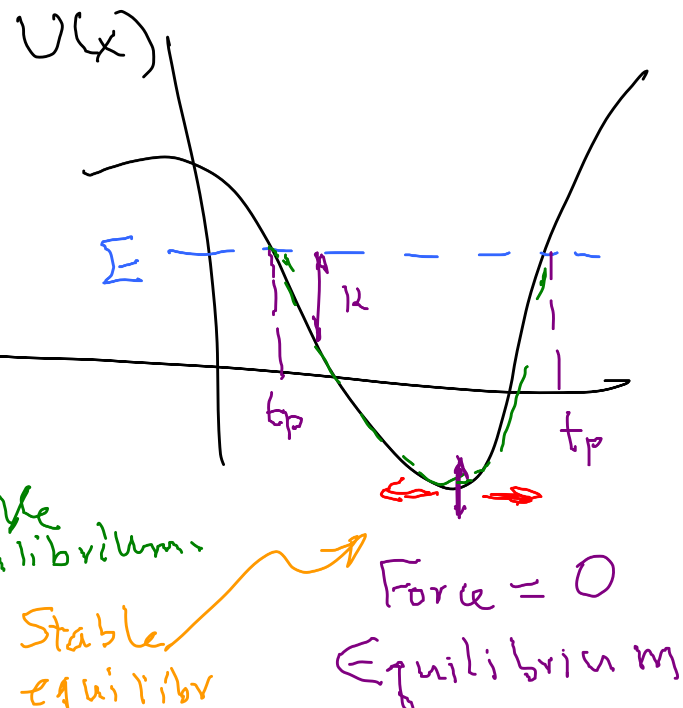
Phys 2110-4 3/14/12

Note Title 3/14/2012

Loose ends

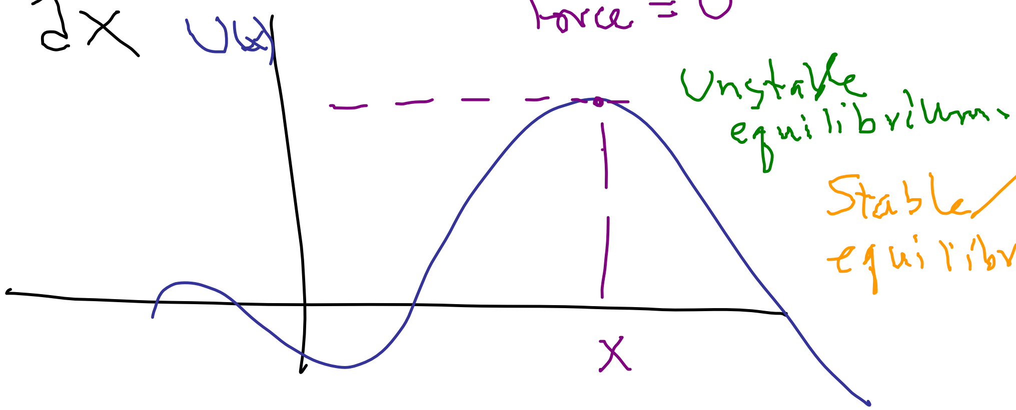
Potential energy curves

$$F_x = -\frac{dU}{dx}$$

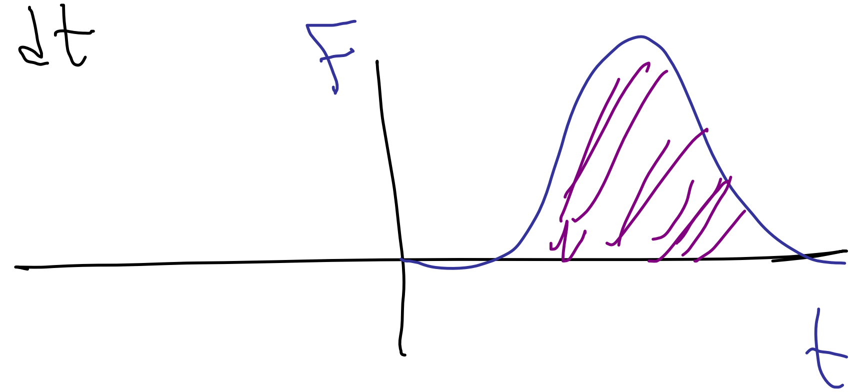


Equilibrium

Force = 0



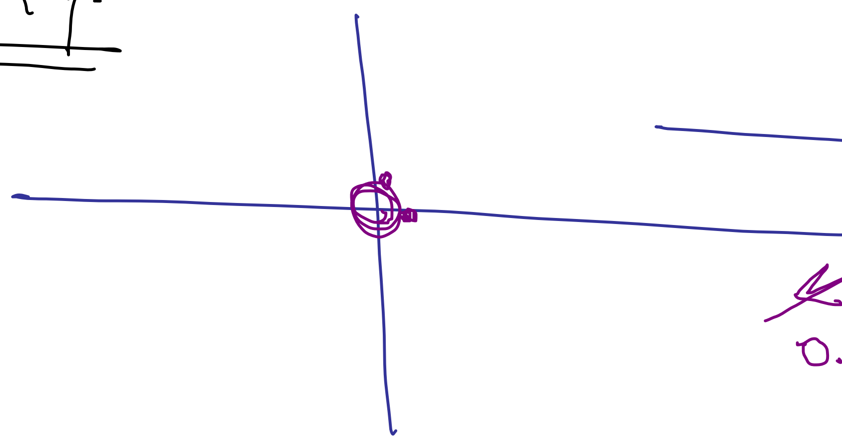
$$\vec{J} = \Delta\vec{p} = \int_{t_1}^{t_2} \vec{F}\, dt$$

