Physics 201 Review

The principal idea of this course, and all of physics is:

> ① Identify the type of problem
> ② Follow the recipe for that type of problem.

Let's build a "Table of Contents" for our recipe book!

1. Kinematics
   - 1.1 Basic Ideas
   - 1.2 1D Motion

1.3 2D Motion

1.3.1 Projectile Motion

1.3.2 Relative motion

1.3.3 Uniform Circular Motion

2. Dynamics

2.1 Basic Ideas / Newton's Laws

2.2 Single Object (Newton's 2nd Law)

2.3 Multiple Objects (Newton's 3rd Law)

3. Energy and Momentum.

3.1 Basic Ideas

3.2 Work - Energy Theorem.

[illegible] Momentum /

3.3 Conservation of [illegible]
Collisions

4. Rotational Motion.
4.1 Moment of Inertia
4.2 Kinematics
4.3 Dynamics / Torque

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1. Kinematics.

1.1 Basic ideas.

$\vec{x}(t)$ - position ?
$\vec{v}(t)$ - how fast?
$\vec{a}(t)$ - how is $\vec{v}$ changing.

} VECTOR

$$\vec{v} = \frac{d\vec{x}}{dt} \qquad \vec{a} = \frac{d\vec{v}}{dt}$$

INSTANTANEOUS

$\Delta\vec{x}$ → displacement

$\equiv \vec{x}(t_f) - \vec{x}(t_i)$

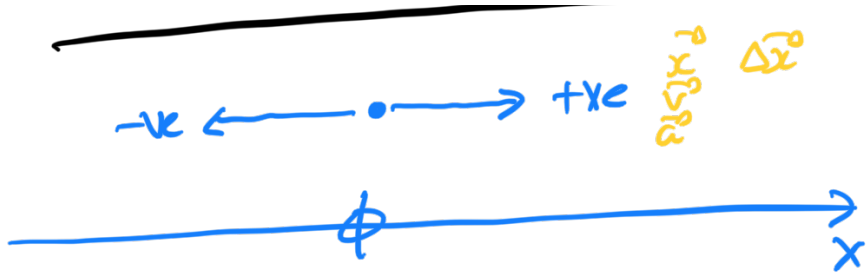
$$\vec{v}_{avg} \equiv \frac{\Delta\vec{x}}{\Delta t} = \frac{\vec{x}_f - \vec{x}_i}{t_f - t_i}$$

$$S_{avg} \equiv \frac{\text{Total Distance}}{\text{Total time}}$$

INTERVAL

1.2 1D Motion.

Motion in 1D with constant acceleration



v_f
v_i
a
t
Δx

① $v_f = v_i + at$

② $\Delta x = v_i t + \frac{1}{2} a t^2$

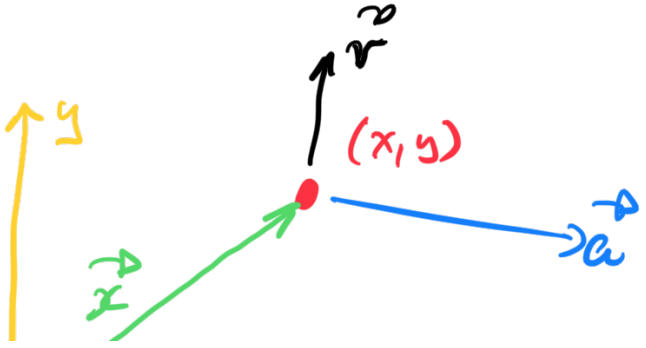
③ $\Delta x = v_f t - \frac{1}{2} a t^2$

