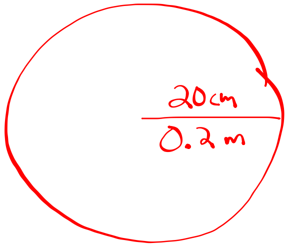
14. A 40-cm diameter wheel accelerates uniformly from 80 rpm to 300 rpm in 3.6 seconds. Assume the axis of rotation is fixed and the wheel is just spinning. Determine

a) its angular acceleration.

b) the radial and tangential components of the linear acceleration of a point on the edge of the wheel 2.0 seconds after it started accelerating. (Hint: what acceleration have we talked about that points into the center of circular motion? What acceleration have you learned about that is always tangent to the object's circular path?)



$\omega_0 = 80\text{ rpm} = 8.37\ \frac{\text{rad}}{s}$

$\omega = 300\text{ rpm} = 31.4\ \frac{\text{rad}}{s}$

$\theta_0 = 0$

$\theta =$

(a) $\omega_0 = 8.37$

$\omega = 31.4$

$\alpha = 6.4\ \text{rad}/s^2$

$t = 3.6$

$\omega = \omega_0 + \alpha t$

$31.4 = 8.37 + \alpha(3.6)$

$\alpha = 6.4\ \text{rad}/s^2$

$x_0 = 0$

(b) $x =$

$v_0 = 1.67\ m/s$

$v = 4.23\ m/s$

$a_t = 1.28\ m/s^2$

$t = 2.0\ s$

$\omega = \frac{v}{r}$

$\alpha = \frac{a_t}{r}$

$v = v_0 + a_t t$

$v = 4.23\ m/s$

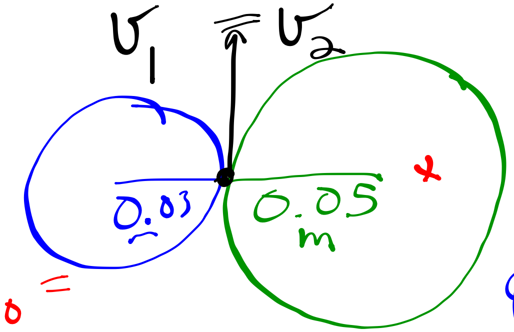
$a_c = \frac{v^2}{r}$

$a_c = \frac{(4.23)^2}{0.2} = \boxed{89.5\ m/s^2}$

18. Two rubber wheels are mounted next to one another so their circular edges touch. The first wheel, of radius R_1 = 3.0 cm, accelerates at a rate 0.88 rad/s^2 and drives the second wheel, of radius R_2 = 5.0 cm, by contact (without slipping).

a) Starting from rest, how long does it take the second wheel to reach an angular speed of 33 rpm?

b) What was the angular acceleration of the second wheel?



$\alpha = \frac{a_t}{r}$

$\omega = \frac{v}{r}$

$x_0 =$
$x =$
$v_0 = 0$
$v = \omega \cdot r = 3.45 \cdot 0.05 = 0.173\ m/s$
$a_t = \alpha \cdot r = 0.88 \cdot 0.03 = 0.026\ m/s^2$
$t = 6.65\ s$

$\theta_0 =$
$\theta =$
$\omega_0 = 0$
$\omega = 5.77\ m/s$
$\alpha = 0.88\ rad/s^2$
$t = 6.6\ s$
$r = 0.03$

$\theta_0 =$
$\theta =$
$\omega_0 = 0$
$\omega = 33\ rpm = 3.45\ rad/s$
$\alpha = 0.52\ rad/s^2$
$t = 6.6\ s$
$r = 0.05$

$v = v_0 + at$

Atwood Today:

$$\boxed{I = \frac{\Sigma\tau}{\alpha}}$$

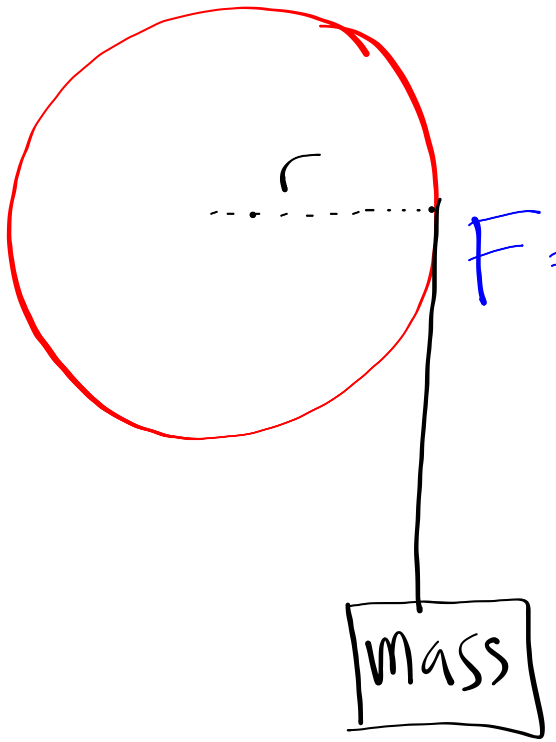
~~$I_{hoop} = mr^2$~~
~~$I_{disk} = \frac{1}{2}mr^2$~~