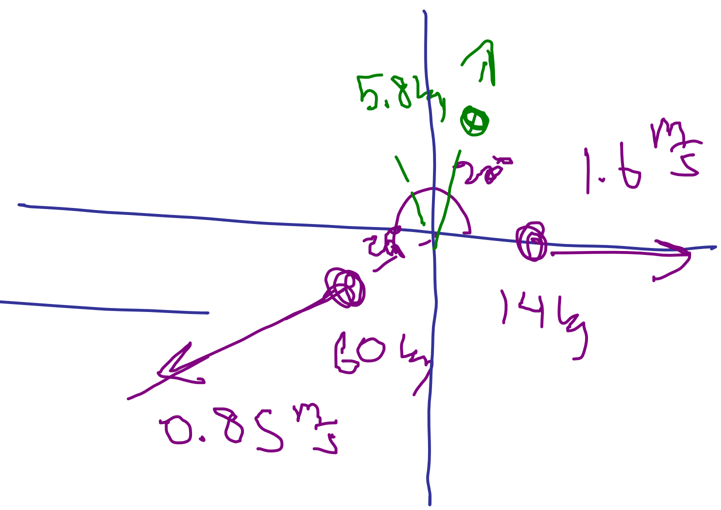


Average force

$$\Delta\vec{p} / \Delta t = \vec{F}_{average}$$

9.51 60 kg astronaut simultaneously tosses away 14 kg tank 5.8 kg camera. Tank moves in x dir at 1.6 m/s. Astronaut recoils at 0.85 m/s in dir 200° ccw from x-axis. Find camera's velocity.





