MECHANICS SUMMARY SHEET

Represent motion of an object by $(x(t), y(t), z(t)) \longleftrightarrow \vec{r}(t)$

VELOCITY: $\quad v_x(t) = \dfrac{dx}{dt}$ (slope of $x(t)$ graph)

ACCELERATION: $\quad a_x(t) = \dfrac{dv_x}{dt}$ (slope of $v(t)$ graph)

MOMENTUM: $\quad \vec{p} = m\vec{v}$ single object

(for $|v| << $ speed of light)

$\vec{p}_{TOT} = \vec{p}_1 + \vec{p}_2 + \ldots$ collection of objects

$\vec{p}_{TOT}$ is CONSERVED for a system with no external forces

$(\vec{p}_{TOT})_{BEFORE} = (\vec{p}_{TOT})_{AFTER}$

WITH FORCES:

$$\frac{d\vec{p}}{dt} = \vec{F}_{NET} \xrightarrow{\text{equivalent to}} \vec{a} = \frac{1}{m}\vec{F}_{NET}$$

Newton's 2nd Law

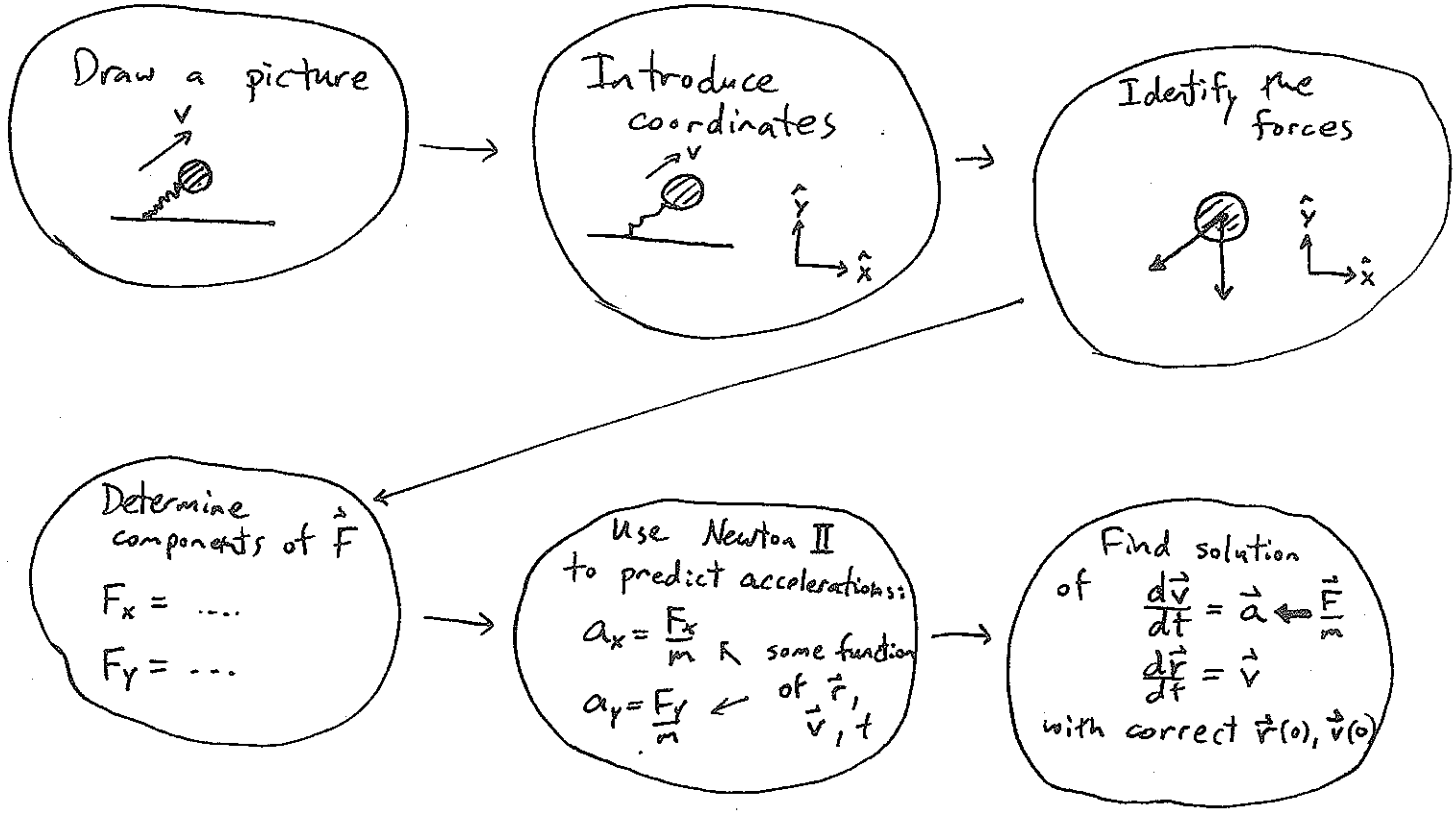
Some function of $\vec{r}$, $\vec{v}$

allows us to predict future since it tells us how fast $\vec{v}$ is changing and $\vec{v}$ tells us how fast $\vec{r}$ is changing

Newton's 3rd Law:

force of 1 on 2
=
force of 2 on 1

PREDICTING THE FUTURE:



AYS TO SOLVE:

A) Euler method: for small δt,

$$v_x(t+\delta t) \approx v_x(t) + \delta t \cdot \underbrace{a_x(t)}_{\frac{1}{m}F_x}$$

$$x(t+\delta t) \approx x(t) + \delta t \cdot v_x(t)$$

use this + repeat.

B) If $\vec{a}$ is some known function of time (e.g. const) $\frac{dv}{dt} = a(t)$ then:

$$v(t) = v(t_0) + \int_{t_0}^{t} a(t)\,dt$$

area under graph of a from t_0 to t

OR $v(t) = g(t) + C$ where g is a function whose derivative is $a(t)$.

find using initial v (i.e. plug in $t=0$)

C) Guess + check

D) Fancy Math 215 methods.

★ Same process to get from $v(t)$ to $x(t)$ as we used to get from $a(t)$ to $v(t)$