C1

10-18-13

2A

Test 2 Oct 30. WED

CH 3 → PROJECTILE
relative
circular MOTION

CH 4 } newtons LAWS
CH 5 }

*CH6 circular Dynamics

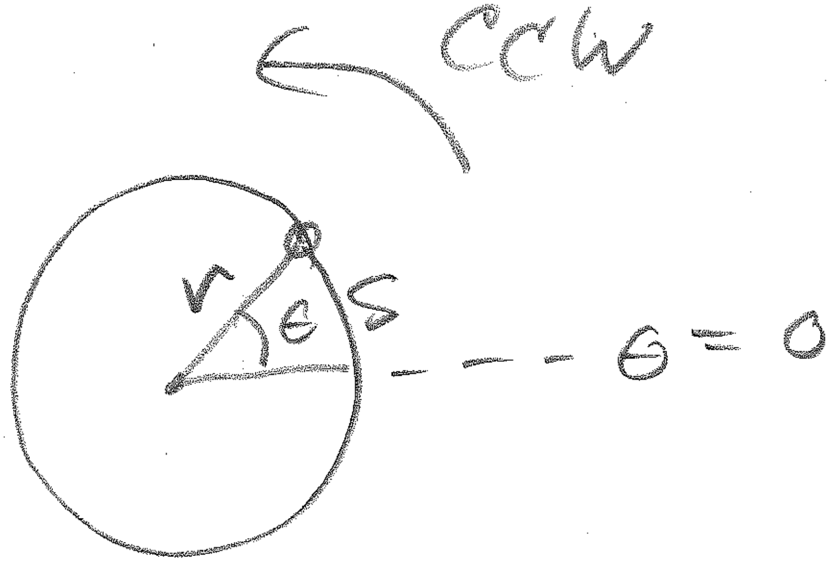
CH 7 conservation of Energy
with KE and Ug only.
NO friction: see *
see #46, 87*-CH 7
ALSO #49, #45, #46 (CH7)

$KE_i + mgy_i$
$= KE_f + mgy_f$
$(KE = \frac{1}{2}mv^2)$
$KE_i = \frac{1}{2}mv_i^2$
$KE_f = \frac{1}{2}mv_f^2$

see All problems I worked out. NOTE *87, CH 7 involves Ch6.

CH 9

Rock moving in a circle.