$$\vec{p} = 0$$

x: $(60\,kg)(0.85\,\tfrac{m}{s})(\cos 200^\circ) + (14\,kg)(1.6\,\tfrac{m}{s})$

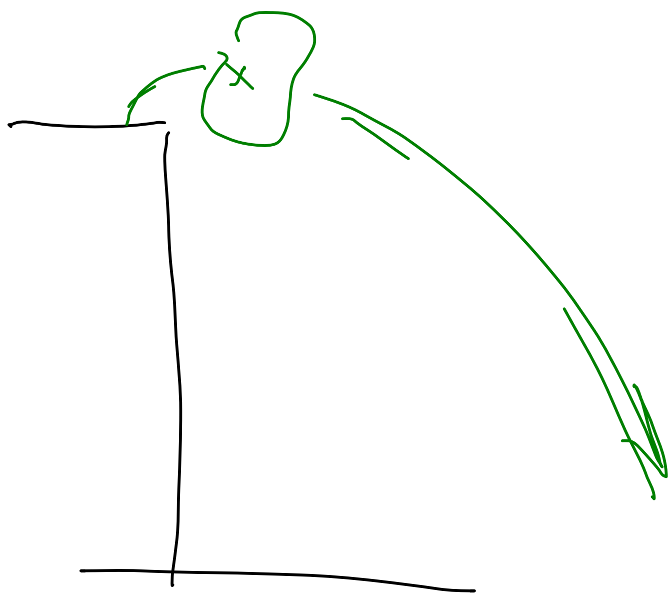
$+ (5.8\,kg)\,v_x = 0$

y: $(60\,kg)(0.85\,\tfrac{m}{s})(\sin 200^\circ) + 0$

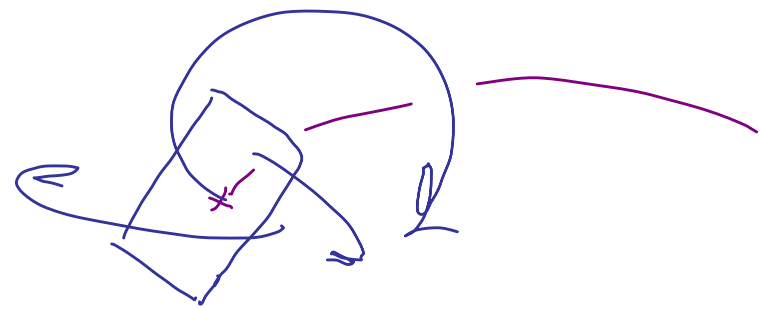
$+ (5.8\,kg)\,v_y = 0$

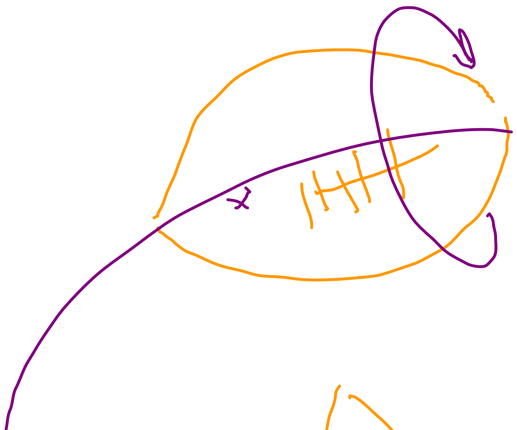
$v_{3x} = 4.4\,\tfrac{m}{s}$ $\qquad$ $v_{3y} = 3.0\,\tfrac{m}{s}$

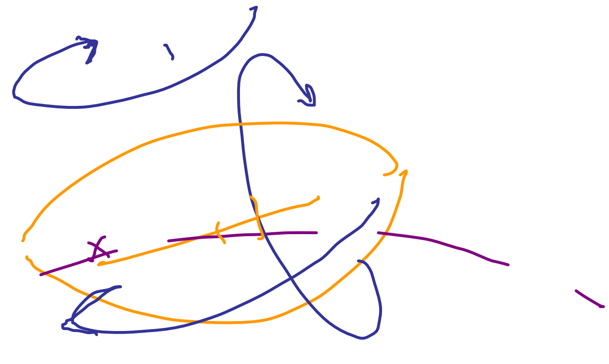
Chap 10 Rotational Motion

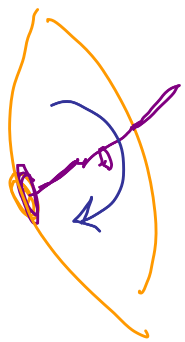


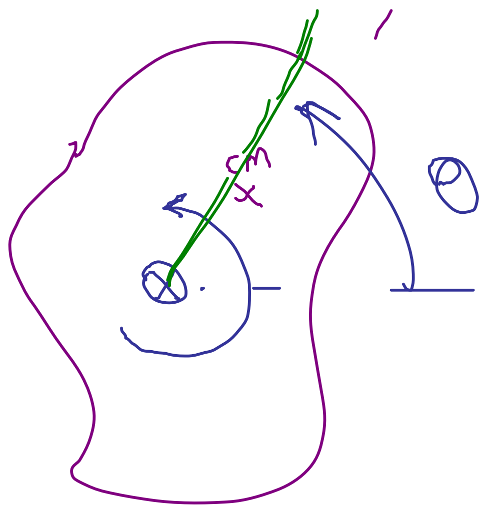
Rigid bodies







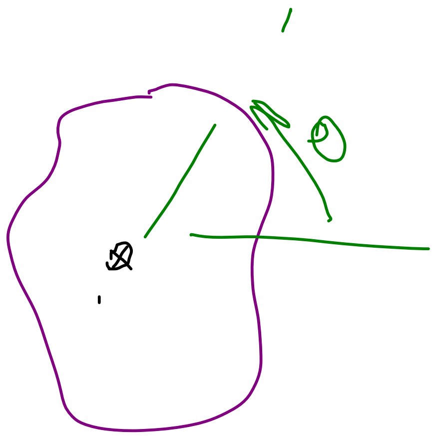




Motion:

Position given by angle.

