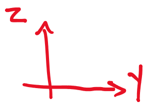
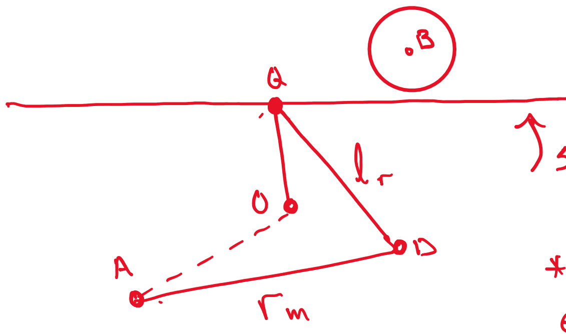
2/9/21 - Lab 5

Tuesday, February 9, 2021 8:12 AM

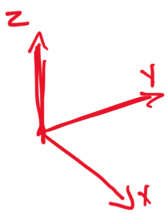
Part 1

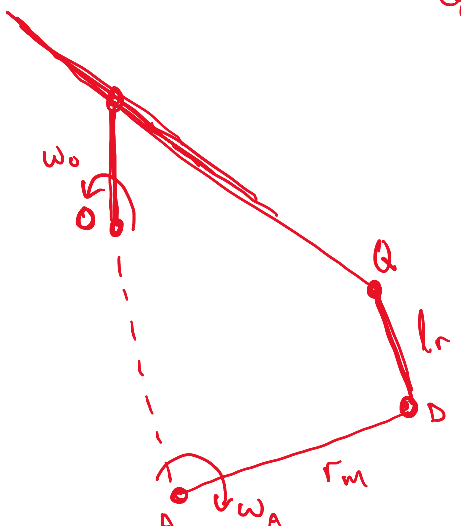


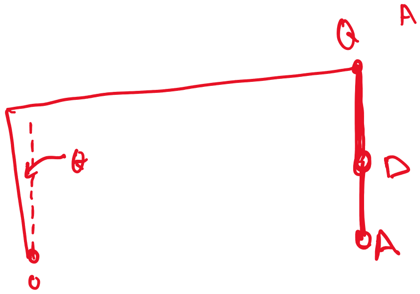


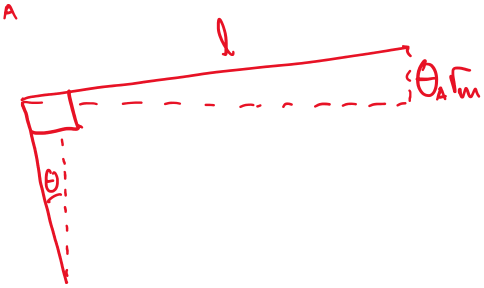
Should offset table

*Trying to find equations as fcn of angle @ O









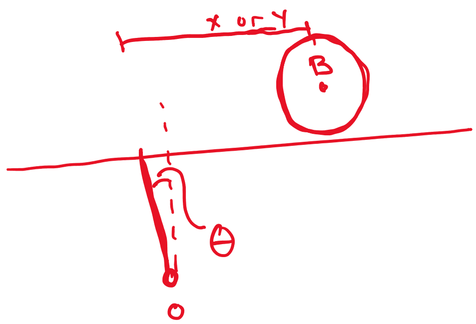
$$\sin\theta = \frac{\theta_A r_m}{l}$$

$$\boxed{\sin^{-1}\left(\frac{\theta_A r_m}{l}\right) = \theta_0}$$

$$\boxed{\begin{aligned}\theta_{oy} &= \sin^{-1}\left(\frac{\theta_{Ax} r_m}{l_p}\right)\\ \theta_{ox} &= \sin^{-1}\left(\frac{\theta_{Ay} r_m}{l_p}\right)\end{aligned}}$$

$$\boxed{\dot{\theta}_o l_p = \dot{\theta}_A r_m}$$

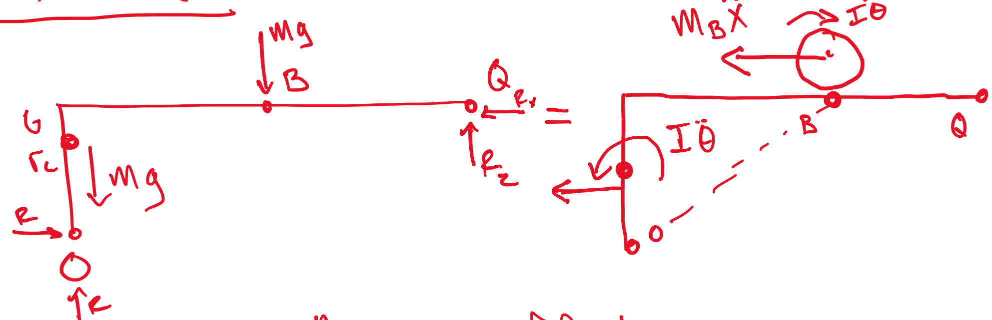
Part 2



$$\boxed{\begin{aligned} Z_B &= X \sin\theta_y = X\theta_y \\ Z_B &= Y \sin\theta_x = Y\theta_x \end{aligned}}$$

