

Problem 3 - Impulse Momentum I

The spool has a mass of 30 kg and a radius of gyration $k_o = .25 \text{ m}$. If the system is released from rest, determine the time required for block A to attain a speed of 2 m/s.

CLASSIFY MOTION

SPOOL - RAFA

BLOCKS - TRANS

PROPERTIES

$$m_s = 30 \text{ kg} \quad I_G = m k^2 = 30 (.25)^2 = 1.875 \text{ kg}\cdot\text{m}^2$$

$$W_A = 25(9.81) = 245.25 \text{ N}$$

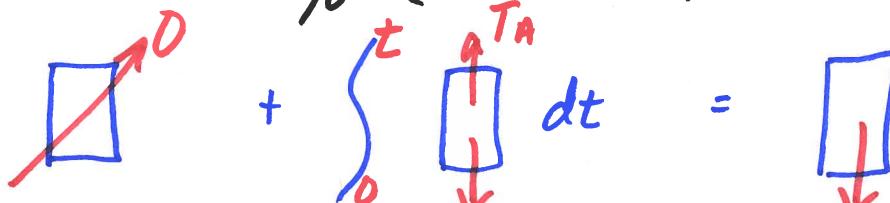
$$m_A = 25 \text{ kg}$$

$$W_B = 10(9.81) = 98.1 \text{ N}$$

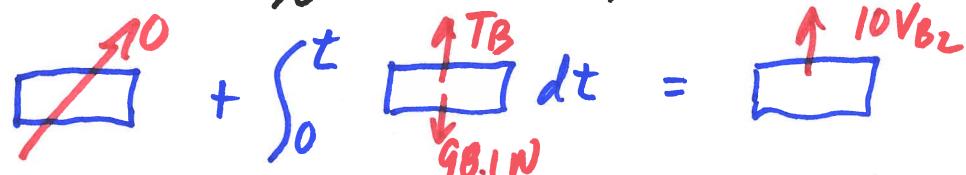
$$m_B = 10 \text{ kg}$$



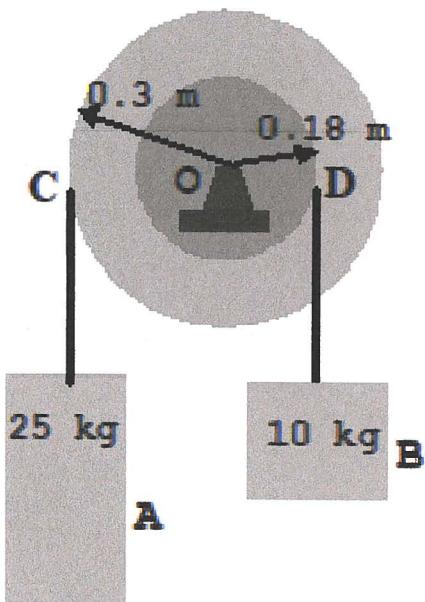
$$\sum M_G = 0 + \int_0^t (-.3T_A + .18T_B) dt = -1.875\omega_2 \quad (1)$$



$$\sum y \quad 0 + \int_0^t (T_A - 245.25) dt = -25V_{A2} \quad (2)$$



$$\sum y \quad 0 + \int_0^t (T_B - 98.1) dt = 10V_{B2} \quad (3)$$



Problem 3 - Impulse Momentum I (Continued)

KINEMATICS

$$V_{A2} = 2 \text{ m/s} \quad (\text{Given})$$

$$V_C = V_{A2} = \omega_2 r \Rightarrow 2 = \omega_2 (0.3) \quad \omega_2 = 6.67 \text{ rps}$$

$$V_{B2} = V_D = \omega_2 r = 6.67 (0.10) = 1.2 \text{ m/s}$$

$$\textcircled{1} \quad \int_0^t -0.3 T_A dt + \int_0^t 0.18 T_B dt = -1.075 (6.67) = -12.5$$

$$\textcircled{2} \quad \int_0^t T_A dt = -245.25 t = -25(2) = -50$$

$$\textcircled{3} \quad \int_0^t T_B dt - 98.1 t = 10(1.2) = 12$$

3 EQNS, 3 UNKS, $\begin{cases} \int_0^t T_A dt \\ \int_0^t T_B dt \\ t \end{cases}$

$$\begin{bmatrix} -0.3 & 0.18 & 0 \\ 1 & 0 & -245.25 \\ 0 & 1 & -98.1 \end{bmatrix} \begin{Bmatrix} \left\{ \begin{array}{l} T_A \\ T_B \\ t \end{array} \right\} \end{Bmatrix} = \begin{Bmatrix} \left\{ \begin{array}{l} -12.5 \\ -50 \\ 12 \end{array} \right\} \end{Bmatrix}$$

SOLVING $t = 0.53 \text{ SEC}$