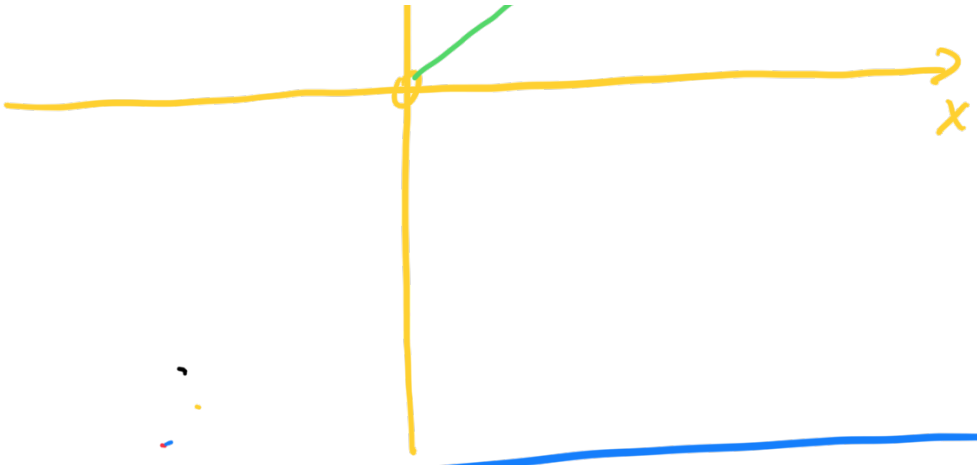
④ $\Delta x = \left(\frac{v_f + v_i}{2}\right) t$

⑤ $v_f^2 = v_i^2 + 2a\Delta x$

RULE OF THREE

1.3 2D Motion (3D Motion)





