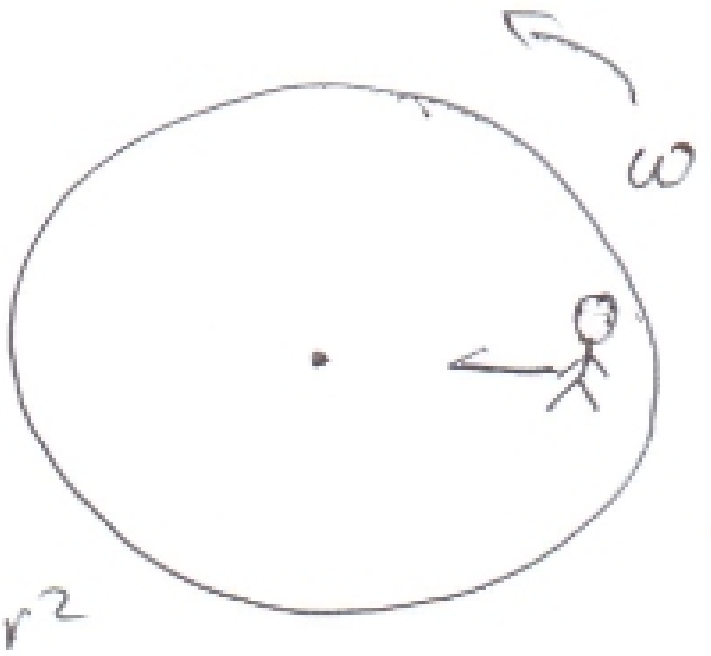
$r_1 > r_2 \Rightarrow \tau_1 = mgr_1 > mgr_2 = \tau_2$

However, $\alpha_1 = \frac{\tau_1}{mr_1^2} = \frac{mgr_1}{mr_1^2} = \frac{g}{r_1} < \alpha_2 = \frac{g}{r_2}$

Since $\alpha_1 < \alpha_2$ the rod on left rotates faster. The answer is C.

past vertical

problem 3:



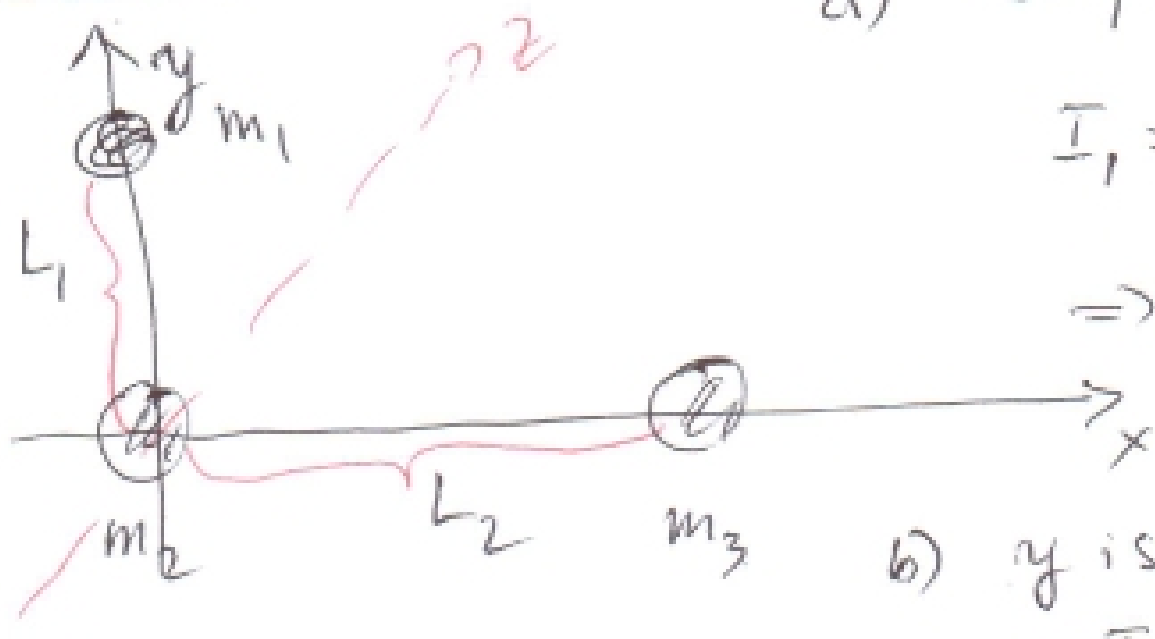
When the child move into the center his moment of inertia, $\underline{I = mr^2}$ reduces since r is smaller.

However, the mass of the system does not change.

Also, potential energy, $U = mgy$ does not change since y does not change.

