Phys 2110-4 3/25/13

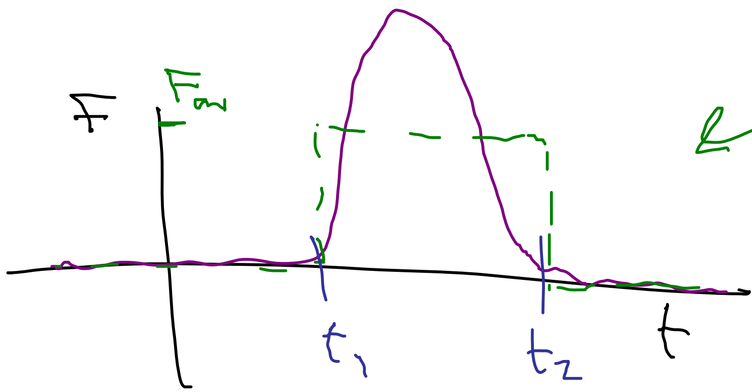
Note Title 3/25/2013

Chap 9

$$J_x = \Delta P_x = \int_{t_1}^{t_2} F_x \, dt$$

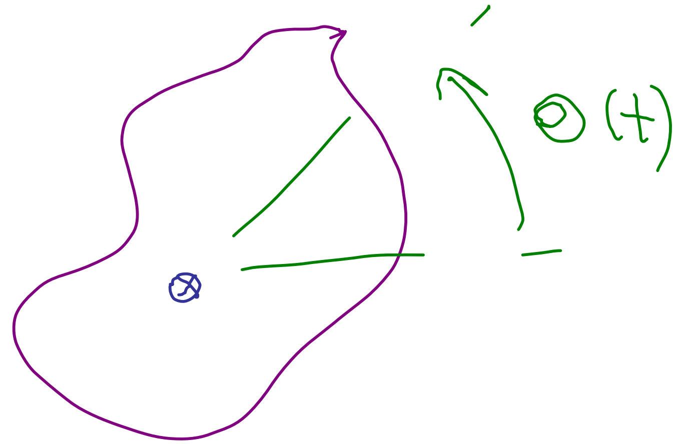
$$\int F \, dx = W$$

$$= F_{av} \Delta t$$



$$F_{av,x} = \frac{\Delta P_x}{\Delta t}$$

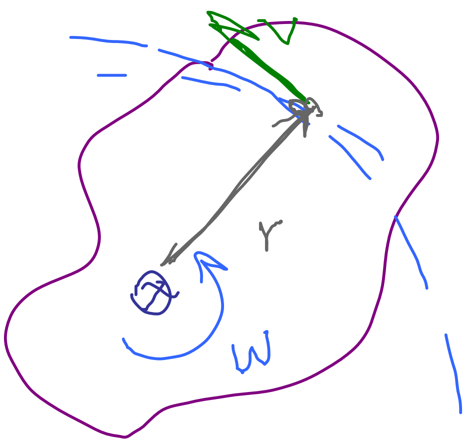
Rotations



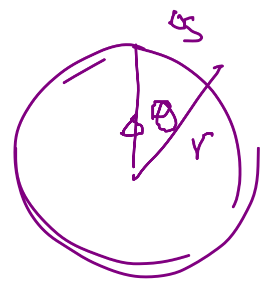
$$\omega = \frac{d\theta}{dt}$$ $\frac{rad}{s}$, $\frac{1}{s}$

$$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$$ $\frac{rad}{s^2}$, $\frac{1}{s^2}$

v, a, x

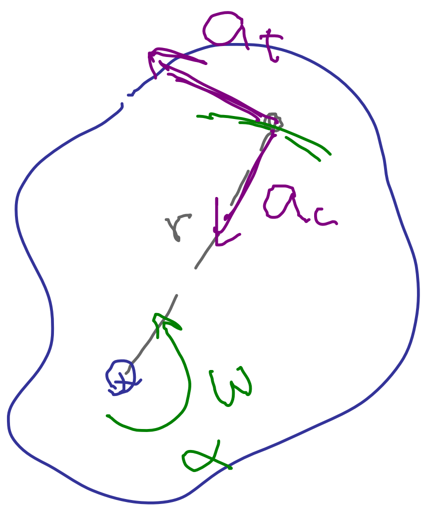


$$v = \omega r$$ $\frac{1}{s} \cdot m = \frac{m}{s}$



$$\Delta s = \Delta\theta \, r$$

θ is in radius.



$$a_t = \frac{d^2 s}{dt^2} = \frac{d}{dt}\underbrace{\frac{ds}{dt}}_{=v} = \frac{d}{dt} r\omega$$

$$= r\alpha$$

$$a_c = \frac{v^2}{r} = \frac{(\omega r)^2}{r} = \omega^2 r$$

10.15 Express in radians/sec.

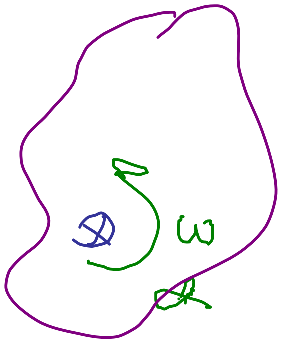
a) $720 \text{ rpm} = 720 \frac{\text{rev}}{\text{min}} \cdot \frac{1 \text{ min}}{60 \text{ s}} \cdot \frac{2\pi \text{ rad}}{1 \text{ rev}}$

$= 75.4 \text{ s}^{-1}$

b) $50°/\text{h} = 50 \frac{\text{deg}}{\text{h}} \left(\frac{1 \text{ h}}{3600 \text{ s}}\right)\left(\frac{\pi \text{ rad}}{180 \text{ deg}}\right) = 2.4 \times 10^{-4} \text{ s}^{-1}$