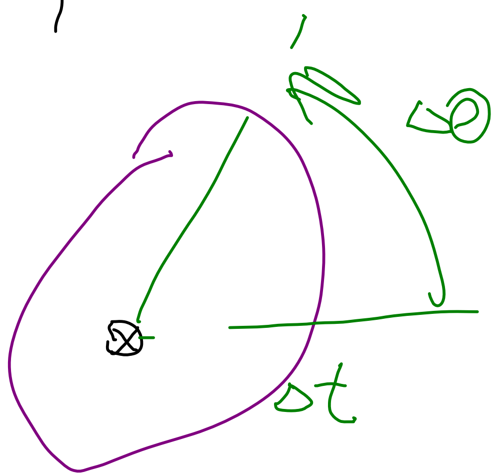
θ



$\theta(t)$

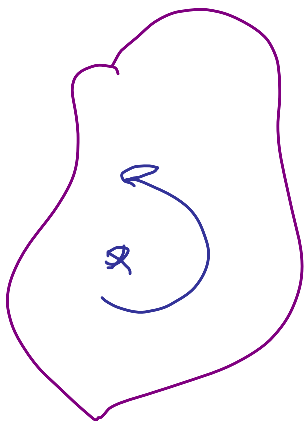
Angles : Radians

$180\,\text{deg} = 180^\circ = \pi\,(\text{radians})$



$\omega_{avg} = \dfrac{\Delta\theta}{\Delta t}$ $\qquad$ rad/s $\qquad$ 1/s

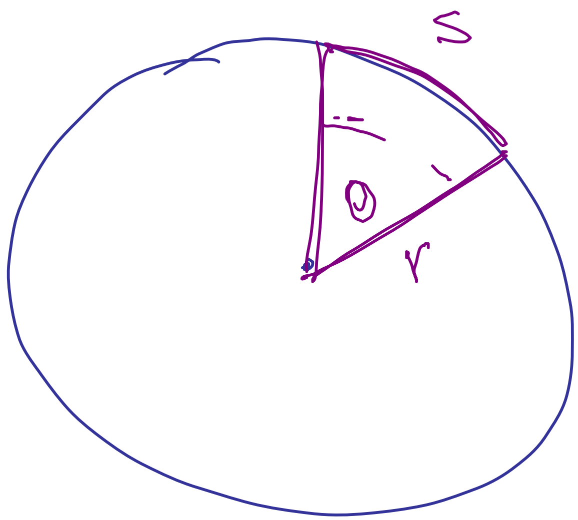
omega



$\theta(t)$

$\omega = \frac{d\theta}{dt}$ Inst. ang. velocity

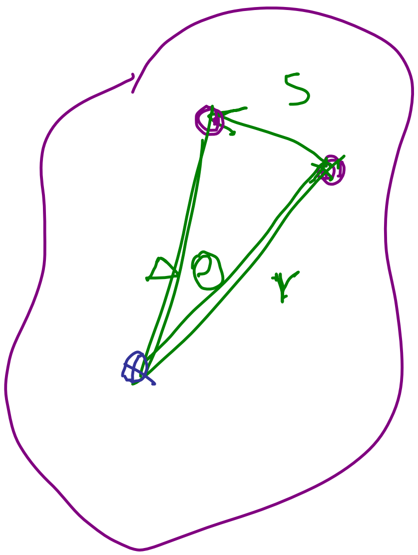
rad/s



$s = r\theta$

m m (rad)

Only when θ is in radians!!