1. What are the measurements you'll take to find I?

$\Sigma\tau = I\alpha$

2. What are the formulas you'll use to turn those measurements into $\Sigma\tau$, α, and I?

NOT PARTICULARLY HELPFUL FOR ATWOOD LAB



$F = m \cdot g$

$mg \downarrow$

$\tau = F \cdot r$

$\tau = m \cdot g \cdot r$

if $a = 0$

hard & … &

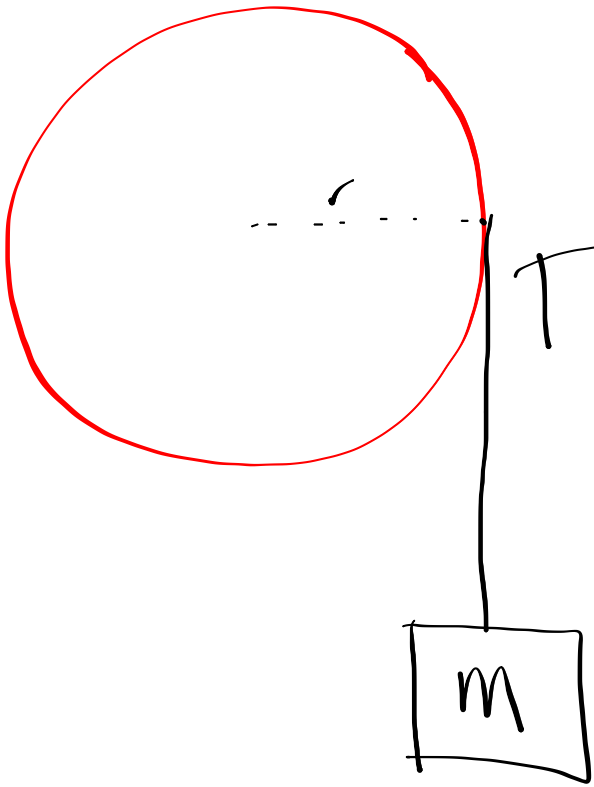
$$\Sigma F = ma$$

$$T - mg = ma$$

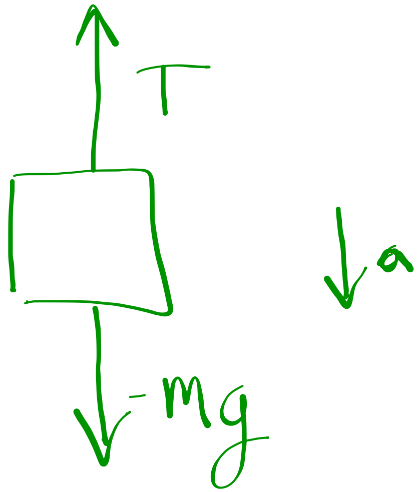
$$T = mg + ma$$

$$\tau = F \cdot r = T \cdot r$$

$$\tau = (mg + ma)r$$

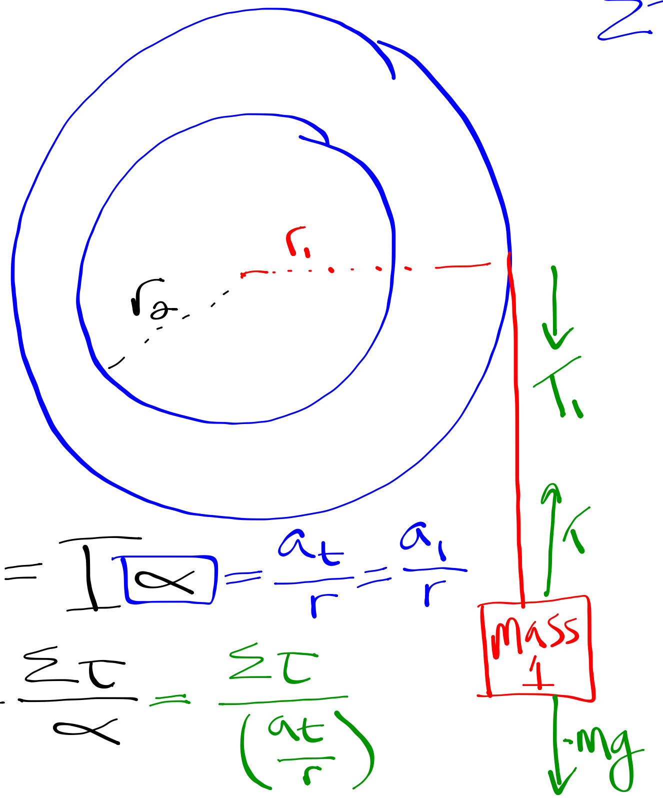


$T \downarrow = mg + ma$



$$\sum \tau = T_1 \cdot r_1$$
$$= (m_1 g + m_1 a_1) r_1$$

$$T_1 = m_1 g + m_1 a_1$$



$$\sum F = ma$$
$$T_1 - m_1 g = m_1 a_1$$
$$x = \cancel{x_0} + \cancel{v_0 t} + \frac{1}{2} a t^2$$

$$\sum \tau = I \boxed{\alpha} = \frac{a_t}{r} = \frac{a_1}{r}$$

$$I = \frac{\sum \tau}{\alpha} = \frac{\sum \tau}{\left(\frac{a_t}{r}\right)}$$

$$\boxed{I = \frac{(m_1 g + m_1 a_1) r_1}{\frac{a_1}{r_1}}}$$