BREAK APART THE
X- and Y- motions

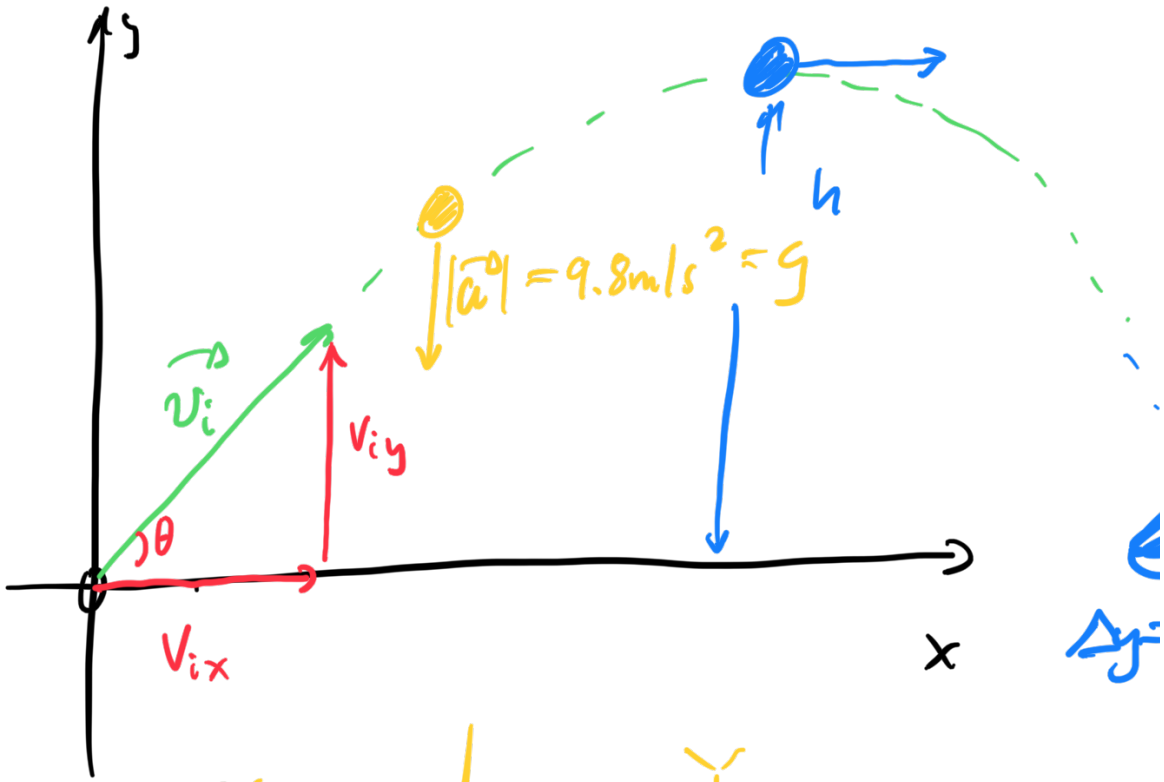
→ trig. SOHCAHTOA

X	Y
Δx	Δy
v_{ix}	v_{iy}
v_{fx}	v_{fy}
a_x	a_y
t	t

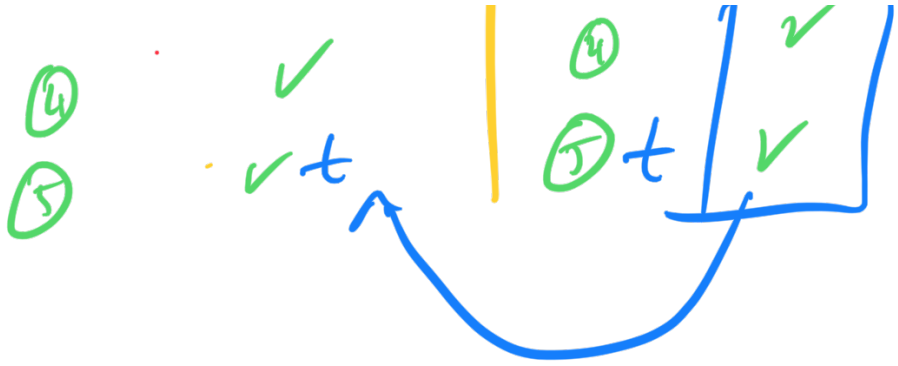
SAME

→ See section 1.2 !

1.3.1 Projectile Motion



X	Y
① $a_x = 0$	① $a_y = -g$
② $v_{ix} = v_i \cos\theta$	② $v_{iy} = v_i \sin\theta$
③ ?	③ $v_{fy} = 0$



1.3.2 Relative Motion

IDENTIFY

→ three reference frames.

→ (boat, shore, water)

(plane, air, ground)

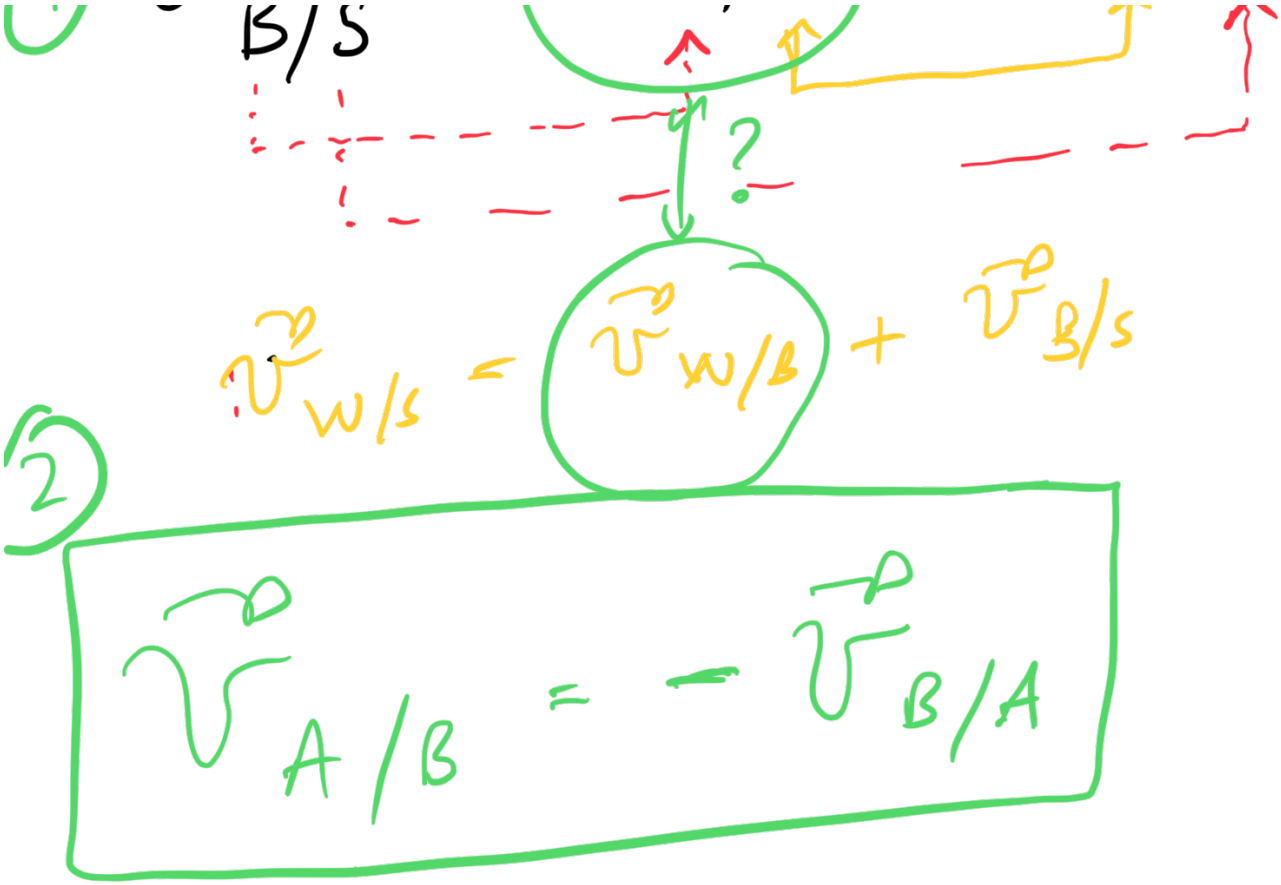
(rain, car, ground)