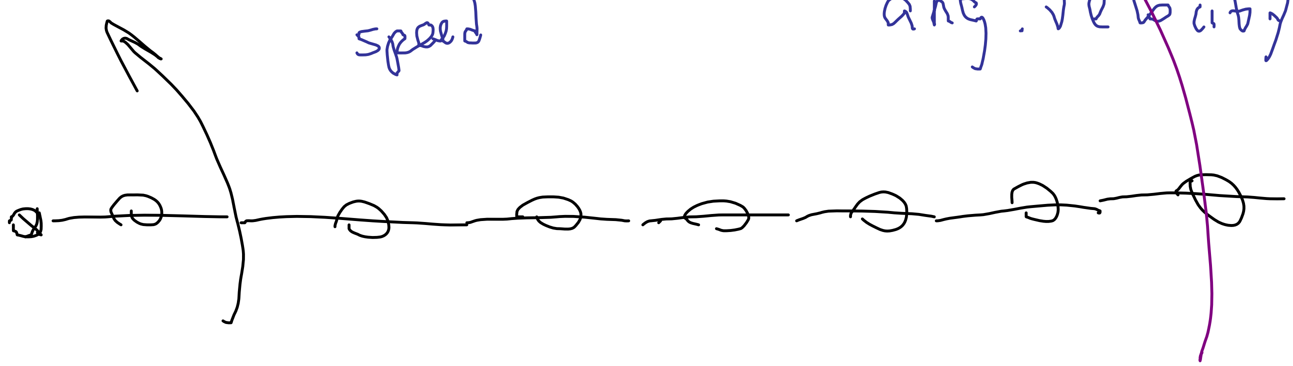


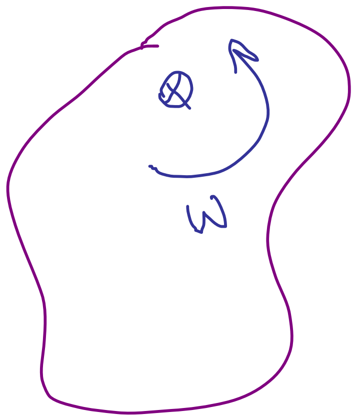
$$v = \frac{s}{\Delta t} = \frac{r\,\Delta\theta}{\Delta t} = r\omega$$

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

speed

ang. velocity





$\omega(t)$

$$\frac{\text{rad}/\text{s}}{\text{s}}$$

$$\alpha_{avg} = \frac{\Delta\omega}{\Delta t}$$

average angular acceleration

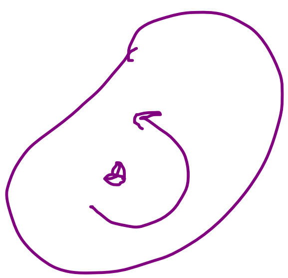
rad/s^2

$\Delta\omega / \Delta t$

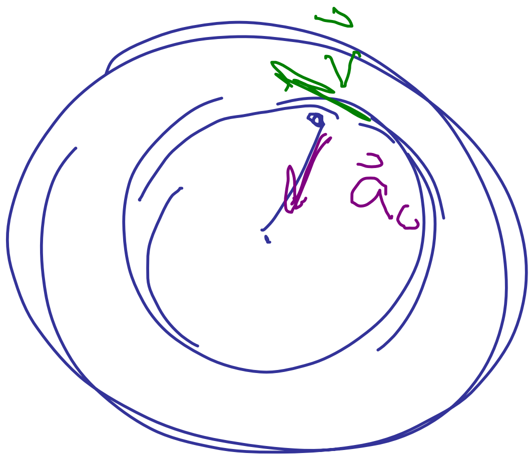
$\Delta t \to 0$

instan. ang. accel.

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



θ, ω, α can all be neg!



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

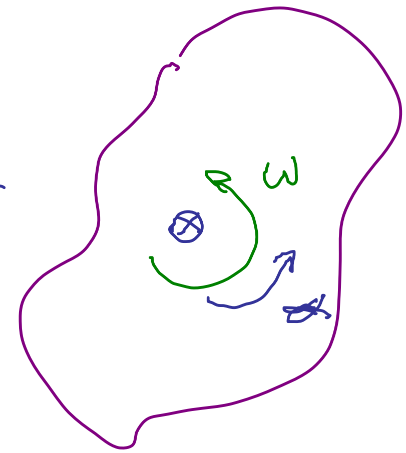
$$= \omega^2 r$$

$$a_t = \frac{dv}{dt} = \frac{d(\omega r)}{dt} = r\frac{d\omega}{dt} = r\alpha$$

Consider simple case

$$\alpha = \text{constant} \qquad \Big\| \quad a = \text{const}$$

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



$$\omega = \omega_0 + \alpha t \qquad\qquad v = v_0 + at$$

initial ang. velocity

ang accel

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

$$\boxed{\omega = \omega_0 + \alpha t}$$

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

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

Eqn have same form !!

initial angle.

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

$v^2 = v_0^2 + 2a(x - x_0)$