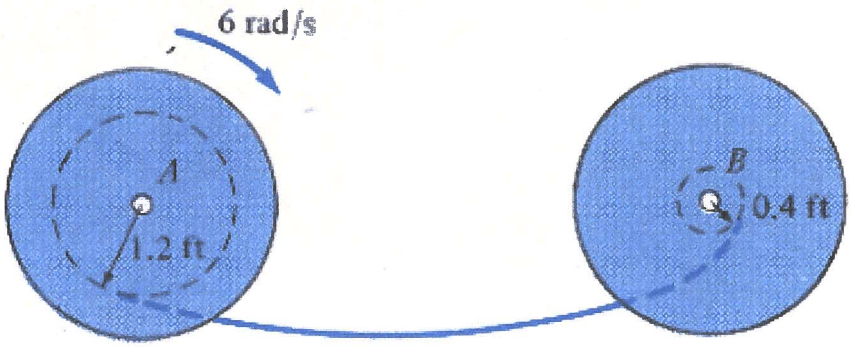
Problem 3: Impulse Momentum II

Spool B is at rest and spool A is rotating at 6 rad/s when the slack in the cord connecting them is taken up. Determine the angular velocity of each spool immediately after the cord is jerked tight by the spinning of spool A. A and B have weights and radii of gyration $W_A = 30$ lb, $k_A = 0.8$ ft and $W_B = 15$ lb , $k_B = 0.6$ ft, respectively.

CLASSIFY MOTION

BOTH RAFA



PROPERTIES

$W_A = 30\,lb$ $\quad m_A = \frac{30}{32.2} = 0.932$ SLUG $\quad I_{GA} = mk^2 = .932(0.8)^2 = 0.596$ SLUG-FT^2

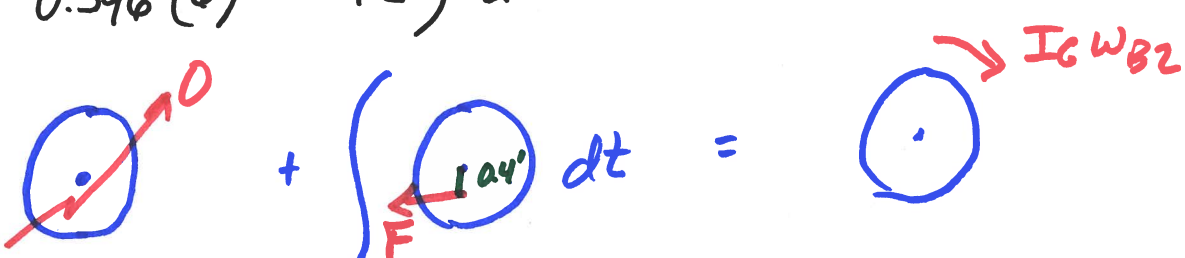
$W_B = 15\,lb$ $\quad m_B = \frac{15}{32.2} = 0.466$ SLUG $\quad I_{GB} = 0.466(0.6)^2 = 0.1677$ SLUG FT

MOMENTUM 1 + IMPULSE = MOMENTUM 2

A

$\circlearrowleft \Sigma M_G \quad 0.596(6) - 1.2\int F\,dt = 0.596\,\omega_{A2}$ (1)

B



$\circlearrowleft \Sigma M_G \quad 0 + 0.4\int F\,dt = 0.1677\,\omega_{B2}$ (2)

Problem 3: Impulse Momentum II

RAFA $V = \omega r$

$V_{COORD_2} \text{ on } A = \omega_{A2} r_A = \omega_{A2}(1.2)$

$V_{COORD_2} \text{ on } B = \omega_{B2} r_B = \omega_{B2}(0.4)$

BUT $V_{COORD_2 A} = V_{COORD_2 B}$

SO... $1.2\,\omega_{A2} = 0.4\,\omega_{B2}$ (3)

(1) $1.2\int F dt + 0.596\,\omega_{A2} + 0\,\omega_{B2} = 3.576$

(2) $0.4\int F dt + 0\,\omega_{A2} - 0.1677\,\omega_{B2} = 0$

(3) $0\int F dt + 1.2\,\omega_{A2} - 0.4\,\omega_{B2} = 0$

$$\begin{bmatrix} 1.2 & 0.596 & 0 \\ 0.4 & 0 & -0.1677 \\ 0 & 1.2 & -0.4 \end{bmatrix} \begin{Bmatrix} \int F dt \\ \omega_{A2} \\ \omega_{B2} \end{Bmatrix} = \begin{Bmatrix} 3.576 \\ 0 \\ 0 \end{Bmatrix}$$

SOLVE

$\int F dt = 2.14$

$\omega_{A2} = 1.70 \text{ rad/s} \circlearrowright$

$\omega_{B2} = 5.10 \text{ rad/s} \circlearrowright$