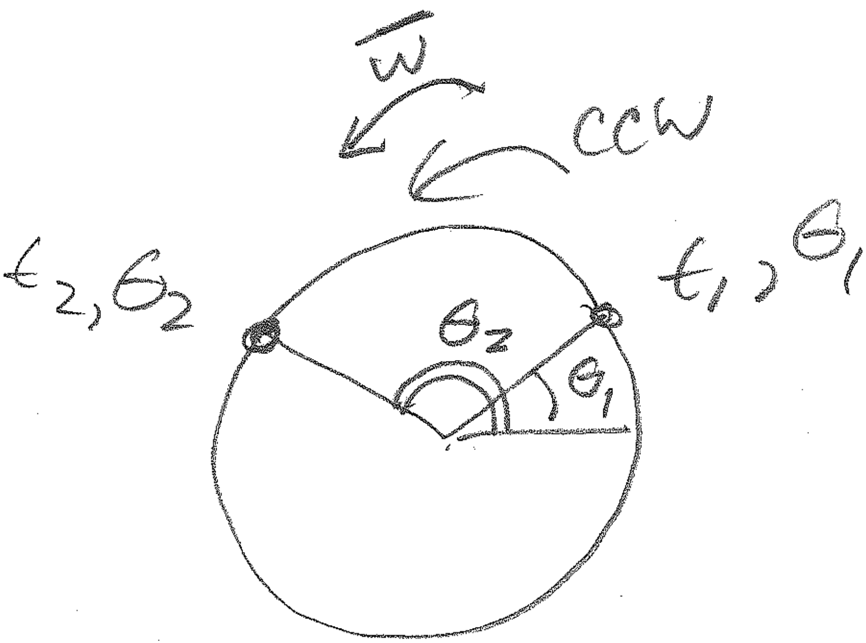


$s = r \cdot \theta$ H.S. geometry

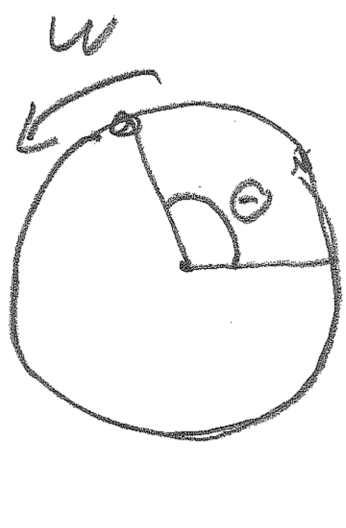
$1 \text{ Rad} = \frac{180}{\pi} \text{ degrees}^\circ$

$30^\circ = 30 \cdot \frac{\pi}{180} \text{ RAD} = \frac{\pi}{6} \text{ RAD}$

$45^\circ = 45 \cdot \frac{\pi}{180} = \frac{\pi}{4} \text{ RAD}$



$$\bar{\omega} = \frac{\theta_2 - \theta_1}{t_2 - t_1} = \frac{\Delta\theta}{\Delta t} \left(\frac{RAD}{S}\right)$$

