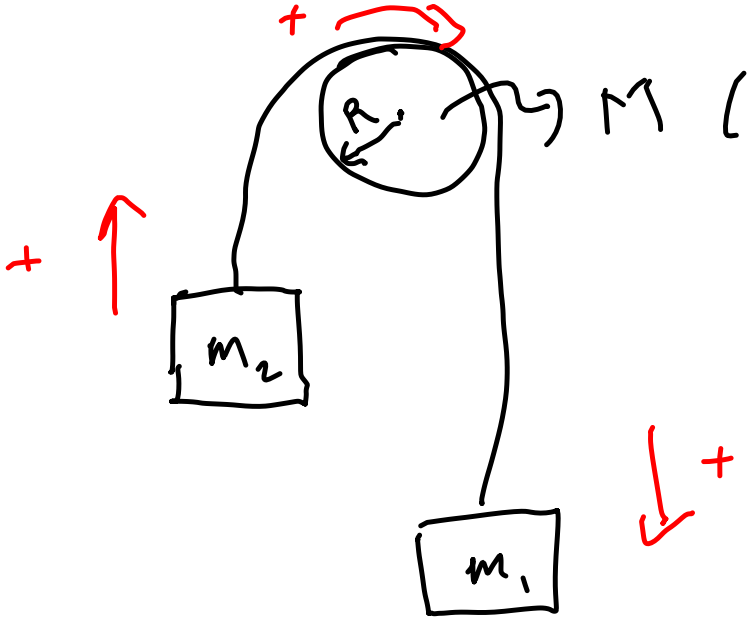
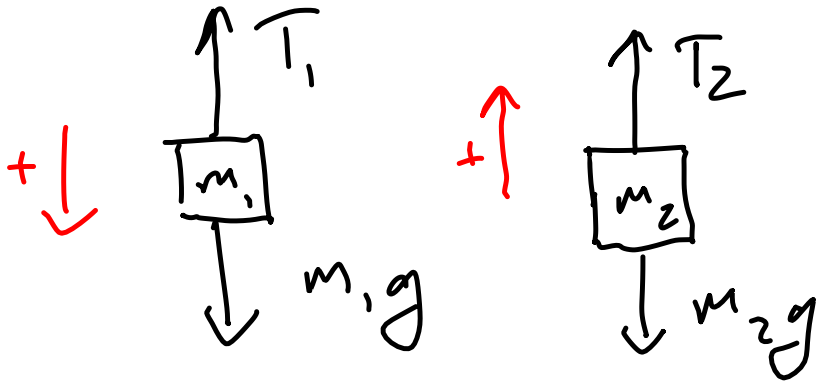
Chapter 12 supplemental (some ~~problems~~)

1) Dynamics ⇒ rotational motion

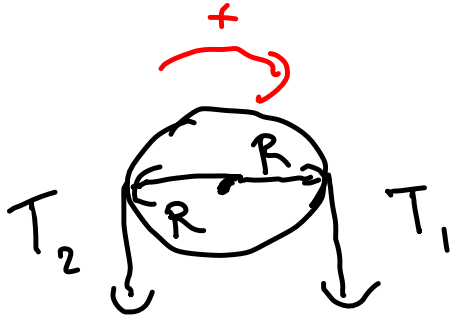
$\vec{F} = m\vec{a}$ becomes $\tau = I\alpha$ ⇝ angular acceleration

↳ moment of inertia





Find a



① $m_1: \sum F = m_1 a \Rightarrow m_1 g - T_1 = m_1 a$

② $m_2: \sum F = m_2 a \Rightarrow T_2 - m_2 g = m_2 a$

$M: \sum \tau = I\alpha \Rightarrow T_1 R - T_2 R = I\alpha$

for a disk $I = \frac{1}{2} M R^2$ & $a = \alpha R \Rightarrow \alpha = \frac{a}{R}$

$\Rightarrow M: \sum \tau = I\alpha \Rightarrow T_1 R - T_2 R = \frac{1}{2} M R^2 \frac{a}{R}$

$\Rightarrow T_1 R - T_2 R = \frac{1}{2} M R a \Rightarrow T_1 - T_2 = \frac{1}{2} M a$ ③

solve ① for T_1 solve ② for T_2 & sub into ③

$$T_1 = m_1 g - m_1 a$$

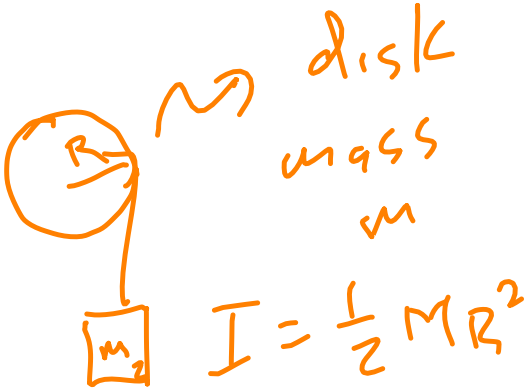
sub. into ③

$$T_2 = m_2 g + m_2 a$$

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

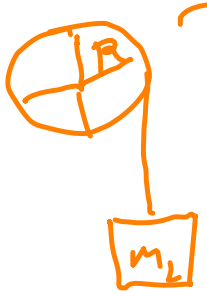
$$m_1 g - m_1 a - m_2 g - m_2 a = \frac{1}{2} M a$$

$$\Rightarrow \boxed{a = \frac{m_1 - m_2}{m_1 + m_2 + \frac{1}{2} M} g}$$



disk
mass
m

$I = \frac{1}{2}MR^2$



hoop or spokes
mass m

$I = MR^2$

a is bigger
because I is smaller

✓
wins race

a is smaller
because I is
bigger