Phys 2110 - 4   1/30/13

Note Title   1/30/2013

2D Motion

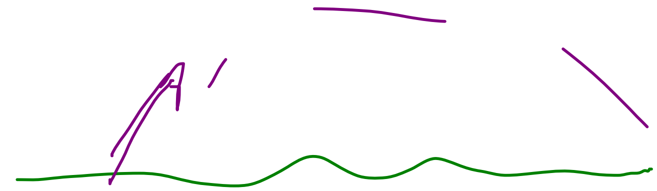
But first...

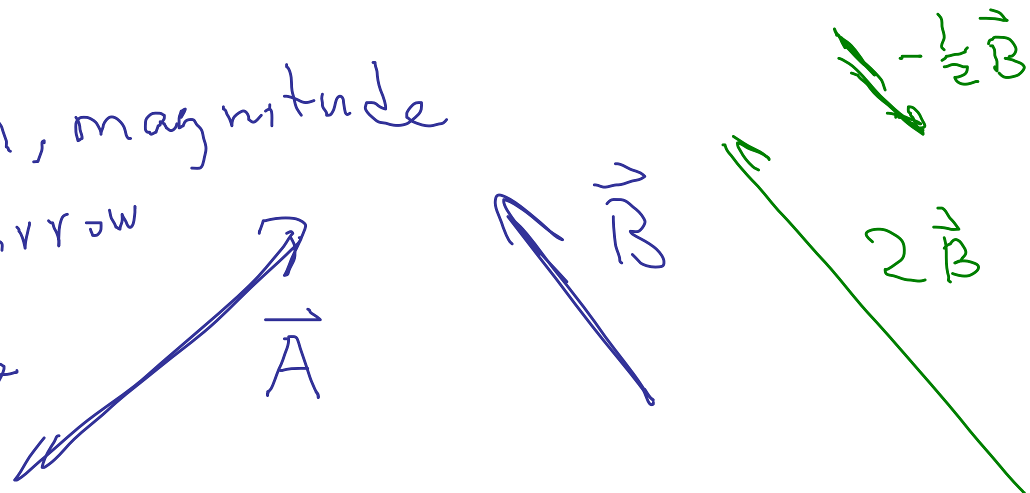
Vectors

Direction, magnitude

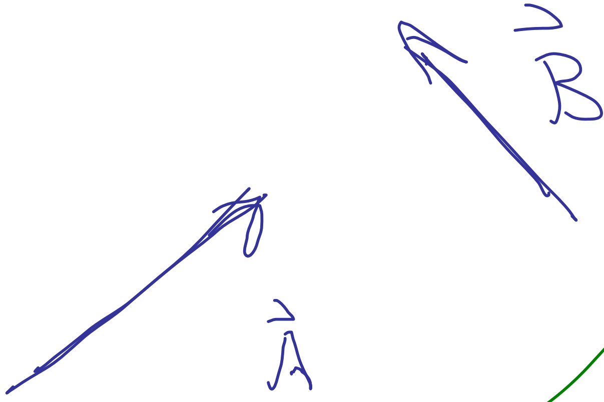
Repr'd by arrow

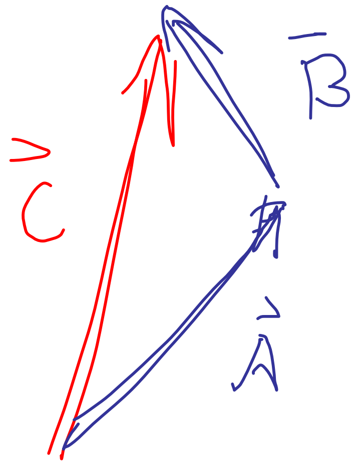
