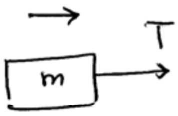
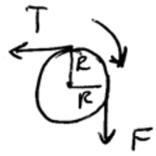
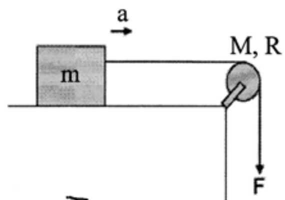
PHYS101.13
QUIZ#9- CHAPTER 10
DATE: 19/5/09

Name: Key Id#:

A rope pulls a box of mass m = 2.0-kg on a frictionless surface through a pulley as shown in the figure. The pulley has a mass M = 1.0 kg and radius R = 10 cm. Calculate the linear acceleration of the box if the force F is 40 N. (Consider the pulley as a uniform disk).







$T = ma$ — ① and $FR - TR = I\alpha = I\frac{a}{R}$ — ②

② ⇒ $F - T = I\frac{a}{R^2}$ ⇒ $F - ma = I\frac{a}{R^2}$

⇒ $a\left(\frac{I}{R^2} + m\right) = F$

⇒ $a = \dfrac{F}{\frac{I}{R^2} + m}$

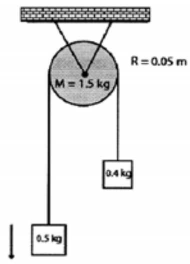
$I_{disk} = \frac{1}{2}MR^2$ ⇒ $a = \dfrac{F}{\frac{1}{2}M + m} = \dfrac{40}{0.5 + 2}$

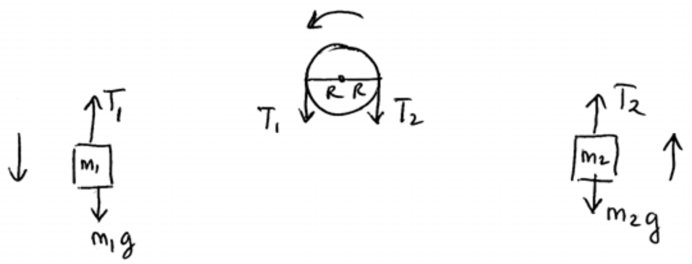
$a = \dfrac{40}{2.5} = \underline{\underline{16\ m/s^2}}$

PHYS101.14
QUIZ#9- CHAPTER 10
DATE: 19/5/09

Name: Key Id#:

In the figure $m_1 = 0.50$ kg, $m_2 = 0.40$ kg and the pulley has a disk shape of radius 0.05 m and mass M = 1.5 kg. What is the angular acceleration of the pulley?





$m_1 g - T_1 = m_1 a$ — ① $T_1 R - T_2 R = I\alpha$ - ② $T_2 - m_2 g = m_2 a$ - ③

$T_1 = m_1 g - m_1 a$ $T_1 - T_2 = I \frac{a}{R^2}$ $T_2 = m_2 g + m_2 a$

$$\underbrace{(m_1 g - m_1 a)}_{T_1} - \underbrace{(m_2 g + m_2 a)}_{T_2} = I \frac{a}{R^2}$$

$$\Rightarrow \quad m_1 g - m_1 a - m_2 g - m_2 a = I \frac{a}{R^2}$$

$$a\left(m_1 + m_2 + I \frac{a}{R^2}\right) = (m_1 - m_2) g$$

$I = \frac{1}{2} M R^2$

$$a = \frac{(m_1 - m_2) g}{m_1 + m_2 + \frac{1}{2} M} = \alpha R$$

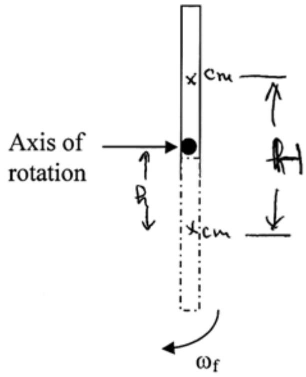
$$\Rightarrow \alpha = \frac{(m_1 - m_2) g}{(m_1 + m_2 + \frac{1}{2} M) R} = \frac{0.98}{0.083} =$$

$$\boxed{\alpha = 11.9 \text{ rad/s}^2}$$

PHYS101.15
QUIZ#9- CHAPTER 10
DATE: 17/5/09

Name: Key Id#:

A thin rod of mass 0.50 kg and length 2.0 m is pivoted at one end and can rotate in a vertical plane about this horizontal frictionless pivot (axis). It is released from rest in the vertical position as shown in the figure. $I_{cm} = ML^2/12$
Find the **angular speed** of the rod as it its lowest point as shown in the figure.



$$\Delta K + \Delta U_g = 0$$

$$\Delta K = \frac{1}{2} I \omega_f^2 - 0$$

$$I = I_{cm} + Mh^2 = \frac{1}{12} ML^2 + M\left(\frac{L}{2}\right)^2 = \frac{1}{3} ML^2$$

$$\Delta U_g = -MgH = -MgL$$

$$\Rightarrow \quad \frac{1}{2}\left(\frac{1}{3} ML^2\right)\omega_f^2 - MgL = 0$$

$$\frac{1}{6} ML^2 \omega_f^2 = MgL$$

$$\Rightarrow \quad \omega_f = \sqrt{6gL} = \boxed{10.8 \text{ rad/s}}$$