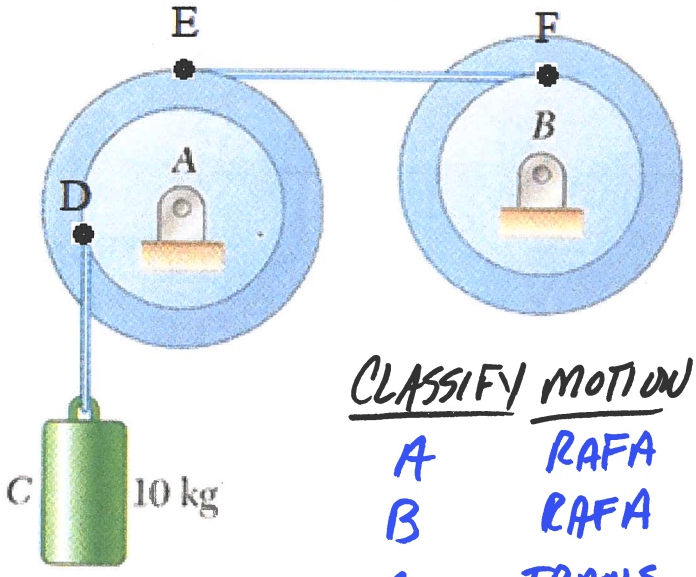
Problem 2: Impulse Momentum III

Each of the double pulleys shown has a centroidal mass moment of inertia of 0.25 kg-m^2, an inner radius of 100 mm, and an outer radius of 150 mm. Neglecting bearing friction, determine (a) the velocity of the cylinder 3 seconds after the system is released from rest, (b) the tension in the cord connecting the pulleys.



CLASSIFY MOTION

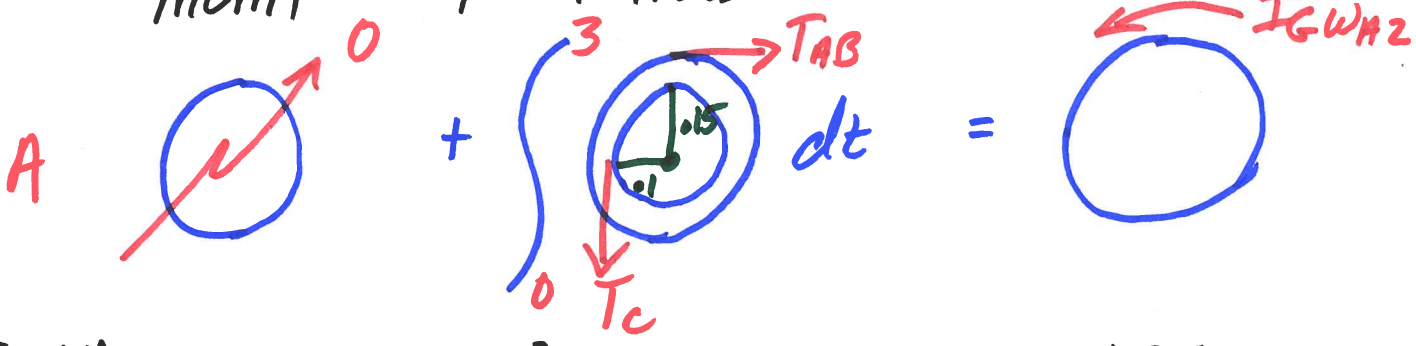
A	RAFA
B	RAFA
C	TRANS

PROPERTIES

$I_{GA} = I_{GB} = 0.25\ kg\text{-}m^2$

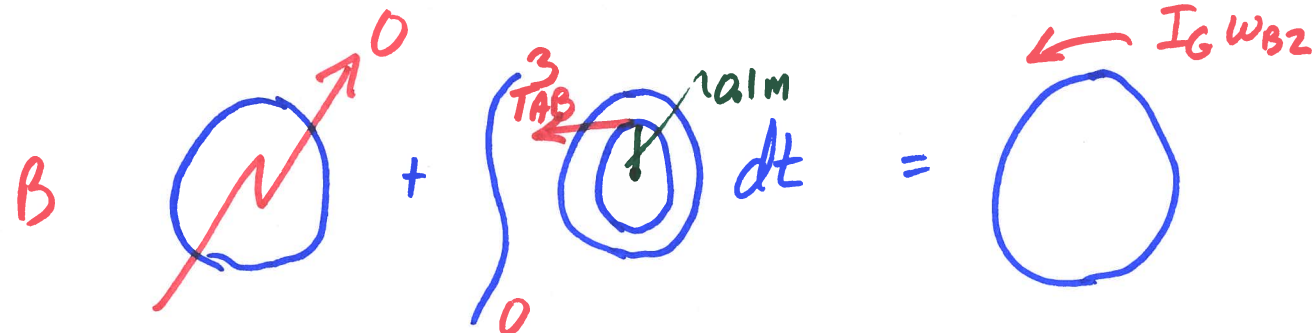
$m_C = 10\ kg \quad W_C = 10(9.81) = 98.1\ N$