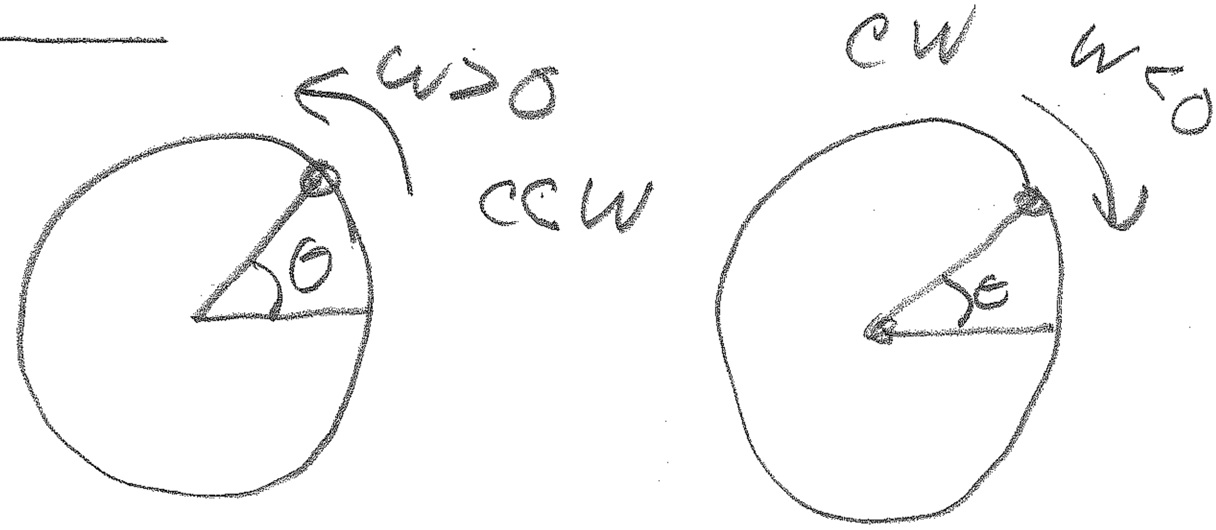


$$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$$

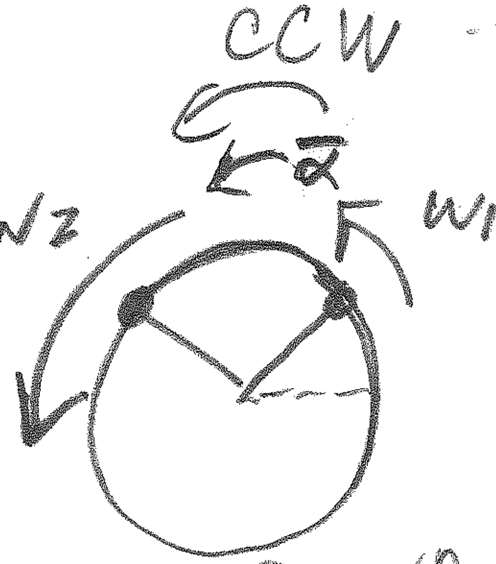
instantaneous angular velocity $\left(\frac{RAD}{S}\right)$

α = Alpha
ω = omega not w

signs:



angular acceleration (α)



$$\bar{\alpha} = \frac{\omega_2 - \omega_1}{t_2 - t_1}$$

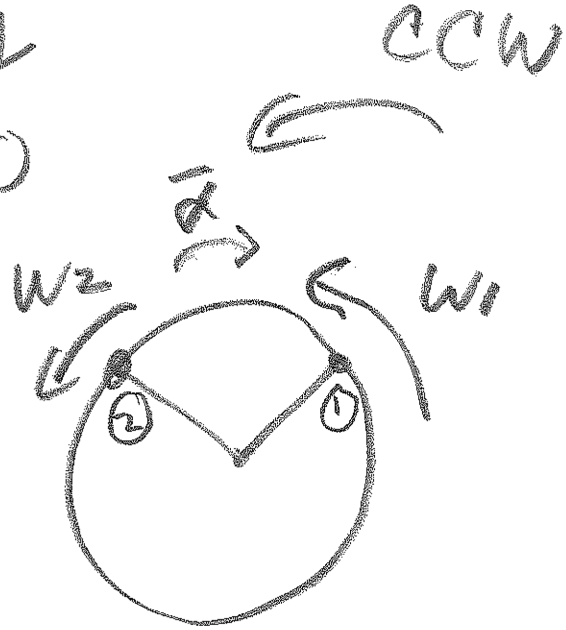
$$\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$$

$$\left(\frac{RAD}{s^2}\right)$$

speeding up

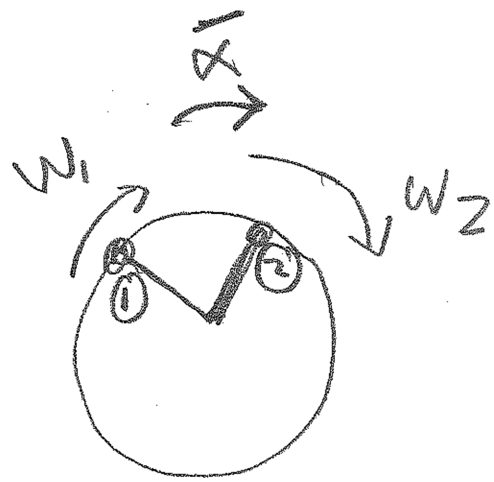
NOTE: $\bar{\alpha} > 0$ in this example