Dir & magnitude



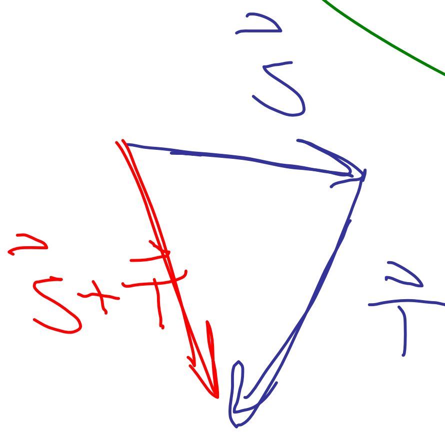


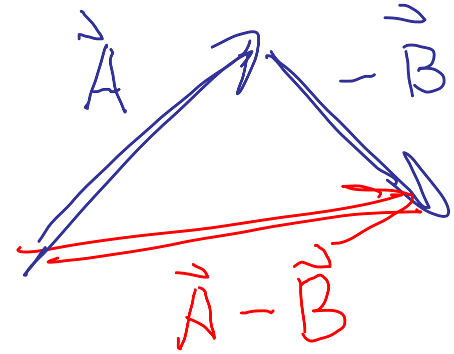
Adding vectors   adding arrows



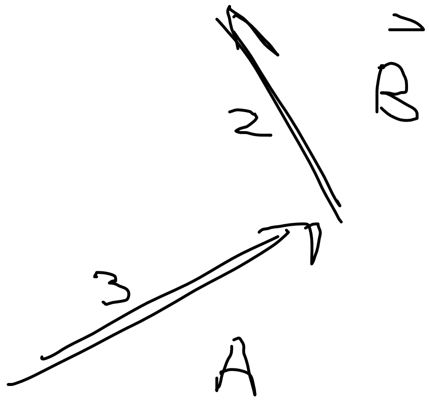


$$\vec{C} = \vec{A} + \vec{B}$$



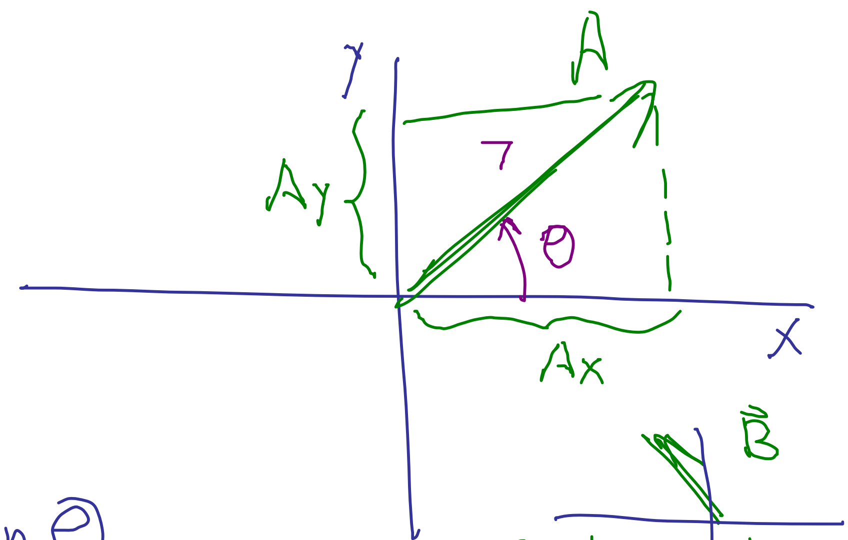


"Adding vectors graphically"