MOM 1 + IMPULSE = MOM 2



$\circlearrowright \Sigma M_G \quad 0 + \int_0^3 ((0.1)T_C - 0.15T_{AB})\,dt = 0.25\omega_{A2}$

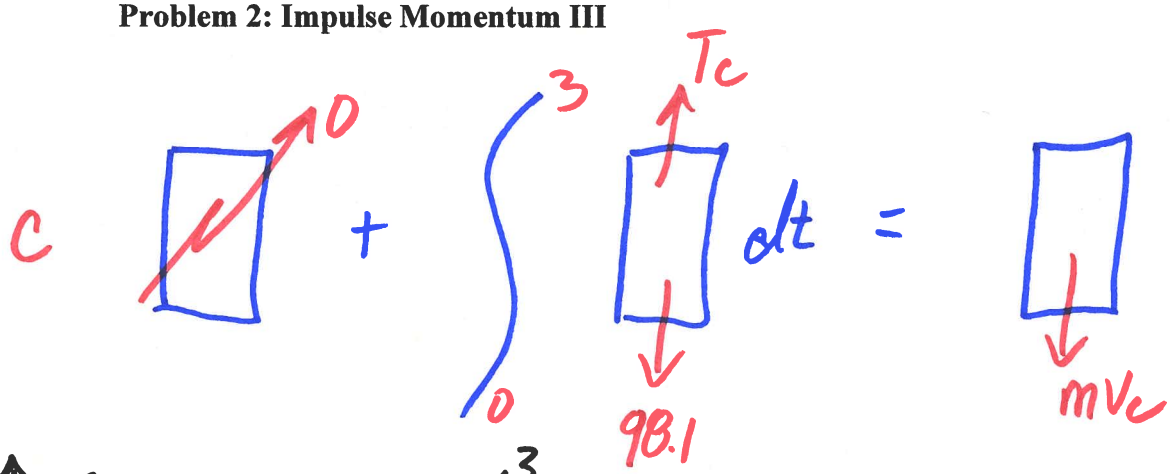
$0.3T_C - 0.45T_{AB} - 0.25\omega_{A2} = 0$ (1)



$\circlearrowright \Sigma M_G \quad 0 + \int_0^3 0.1T_{AB}\,dt = 0.25\omega_{B2}$

$0.3T_{AB} - 0.25\omega_{B2} = 0$ (2)

Problem 2: Impulse Momentum III



$$\uparrow \Sigma Y \quad 0 + \int_0^3 (T_C - 98.1)\,dt = -10V_C$$

$$3T_C - 294.3 = -10V_C$$

$$3T_C + 10V_C = 294.3 \quad (3)$$

3 EQNS, 5 UNKNOWNS !

KINEMATICS

$$V_C = V_D = \omega_{A2}(0.1) \Rightarrow \omega_{A2} = 10V_C$$

$$V_E = \omega_{A2}(0.15) = V_F = \omega_{B2}(0.1)$$

$$\omega_{BL} = 1.5\omega_A = 15V_C$$

$$0.3T_C - 0.45T_{AB} - 0.25(10V_C) = 0$$

$$0.3T_{AB} - 0.25(15V_C) = 0$$

$$3T_C + 10V_C = 294.3$$

$$\begin{bmatrix} 0.3 & -0.45 & -2.5 \\ 0 & 0.3 & -3.75 \\ 3 & 0 & 10 \end{bmatrix} \begin{Bmatrix} T_C \\ T_{AB} \\ V_C \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \\ 294.3 \end{Bmatrix}$$

SOLVE

$T_C = 87.3\,N$

$T_{AB} = 40.3\,N$

$V_C = 3.23\,m/s\downarrow$