Examples of $\bar{\alpha} < 0$



$$\bar{\alpha} = \frac{w_2 - w_1}{t_2 - t_1} < 0$$

$w_2 < w_1$

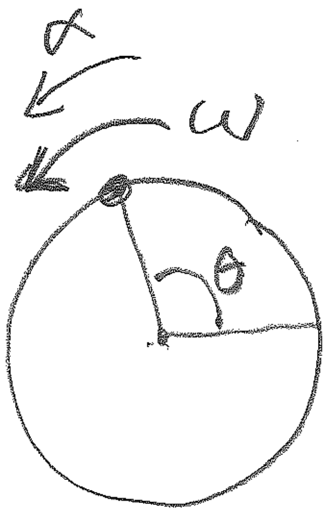


$$\bar{\alpha} = \frac{w_2 - w_1}{t_2 - t_1} < 0$$

$w_2 < 0$

$w_1 < 0$

$|w_2| > |w_1|$



$$\alpha = \lim_{\Delta t \to 0} \frac{\Delta \omega}{\Delta t}$$

$[\theta = \text{theta}]$

SPECIAL CASE; when α = constant

CH 2 → x (POS) a_x = constant	CH 9 α = const. (POS) ↶
$v_2 = v_1 + a_x \cdot \Delta t$	$\omega_2 = \omega_1 + \alpha \cdot \Delta t$
$v_2^2 = v_1^2 + 2 \cdot a_x \cdot \Delta x$	$\omega_2^2 = \omega_1^2 + 2\alpha \cdot \Delta \theta$
$\Delta x = x_2 - x_1 = v_1 \cdot \Delta t + \frac{1}{2} a \Delta t^2$	$\Delta \theta = \omega_1 \cdot \Delta t + \frac{1}{2} \alpha \Delta t^2$
$\bar{v} = \frac{v_1 + v_2}{2} \Rightarrow \Delta x = \bar{v} \cdot \Delta t$	$\bar{\omega} = \frac{\omega_1 + \omega_2}{2}$ and $\Delta \theta = \bar{\omega} \cdot \Delta t$

Example 9.2 Test 3 Review

$\alpha = 2.00\,\frac{RAD}{S^2}$

$\omega_1 = 4.00\,\frac{RAD}{S}$

$t_1 = 0$

$t_2 = 3.00\,(S)$

$\theta_1 = 0$

$\theta_2 = ?$

$\omega_2 = ?$

$\Delta t = t_2 - t_1$

$\Delta\theta = \omega_1 \Delta t + \frac{1}{2}\alpha \cdot \Delta t^2$

$\theta_2 - \theta_1 = \omega_1 \cdot \Delta t + \frac{1}{2}\alpha \cdot \Delta t^2$

$\Delta\theta = 4 \cdot 3 + \frac{1}{2} \cdot 2 \cdot 3^2$

$\Delta\theta = 21$ RADS $= \theta_2$
$(\theta_1 = 0)$

$21 \cdot \frac{180}{\pi} = 1204^\circ$

$\frac{1204^\circ}{360^\circ} = 3.34$ ← RATIO

$= 3$ REV $+ 0.34$ REV

$(0.34)(360^\circ) = 122.4^\circ$

$\omega_2 = \omega_1 + \alpha \cdot \Delta t$

$\omega_2 = 4 + (2) \cdot (3)$

$\omega_2 = 4 + 6 = 10\,\frac{RAD}{S}$

OR

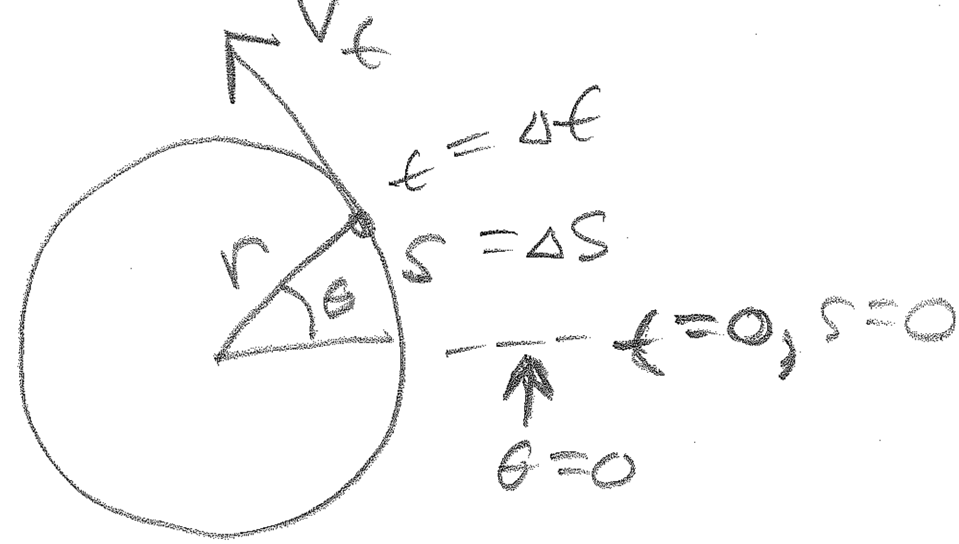
$\omega_2^2 = \omega_1^2 + 2 \cdot \alpha \cdot \Delta\theta$