$L = I\omega = \text{constant}$: Small I leads to larger ω. $K = \frac{1}{2} I\omega^2$ changes. (might be larger or smaller)

problem 4:



a) Torque if x is the rotation axis

$I_1 = m_1 L_1^2$; $I_2 = I_3 = 0$

$\Rightarrow \tau = \underbrace{m_1 L_1^2}_{I} \alpha = 21.2\ N\cdot m$

b) y is the rotation axis

$I_1 = 0$; $I_2 = 0$; $I_3 = m_3 L_2^2$

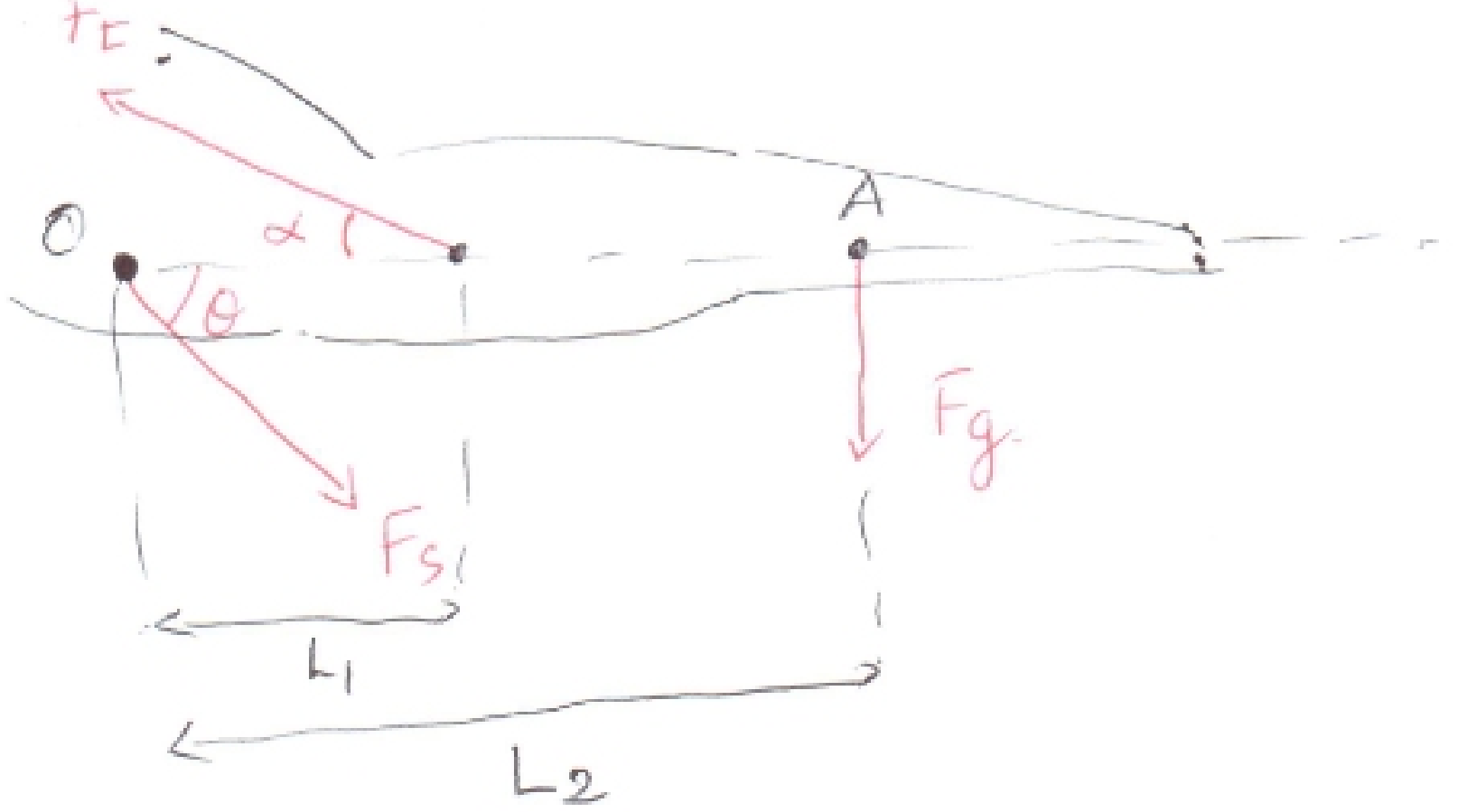
Newton Law: $\tau = I\alpha = m_3 L_2^2 \alpha = 17.2\ N\cdot m$

c) Similarly,

$$I_1 = L_1^2 m_1 \; ; \; I_2 = 0 \; ; \; I_3 = m_3 L_3^2$$

$$\tau = I\alpha = (m_1 L_1^2 + m_3 L_3^2)\alpha = 385\ N\,m.$$

Problem 5 :



a) $\Sigma \tau = 0$

$$\tau_{Ft} + \tau_{Fg} + \tau_{Fs} = 0$$

$$F_t L_1 \sin\alpha - F_g L_2 + 0 = 0$$

$$F_t = \frac{F_g L_2}{L_1 \sin\alpha} = 853\ N$$

b) $\Sigma F_y = 0$

$$F_t \sin\alpha - F_g - F_{s,y} = 0 \rightarrow F_{s,y} = F_t \sin\alpha - F_g = 108.0\ N$$