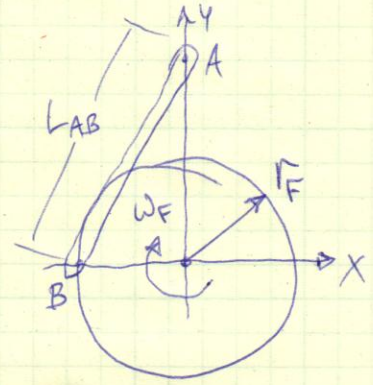
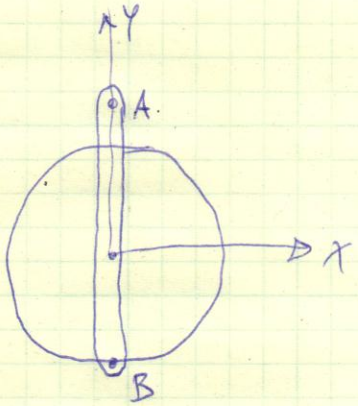
$m_{AB} = 4^{kg}$, $L_{AB} = 0.72^{m}$, $m_F = 16^{kg}$, $\bar{r}_F = 0.24^{m}$, $K = 0.18^{m}$

$\omega_{F1} = \left(60 \frac{REV}{MIN}\right)\left(\frac{MIN}{60\,s}\right)\left(\frac{2\pi}{REV}\right) = 2\pi \frac{RAD}{s}$

FIND ω_{F2}

POSITION 1





CONSERVATION OF ENERGY:

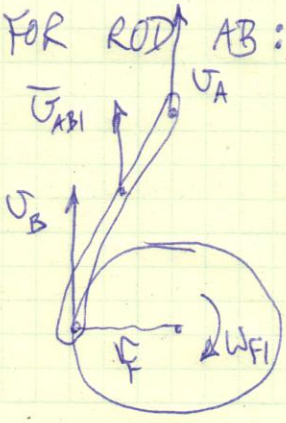
$T_1 + V_1 = T_2 + V_2$

POSITION 1:

$T_1 = \frac{1}{2} m \bar{v}^2 + \frac{1}{2} \bar{I} \omega^2$

$T_1 = \frac{1}{2} m_{AB} \bar{v}_{AB1}^2 + \frac{1}{2} \bar{I}_{AB} \omega_{AB1}^2 + \frac{1}{2} \bar{I}_F \omega_{F1}^2$

FOR ROD AB: ROD IS IN TRANSLATION ONLY: $\omega_{AB1} = 0$

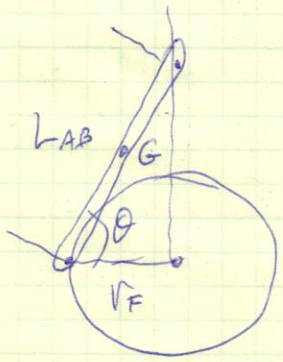


$v_B = \bar{r}_F \omega_{F1} = \bar{v}_{AB1}$

$\bar{I}_F = m_F K^2$

$$T_1 = \frac{1}{2} m_{AB} (\bar{r}_F \omega_{F1})^2 + \frac{1}{2} (m_F k^2) \omega_{F1}^2$$

$$\boxed{T_1 = \frac{1}{2} \omega_{F1}^2 \left(m_{AB} \bar{r}_F^2 + m_F k^2 \right)}$$



$$\cos\theta = \frac{\bar{r}_F}{L_{AB}}$$

$$\theta = \cos^{-1}\left(\frac{\bar{r}_F}{L_{AB}}\right) = \cos^{-1}\left(\frac{0.24}{0.72}\right) = 70.53^\circ$$