$\omega_2^2 = 4^2 + 2 \cdot 2 \cdot 21$

$16 + 4 \cdot 21 = 100$

$\omega_2 = 10\,RAD/S$

sec 9.3

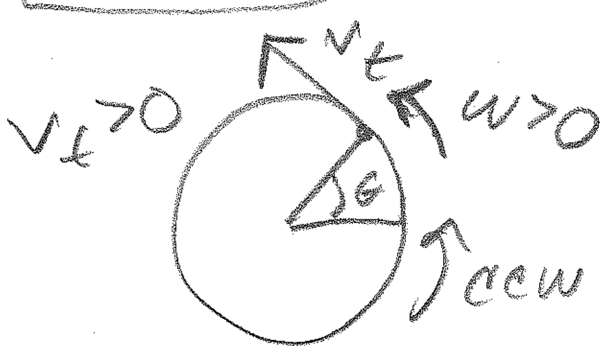


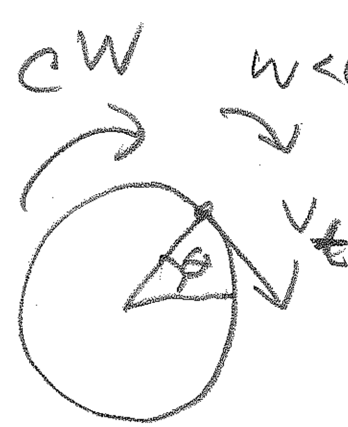
$$v_t = \lim_{\Delta t \to 0} \frac{\Delta s}{\Delta t}$$