⋮

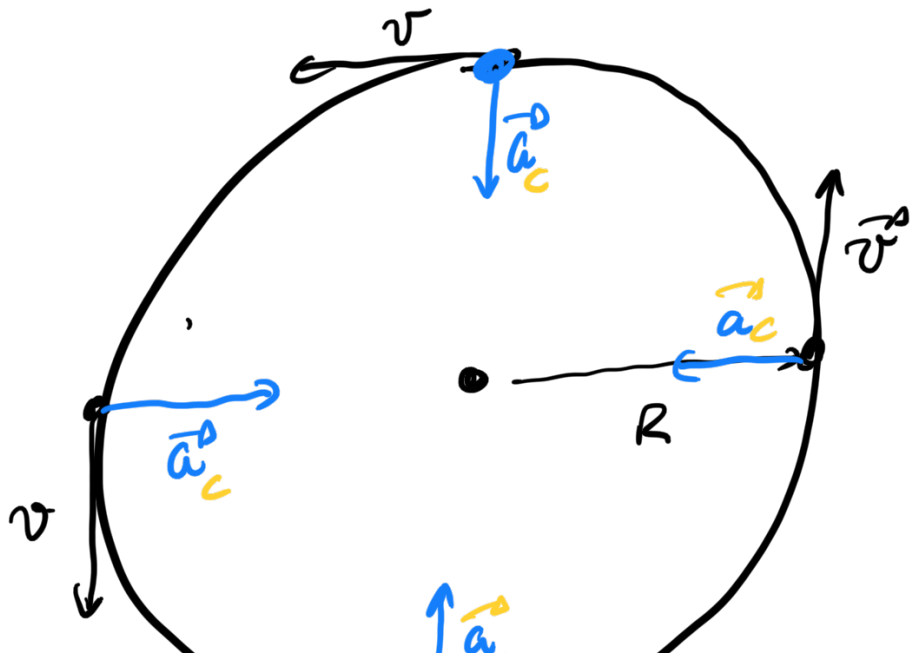
BOAT, SHORE, WATER

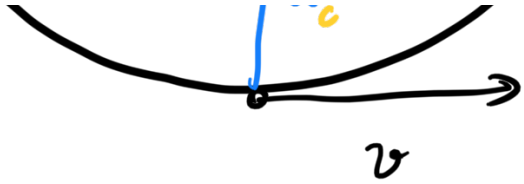
(B) (S) (W)

$$\vec{v}_{B/S} = \vec{v}_{B/W} + \vec{v}_{W/S}$$



1.3.3 Uniform Circular Motion.





→ acceleration is directed to the centre of the circle!

$$|\vec{a}_c| = \frac{v^2}{R}$$

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2. Dynamics

2.1 Basic Ideas

N2L

$$\sum_i \vec{F}_i = \vec{F}_{NET} = m\vec{a}$$

S.I. Object

2.2

① Identify all forces! (external)

→ gravity

→ contact forces

FBD (normal force, friction, tension, ...

② Choose a coordinate system!

· such that $a_y = 0$, $a_x = a$

③ Break all forces down into x- and y- components.

④ $\sum F_x = ma_x$ $\quad \sum F_y = ma_y = 0$

⋮

Solve.

2.3 Multiple Objects