Ang accel's occur from torque, τ

$$\tau \Rightarrow \alpha$$



Consider constant $\underset{\sim}{\alpha}$

$$\alpha = \frac{d\omega}{dt} \qquad \omega = \alpha t + C$$

$\rightarrow$ constant

At $t = 0$ $\quad \omega = C$ = initial ang velocity $= \omega_0$

$$\frac{d\theta}{dt} = \qquad \boxed{\omega = \omega_0 + \alpha t}$$

$$v = v_0 + at$$

$$\omega = \frac{d\theta}{dt}$$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2 + C$$

C is initial angle, θ_0

$$\boxed{\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2}$$

$x = x_0 + v_0 t + \frac{1}{2} a t^2$

oftentimes, we let $\theta_0 = 0$

Can show

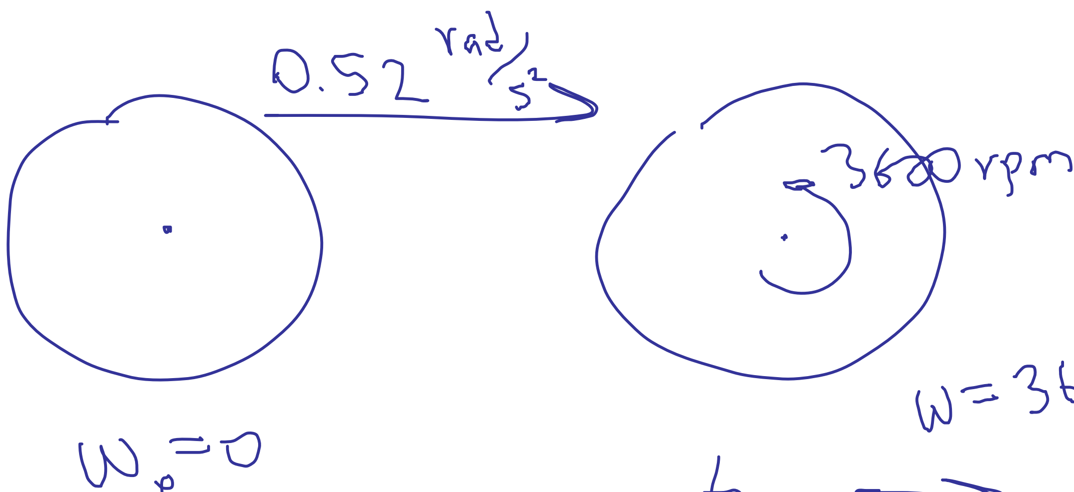
$$\boxed{\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)}$$

$$\boxed{\theta = \theta_0 + \frac{1}{2}(\omega + \omega_0)t}$$

10.18 During startup a power plant's turbine acc's from rest at $0.52\ \mathrm{rad/s^2}$.

a) How long does it take it to reach 3600 rpm op'ing speed?

b) How many rev's it make?



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

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

$$\omega = 3600\ \frac{\text{rev}}{\text{min}} \cdot \frac{2\pi\ \text{rad}}{1\ \text{rev}} \cdot \frac{1\ \text{min}}{60\ \text{sec}}$$ Do it.

$$t \longrightarrow \Delta t = 12\ \text{min.}$$

How many rev's

$$\theta = \cancel{\omega_0 t} + \frac{1}{2}\alpha t^2$$

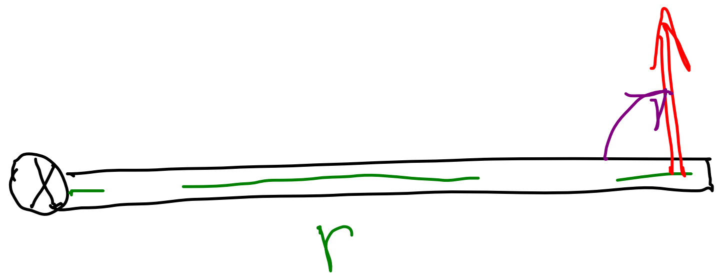
$$\omega_0 \to 0$$

$$\theta = \frac{1}{2}\left(0.52\,\frac{\text{rad}}{\text{s}^2}\right)(770\,\text{s})^2 = 1.37\times10^5\ \text{rad}$$

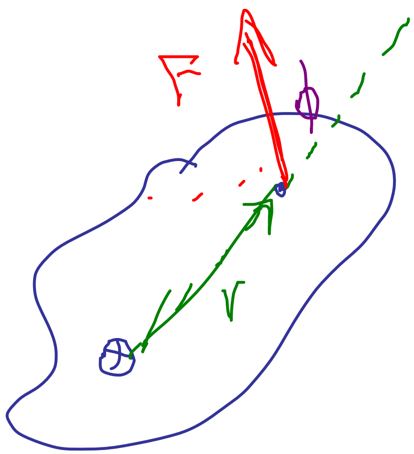
$$\#\text{rev} = (1.37\times10^5\ \text{rad})\left(\frac{1\ \text{rev}}{2\pi\ \text{rad}}\right) = 2.17\times10^4\ \text{rev}$$

Why do we get ang. accel.?

Push on it.



$F r \sin\theta$ = torque

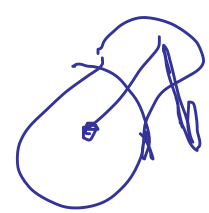


$\tau = rF\sin\phi$

sign, ($\pm$)

+ ccw

− cw



$$\tau = rF\sin\phi$$

Units?

$$[\tau] = m \cdot N = N \cdot m = J$$