$$v_t = \lim_{\Delta t \to 0} \frac{r \cdot \Delta \theta}{\Delta t}$$

$$v_t = r \lim_{\Delta t \to 0} \frac{\Delta \theta}{\Delta t}$$

$$\boxed{v_t = r \cdot \omega}$$

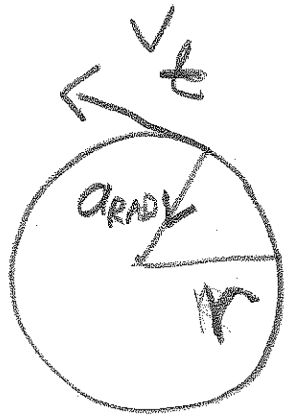




$v_t < 0$

sec 9.3

CW3



$|v_t| = \text{CONSTANT}$

UNIFORM CIRCULAR MOTION

$(\alpha = 0)$

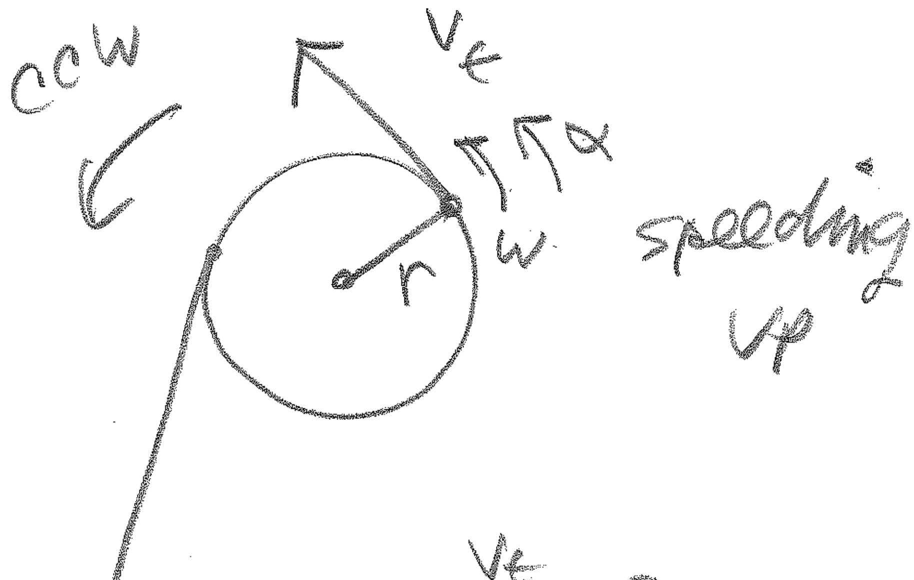
$$a_{RAD} = \frac{v_t^2}{R}$$

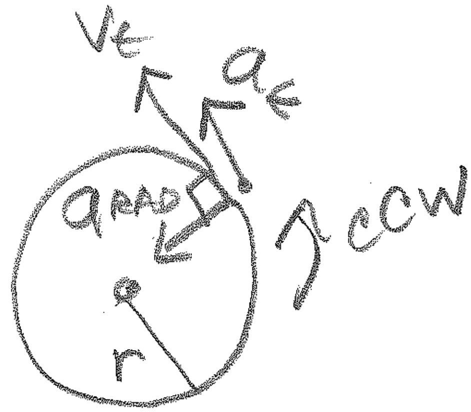
CW9 $v_t = r \cdot \omega$

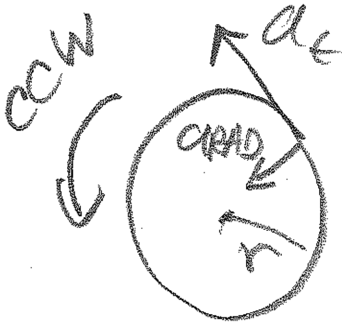
$$a_{RAD} = \frac{(r\omega)^2}{r}$$

$$a_{RAD} = \frac{r^2\omega^2}{r}$$

$$a_{RAD} = r\omega^2$$

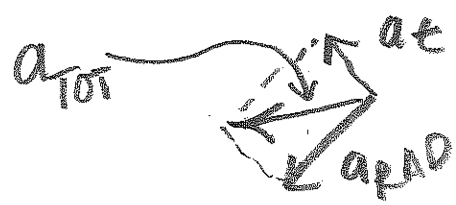






$$\boxed{a_t = r \cdot \alpha}$$

$$a_{TOT} = \sqrt{a_{RAD}^2 + a_t^2}$$



Sec. 9.4

Rotational KE.

