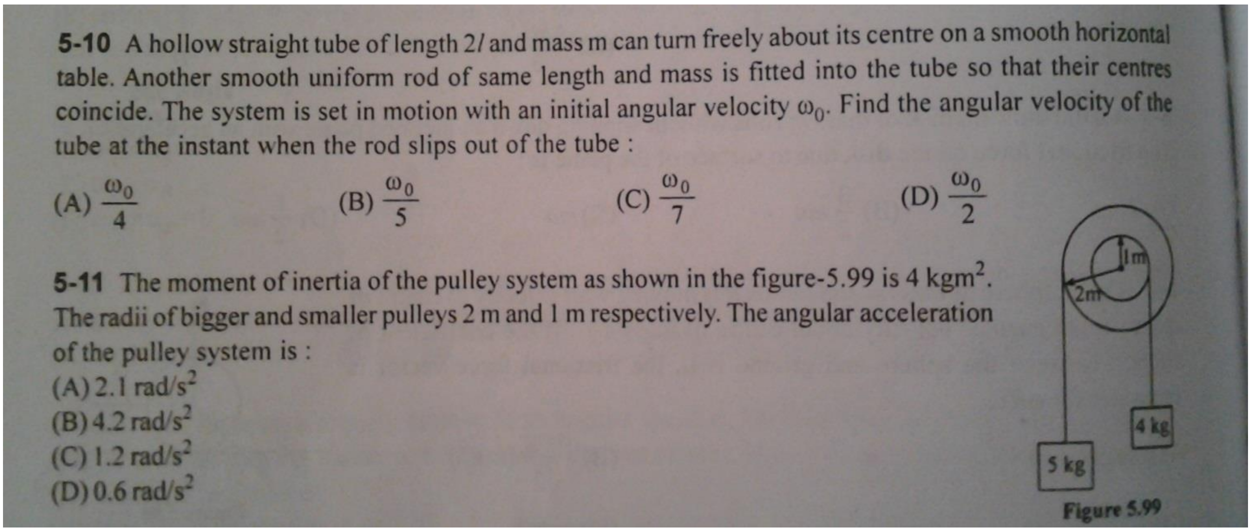
Answer on Question #56569 - Physics - Mechanics - Relativity



5-10 A hollow straight tube of length $2l$ and mass m can turn freely about its centre on a smooth horizontal table. Another smooth uniform rod of same length and mass is fitted into the tube so that their centres coincide. The system is set in motion with an initial angular velocity ω_0. Find the angular velocity of the tube at the instant when the rod slips out of the tube :

(A) $\frac{\omega_0}{4}$ (B) $\frac{\omega_0}{5}$ (C) $\frac{\omega_0}{7}$ (D) $\frac{\omega_0}{2}$

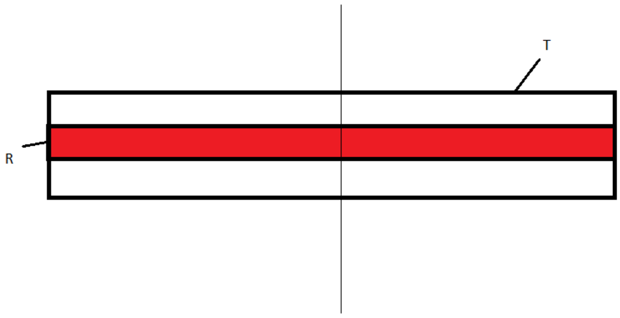
5-11 The moment of inertia of the pulley system as shown in the figure-5.99 is 4 kgm^2. The radii of bigger and smaller pulleys 2 m and 1 m respectively. The angular acceleration of the pulley system is :

(A) 2.1 rad/s^2
(B) 4.2 rad/s^2
(C) 1.2 rad/s^2
(D) 0.6 rad/s^2

Figure 5.99

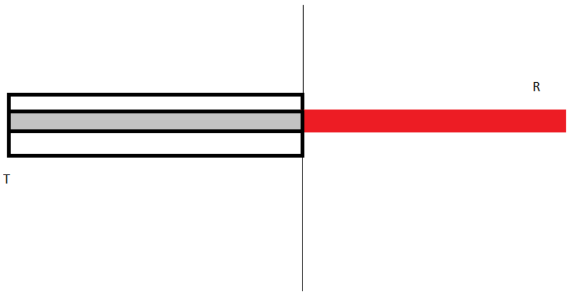
5.10 Solution.

Let`s define the moment of inertia at the initial and final moments. At the beginning:



$$J_1 = J_t + J_r = \frac{m4l^2}{12} + \frac{m4l^2}{12} = \frac{2ml^2}{3}$$

At the final moment:



$$J_2 = J_t + J_r = \frac{m4l^2}{3} + \frac{m4l^2}{3} = \frac{8ml^2}{3}$$

As the energy of the system is constant:

$$\frac{J_1\omega_0^2}{2} = \frac{J_2\omega^2}{2}$$

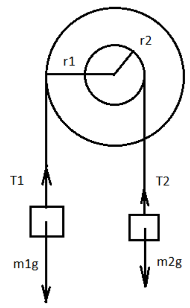
$$\frac{2ml^2}{3}\omega_0^2 = \frac{8ml^2}{3}\omega^2$$

$$\omega = \frac{\omega_0}{2}$$

Answer: D $\omega = \frac{\omega_0}{2}$.

5.11 Solution.

$$\begin{cases} m_1 g - T_1 = m_1 a_1 = m_1 r_1 \varepsilon \\ -m_2 g + T_2 = m_2 a_2 = m_2 r_2 \varepsilon \\ T_1 r_1 - T_2 r_2 = J\varepsilon \end{cases}$$



$$\begin{cases} T_1 = m_1 g - m_1 r_1 \varepsilon \\ T_2 = m_2 g + m_2 r_2 \varepsilon \\ T_1 r_1 - T_2 r_2 = J\varepsilon \end{cases}$$

$$(m_1 g - m_1 r_1 \varepsilon) r_1 - (m_2 g + m_2 r_2 \varepsilon) r_2 = J\varepsilon$$

$$\varepsilon = \frac{g(m_1 r_1 - m_2 r_2)}{J + m_1 r_1^2 + m_2 r_2^2} = \frac{9.8(5 * 2 - 4 * 1)}{4 + 5 * 2^2 + 4 * 1^2} = 2.1$$

Answer: A 2.1