My notes for Exam 2 Review — Phys 10 Kintner — F'19

Work, W

- scalar
- units Joules, $J = Nm$

Best def: $W \equiv \int \vec{F} \cdot d\vec{r}$

if $\vec{F}$ is const ← (not springs, not univ grav)

$W = \vec{F} \cdot \Delta\vec{r}$

↑ book uses $\vec{d}$

$W = F d \cos\theta = F_{\parallel} d$

Conservative forces ≡ those for which work done by the force is path ind.

ex: gravity (both forms)
spring force

Work - Kinetic Energy Thm

$$W_{net} = \Delta KE$$

$$KE \equiv \frac{1}{2} m v^2$$

- scalar
- units, J

[later also $KE_{rot} = \frac{1}{2} I \omega^2$]

Potential Energy, PE

$$\Delta PE_c \equiv -W_c$$

$$PE_g = mgh$$

$$PE_s = \frac{1}{2} k x^2$$

Cons of Energy

$$E \equiv KE + PE$$

← Total mech. energy, E

Cons of E

$$E_i + W_{nc} = E_f$$

if $W_{nc} = 0$

$$E_i = E_f$$

Momentum, $\vec{p}$

$$\vec{p} \equiv m\vec{v}$$

- vector
- units $kg\frac{m}{s}$

Rewrite 2nd Law: $\Sigma \vec{F} = \frac{d\vec{p}}{dt}$

$\vec{p}$ is cons if no net, ext force

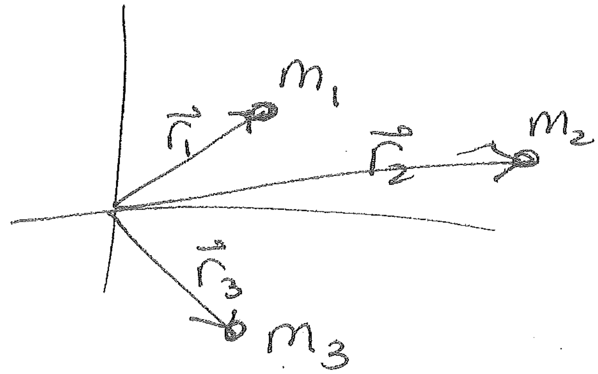
Collisions

$\vec{p}_{tot}$ is conserved (include all objects that "collide")

KE may or may not be cons.

Center of mass

$$\vec{R}_{cm} = \frac{\Sigma m_i \vec{r}_i}{\Sigma m_i}$$

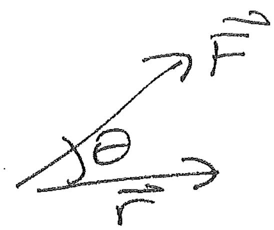


Rotational Motion

kinematics

dynamics

Torque, $\vec{\tau} \equiv \vec{r} \times \vec{F}$



·vector
units m·N

$$\boxed{\tau = rF\sin\theta}$$

$$\tau = r_\perp F$$

dir: CW or CCW is fine

(also Right Hand Rule)

Moment of Inertia & 2nd Law for Rotation

$$\sum \vec{\tau} = I \vec{\alpha}$$

where $I = \sum_i m_i r_i^2$

for point pls

I = look up on table for solid objects (given on exams)

Angular momentum, $\vec{L}$

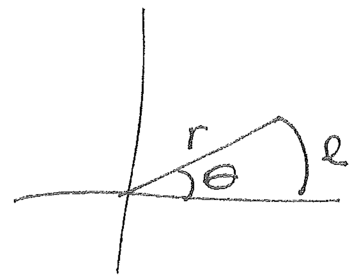
$$\vec{L} \equiv \vec{r} \times \vec{p}$$

for circ motion, $L = rmv$

$$L = rp\sin\theta$$

$$\vec{L} = I\vec{\omega}$$

Rotational kinematics



ang position, θ

arc length $l = r\theta$

- units radians
- is a vector (we use CW or CCW)

ang velocity, ω

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

- vector
- $rad/s = 1/s$

ang acceleration, α

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

- vector
- $rad/s^2 = \frac{1}{s^2}$

for const r (circ motion rot motion)

$$l = r\theta$$

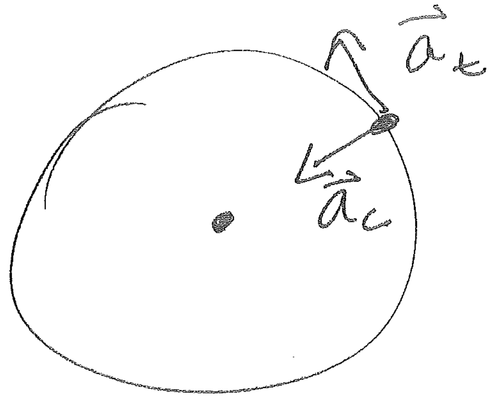
take deriv

$$v_l = r\omega$$

take deriv

$$a_l = r\alpha$$

↑ $\vec{a}$ in tangential (along arc length)



$\vec{a}$ can have a comp along motion <u>and</u> toward center.

$$a_t = r\alpha \qquad a_c = \frac{v^2}{r}$$

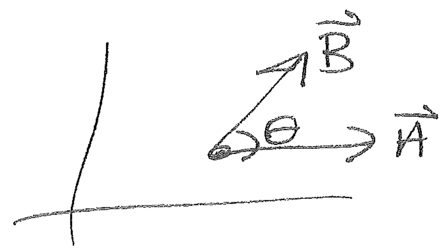
Rotational kinematic eq's (const $\vec{\alpha}$)

$$\vec{\theta} = \vec{\theta}_0 + \vec{\omega}_0 t + \frac{1}{2}\vec{\alpha} t^2$$

$$\vec{\omega} = \vec{\omega}_0 + \vec{\alpha} t$$

$$\omega^2 = \omega_0^2 + 2\vec{\alpha} \cdot \Delta\vec{\theta}$$

5. Dot prod / Scalar product



$$C = \vec{A} \cdot \vec{B}$$
$$= AB\cos\theta$$
$$= A_x B_x + A_y B_y$$

ex: Work $\quad W = \vec{F} \cdot \vec{d}$

6. Vector Product / Cross Product

$$\vec{C} = \vec{A} \times \vec{B}$$
$$|\vec{C}| = C = AB\sin\theta$$

dir of $\vec{C}$ from Right Hand Rule

ex: Torque, $\vec{\tau} = \vec{r} \times \vec{F}$

ang mom, $\vec{L} = \vec{r} \times \vec{p}$