$$V_1 = (V_g)_1 = W_{AB} h_{AB1}$$

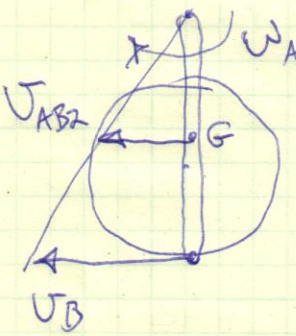
$$V_1 = m_{AB} g \cdot \frac{1}{2} L_{AB} \sin\theta$$

$$\boxed{V_1 = \frac{1}{2} m_{AB} L_{AB} g \sin\theta}$$

POSITION 2:

$$T_2 = \frac{1}{2} m_{AB} \bar{v}_{AB2}^2 + \frac{1}{2} \bar{I}_{AB} \omega_{AB2}^2 + \frac{1}{2} \bar{I}_F \omega_{F2}^2$$

FOR ROD AB:



$$v_B = \bar{r}_F \omega_{F2}$$

$$v_B = L_{AB} \omega_{AB2}$$

$$\bar{r}_F \omega_{F2} = L_{AB} \omega_{AB2}$$

$$\omega_{AB2} = \left(\frac{\bar{r}_F}{L_{AB}}\right) \omega_{F2}$$

$$v_{AB2} = \frac{1}{2} L_{AB} \omega_{AB2}$$

$$v_{AB2} = \frac{1}{2} L_{AB} \left(\frac{\bar{r}_F}{L_{AB}}\right) \omega_{F2}$$

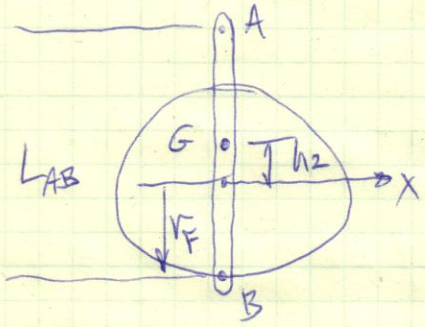
$$v_{AB2} = \frac{1}{2} \bar{r}_F \omega_{F2}$$

$$T_2 = \frac{1}{2} m_{AB}\left(\frac{1}{2} r_F \omega_{F2}\right)^2 + \frac{1}{2}\left(\frac{1}{12} m_{AB} L_{AB}^2\right)\left[\left(\frac{r_F}{L_{AB}}\right)\omega_{F2}\right]^2$$

$$+ \frac{1}{2}\left(m_F k^2\right)\omega_{F2}^2$$

$$T_2 = \frac{1}{8} m_{AB} r_F^2 \omega_{F2}^2 + \frac{1}{24} m_{AB} r_F^2 \omega_{F2}^2 + \frac{1}{2} m_F k^2 \omega_{F2}^2$$

$$\boxed{T_2 = \frac{1}{6}\omega_{F2}^2\left(m_{AB} r_F^2 + 3 m_F k^2\right)}$$



$$V_2 = (V_g)_2 = W_{AB} h_{AB2}$$

$$\boxed{V_2 = m_{AB} g\left(\frac{1}{2} L_{AB} - r_F\right)}$$

$T_1 + V_1 = T_2 + V_2$:

$$\frac{1}{2}\omega_{F1}^2\left(m_{AB} r_F^2 + m_F k^2\right) + \frac{1}{2} m_{AB} L_{AB} g \sin\theta$$

$$= \frac{1}{6}\omega_{F2}^2\left(m_{AB} r_F^2 + 3 m_F k^2\right) + m_{AB} g\left(\frac{1}{2} L_{AB} - r_F\right)$$

$$\omega_{F2} = \sqrt{\frac{\frac{1}{2}\omega_{F1}^2\left(m_{AB} r_F^2 + m_F k^2\right) + m_{AB} g\left(\frac{1}{2} L_{AB}\sin\theta - \frac{1}{2} L_{AB} + r_F\right)}{\frac{1}{6}\left(m_{AB} r_F^2 + 3 m_F k^2\right)}}$$

$$\boxed{\omega_{F2} = 84.66 \text{ RPM}}$$