Task 1:

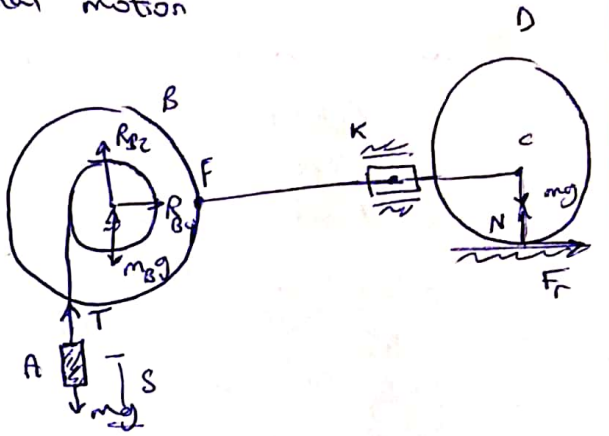
Research object: system of 6 bodies

Cylinder (object D) - rotational and translational motion

Pulley (object B) - rotational motion

Blocle (obj A) - translational motion

object K - translational motion



Conditions:

Initial
- starts at rest
- all velocities = 0

final
A moves 8 cm

$v_A(s) = ?$ $s = f(t)$

Force Analysis

G_A G_B G_D

T R_{By} R_{Bz}

N_D F_r

Solution:

$$T_2 - T_1 = \Sigma_i A_i$$

Based on the lagragian dynamics using kinetic Energy T and work for external forces A

The system starts at rest $T_1 = 0$

$$T_2 = T_{A2} + T_{B2} + T_{D2} + T_{K2}$$

$$T_{A2} = 0.5\, m_A v_A^2$$

$$T_{B2} = 0.5\, I_{Bm}\, \omega_B \cdot 2$$

$$\Rightarrow T_{B2} = \frac{m_B\, i_{Bm}^2\, v_A^2}{2\, r_B^2}$$

$$I_{Bm} = m_B\, i_{Bm}^2$$

$$\omega_B = v_A / r_B$$

$$T_{K2} = 0.5\, m_k\, v_c^2$$

$$v_k = v_A \frac{R_B}{r_B}$$

$$T_{K2} = 0.5\, m_K v_A^2 \frac{R_B^2}{r_B^2} = 0$$

$$T_{D_2} = 0.5\, m_D\, v_c^2 + 0.5\, I_{Dx}\, \omega_D^2$$

$$\omega_D = v_c / R_D = v_A\, R_B / (r_B R_D)$$

$$v_c = v_K = v_A\, R_B / r_B$$

$$I_{Dx} = 0.5\, m_D\, R_D^2$$

$$T_{D_2} = 0.5\, m_D\, v_A^2\, \frac{R_B^2}{r_B^2} + 0.25\, m_D\, R_D^2\, v_A^2\, \frac{R_B^2}{r_B^2\, R_D^2}$$

work done by external forces:

$$A = \Sigma_i A_i$$

$$A_A = m_a\, g\, s$$

$$A_B = 0 \qquad A_K = 0$$

$$A_D = m_D\, g.0 + A(F_r) + \delta N \phi_D$$

$$A(F_r) = 0$$

$\phi_D = ?$

$$x_D = F_K + R_B - \sqrt{(F_K)^2 - R_B^2}$$

$$\phi_D = r_B / (R_B . R_D)\, x_D$$

$$\phi_D = \frac{r_B\, x_D}{R_B\, R_D}$$

$T_2 = \Sigma_i A_i$

everything is known, we get $v_A(s) = v_A(s(t))$

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