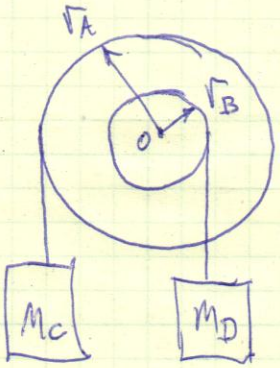
17.60



$m_A = 10^{kg}$, $m_B = 6^{kg}$, $m_C = 6^{kg}$

$m_D = 10^{kg}$, $\omega_1 = 0$

FIND t FOR $v_{C2} = 0.5 \frac{m}{s}$

$r_A = 0.2^m$, $r_B = 0.15^m$

ΣM_O: $+\circlearrowleft$:

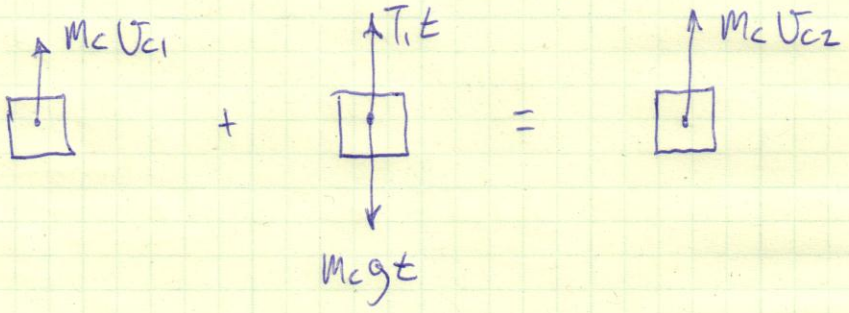
$m_C g r_A = (6^{kg})(9.81 \frac{m}{s^2})(0.2^m) = 11.77^{N\text{-}m}$

$-m_D g r_B = -(10^{kg})(9.81 \frac{m}{s^2})(0.15^m) = -14.72^{N\text{-}m}$

SYSTEM WILL ROTATE CLOCKWISE.

PRINCIPLE OF IMPULSE AND MOMENTUM:

CYLINDER C:

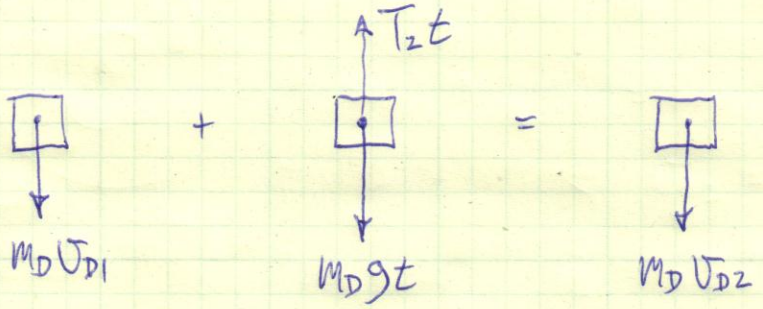


Y-DIRECTION LINEAR MOMENTUM: $\uparrow +$:

$m_C v_{C1}^{\,0} + T_1 t - m_C g t = m_C v_{C2}$

$$\boxed{T_1 t = m_C (g t + v_{C2})}$$

CYLINDER D:

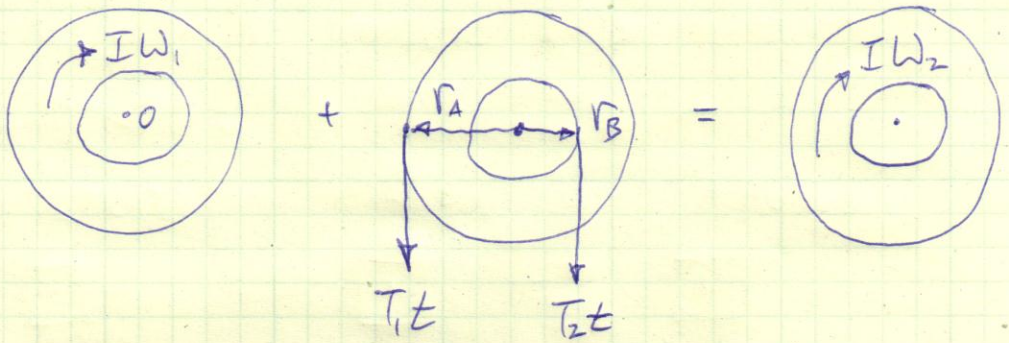


Y-DIRECTION LINEAR MOMENTUM $\downarrow +$:

$$m_D \cancel{v_{D1}}^{0} + m_D g t - T_2 t = m_D v_{D2}$$

$$\boxed{T_2 t = m_D (g t - v_{D2})}$$

DISKS A AND B:



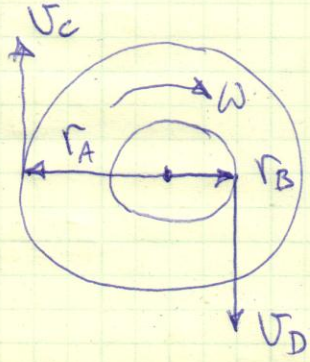
ANGULAR MOMENTUM ABOUT O $+\circlearrowright$:

$$-I\cancel{\omega_1}^{0} + T_1 t \cdot r_A - T_2 t \cdot r_B = -I\omega_2$$

$$m_C (g t + v_{C2}) \cdot r_A - m_D (g t - v_{D2}) \cdot r_B = -I\omega_2$$

$$I = I_A + I_B = \tfrac{1}{2} m_A r_A^2 + \tfrac{1}{2} m_B r_B^2$$

KINEMATICS:



$$v_{C2} = r_A \omega_2, \quad \omega_2 = \frac{v_{C2}}{r_A}$$

$$v_{D2} = r_B \omega_2 = \left(\frac{r_B}{r_A}\right) v_{C2}$$

$$m_C r_A (g t + v_{C2}) - m_D r_B \left[g t - \left(\frac{r_B}{r_A}\right) v_{C2}\right]$$

$$= -\frac{1}{2}\left(m_A r_A^2 + m_B r_B^2\right)\left(\frac{v_{C2}}{r_A}\right)$$

$$t = \frac{v_{C2}\left[r_A\left(m_C + \frac{1}{2}m_A\right) + \left(\frac{r_B^2}{r_A}\right)\left(m_D + \frac{1}{2}m_B\right)\right]}{g\left(m_D r_B - m_C r_A\right)}$$

$$t = \frac{\left(0.5\,\frac{m}{s}\right)\left\{\left(0.2^m\right)\left[\left(6^{kg}\right) + \frac{1}{2}\left(10^{kg}\right)\right] + \left[\frac{\left(0.15^m\right)^2}{\left(0.2^m\right)}\right]\left[\left(10^{kg}\right) + \frac{1}{2}\left(6^{kg}\right)\right]\right\}}{\left(9.81\,\frac{m}{s^2}\right)\left[\left(10^{kg}\right)\left(0.15^m\right) - \left(6^{kg}\right)\left(0.2^m\right)\right]}$$

$$\boxed{t = 0.6222^s}$$