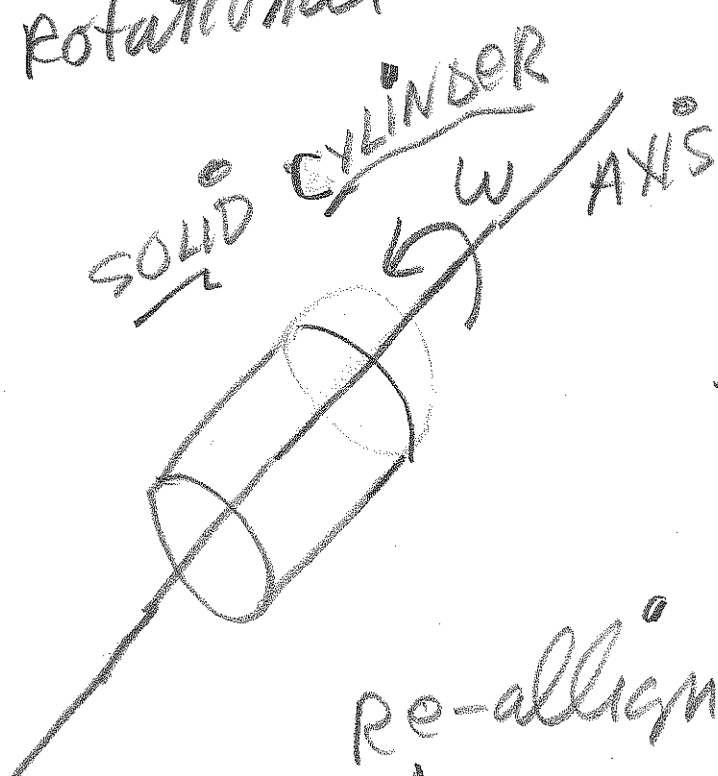
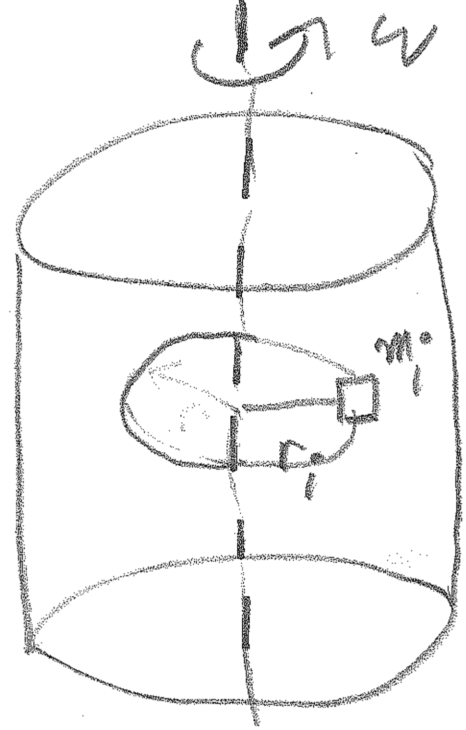


fig 9.2(f)

Re-allign picture



ABOUT 25
6 X 10
molecules
in disk of
Fe.

m_i = ith molecule

$$KE_i = \frac{1}{2} m_i v_{t_i}^2$$

$$= \frac{1}{2} m_i r_i^2 \omega^2$$

$$KE_{TOT} = \sum_{i=1}^{N} \frac{1}{2} m_i r_i^2 \omega^2$$

$N \cong 6 \times 10^{25}$

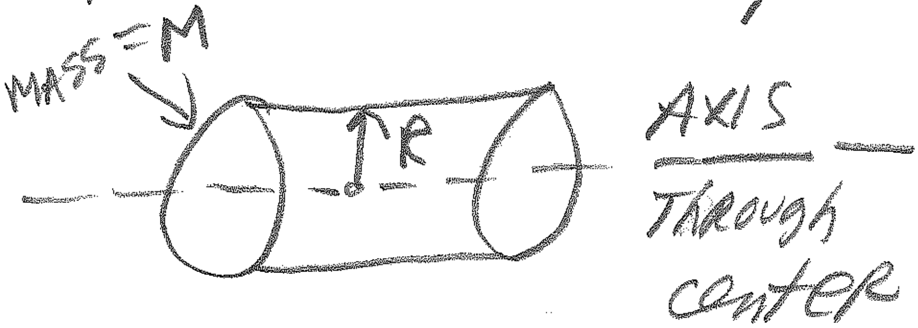
$$\sum_{i=1}^{N} \frac{1}{2} m_i r_i^2 \omega^2 = \frac{\omega^2}{2} \cdot \sum_{i=1}^{N} m_i r_i^2 = \frac{\omega^2}{2} \cdot I = \frac{1}{2} I \omega^2$$

I = moment of inertia

= rotational inertia of a solid disk

$$I = \sum_{i=1}^{N} m_i r_i^2$$

note: $I = \frac{1}{2} MR^2$ for solid disk



see table for various shapes:

solid sphere

$I = \frac{2}{5} MR^2$