$$\boxed{Z_B = X\ddot{\theta}_0}$$

Part 3a



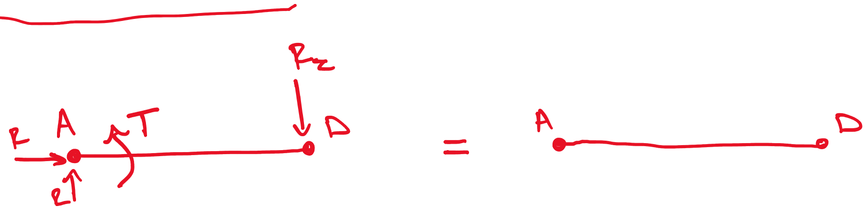
*Assume offset CCW

$$\Sigma M_o (\overset{+}{\circlearrowleft}): \quad M_p g r_G \theta - M_B g X + M_B g r_c \theta + R_z l_p =$$

$$(I_p + M_p r_G^2)\ddot{\theta}_0 + \left(I_B + M_B\left((r_c + r_b)^2 + X^2\right)\right)\ddot{\theta}_0$$

$$+ M_B \ddot{X}_B (r_c + r_B) + M_p \ddot{\theta} r_g^2$$

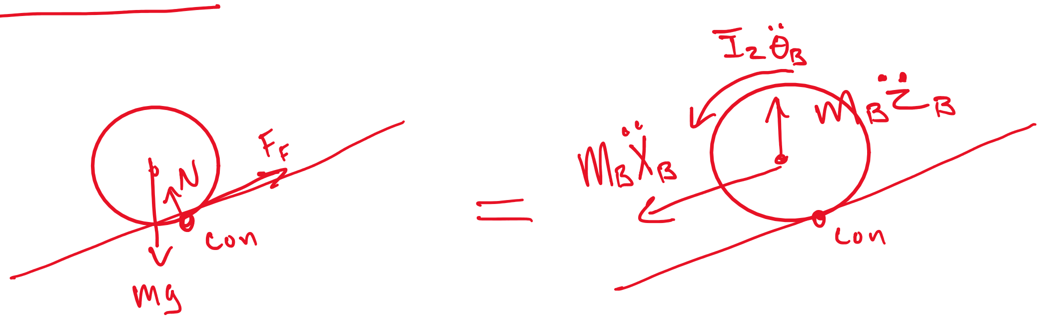
Part 3b



$\sum M_A$ (↺+): $-R_z r_m + T = 0$

$T = R_z r_m$

Part 3C



$$\sum M_{con} (↺+):\ m_B g r_B \cancel{\sin\theta}^{\,\theta} = \bar{I}_z \ddot{\theta}_B + m_B \ddot{x}_B r_B - m_B \ddot{\theta} x r_B \cos\theta$$

$$m_B g r_B \theta_o = \bar{I}_B r_B^2 \ddot{\theta}_o + m_B \ddot{x}_B r_B - m_B \ddot{\theta} x r_B \theta$$

Part 4

Equation 1:

$$\left(m_p r_G^2 + I_p + M_p r_G^2 + I_B + m_B (r_c + r_b)^2 + x^2\right)\ddot{\theta}_o + \left(m_B (r_c + r_B)\right)\ddot{x}$$

$$= (m_p g r_G + m_b r_c g)\theta + (-m_B g)x + T/r_m \, l_p$$

Equation 2:

$$(I_B r_B^2 - m_B \theta x r_B)\ddot{\theta} + (m_B r_B)\ddot{x} = m_B g r_B \theta$$

Part 5

$$\begin{bmatrix} m_B(r_c + r_B) & m_p r_G^2 + I_p + M_p r_g^2 + I_B + M_B((r_c + r_B)^2 + x^2) \\ m_B r_B & I_B r_B^2 - m_B \theta x r_B \end{bmatrix} \begin{bmatrix} \ddot{x} \\ \ddot{\theta} \end{bmatrix}$$

$$= \begin{bmatrix} (m_p g r_b + m_b g r_c)\theta - (m_B g)x + T/r_m \, l_p \\ m_B g r_B \theta \end{bmatrix}$$