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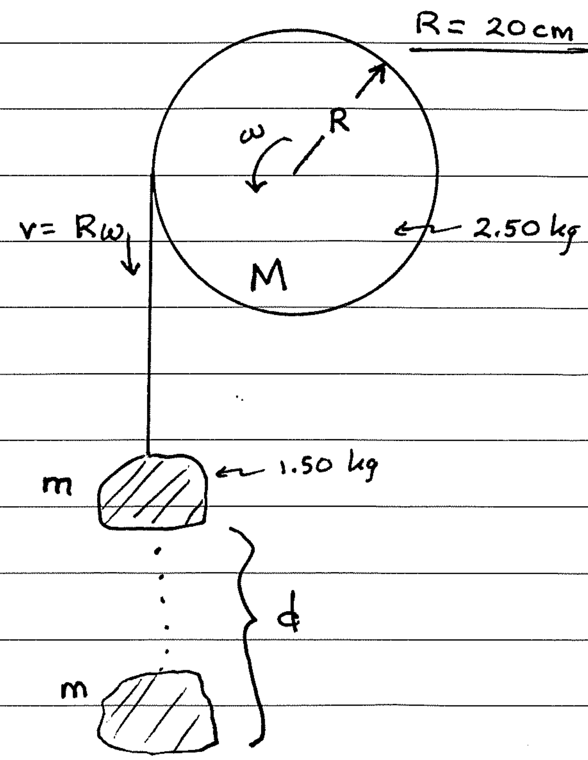
Ch. 9 Ex. 43

43. A frictionless pulley has the shape of a uniform disk ...



a.) $W_{TOT} = K_f - K_i \qquad K_i = 0$

$$mgd = \frac{1}{2}mv^2 + \underbrace{K_{rot}^{disk}}_{4.50\ J}$$

$$mgd = \frac{1}{2}m(R\omega)^2 + 4.50\ J$$

$$K_{rot}^{disk} = \frac{1}{2}\left(\frac{1}{2}MR^2\right)\omega^2 = \frac{1}{4}MR^2\omega^2$$

$$\omega^2 = \frac{4K_{rot}^{disk}}{MR^2} = \frac{4(4.50\ J)}{2.50(0.20\ m)^2}$$

$$\omega^2 = 180\ \frac{rad^2}{s^2} \qquad \omega = 13.4\ rad/s$$

$$d = \frac{\frac{1}{2}m(R\omega)^2 + 4.50\ J}{mg} = \frac{\frac{1}{2}(1.5)((0.20)\,13.4)^2 + 4.50\ J}{(1.50)\,9.8}$$

$$\boxed{d = 0.673\ \text{meters}}$$

b.) What percent of the total KE does the pulley have?

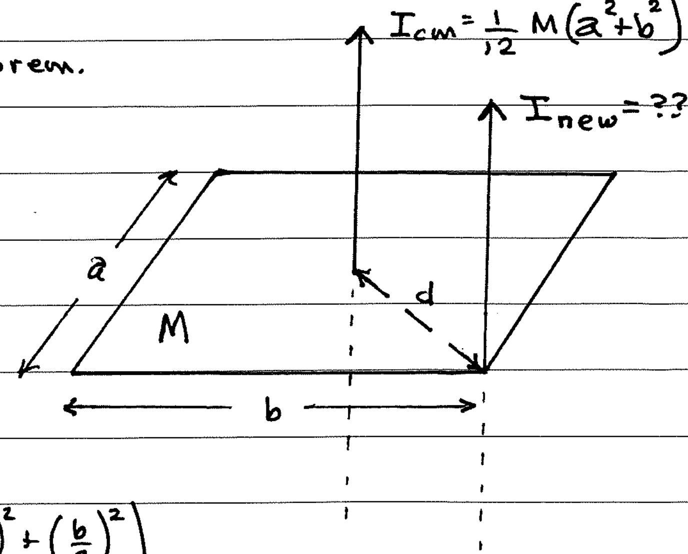
Total KE = mgd So, $\frac{KE_{pulley}}{mgd} \times 100\% = \frac{4.50\ J}{1.5(9.8)(0.673)} \times 100\%$

$$\boxed{\text{Percent} = 45.5\%}$$

51. A thin rectangular sheet has mass M and sides of length a and b.

Parallel Axis Theorem.

$$I_{new} = I_{cm} + Md^2$$



$$I_{new} = \frac{1}{12} M\left(a^2 + b^2\right) + M\underbrace{\left(\left(\frac{a}{2}\right)^2 + \left(\frac{b}{2}\right)^2\right)}_{d^2}$$

d^2 from Pythagorean Theorem.

$$I_{new} = \left(\frac{1}{12} + \frac{1}{4}\right) Ma^2 + \left(\frac{1}{12} + \frac{1}{4}\right) Mb^2 = \frac{1}{3} M\left(a^2 + b^2\right)$$

$$\boxed{I_{new} = \frac{1}{3} M\left(a^2 + b^2\right)}$$

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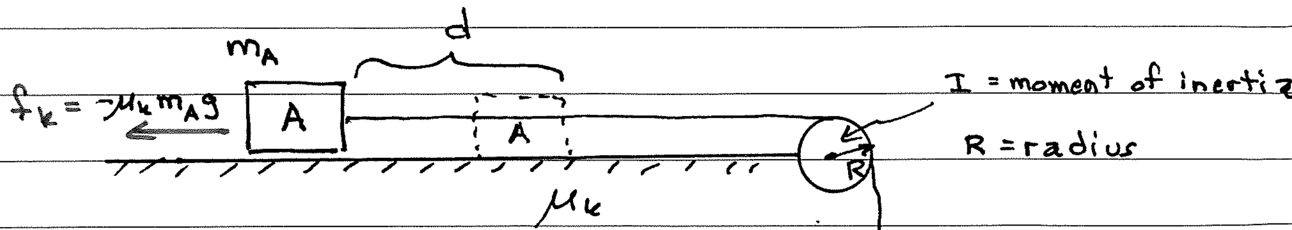
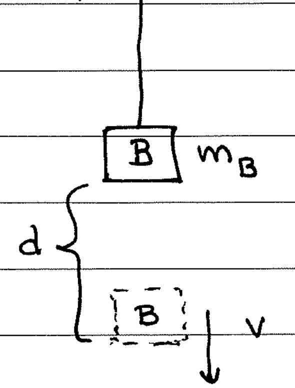
Chapter 9 Prob. 75

75.



$$W_{TOT} = K_f - K_i \quad \text{but } K_i = 0$$

$$W_{fr} + W_{gr} = \frac{1}{2}(m_A + m_B)v^2 + \frac{1}{2}I\omega^2$$



However, $\omega = \dfrac{v}{R}$

$$-\mu_k m_A g d + m_B g d = \frac{1}{2}(m_A + m_B)v^2 + \frac{1}{2}I\left(\frac{v^2}{R^2}\right)$$

$$-\mu_k m_A g d + m_B g d = \frac{v^2}{2}\left(m_A + m_B + \frac{I}{R^2}\right)$$

$$v^2 = \frac{2(-\mu_k m_A + m_B)\, g d}{(m_A + m_B + I/R^2)}$$

$$\boxed{v = \sqrt{\frac{2(-\mu_k m_A + m_B)\, g d}{(m_A + m_B + I/R^2)}}}$$