Tell me the magnitude of $\vec{A}+\vec{B}$

Not 5



Use components

Direction, magnitude

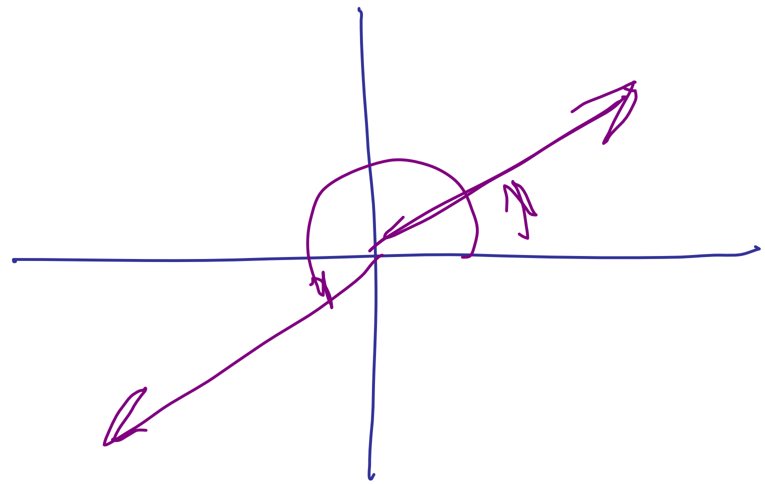
θ , A

$A_x = A\cos\theta$ $A_y = A\sin\theta$

B_x is negative
B_y is positive

$$A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = \frac{A_y}{A_x}$$

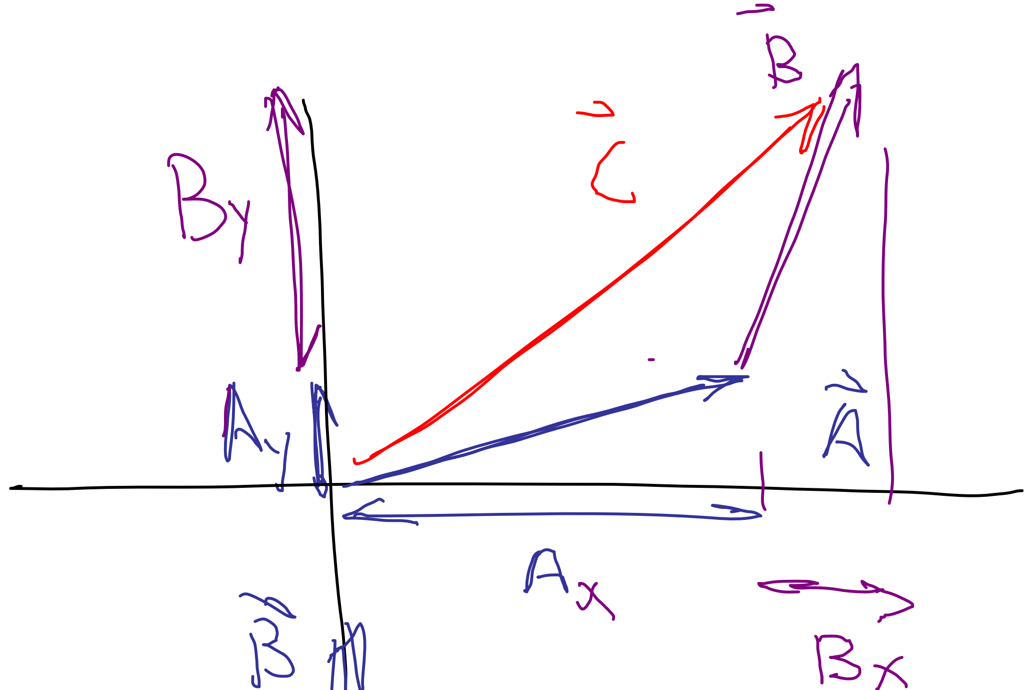
$$\underbrace{\theta = \tan^{-1}\left(A_y/A_x\right)}_{\text{can give wrong answer}}$$



$$\theta = \tan^{-1}\left(A_y/A_x\right) + \text{Brain}$$

Add vectors, find components of vectors

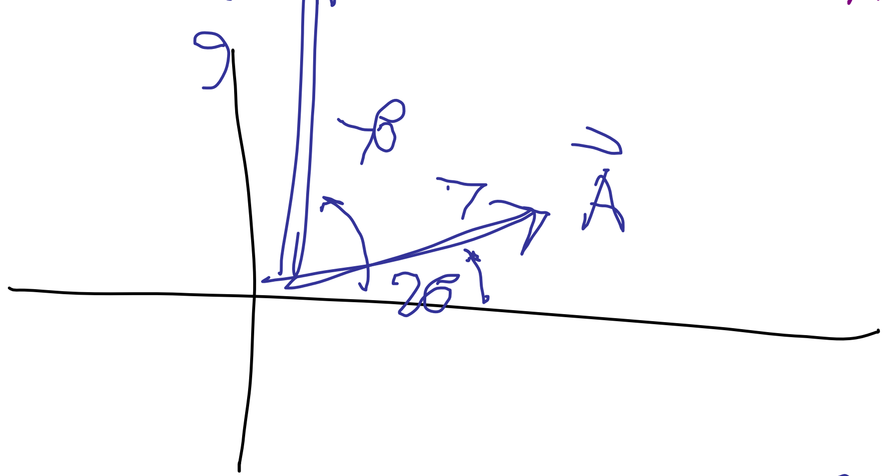
Add components separately.



$C_x = A_x + B_x$

$C_y = A_y + B_y$

& use this to find dir & mag of $\vec{C}$



Find $\vec{A} + \vec{B}$. $A_x = 7\cos 20°$

$A_y = 7\sin 20°$

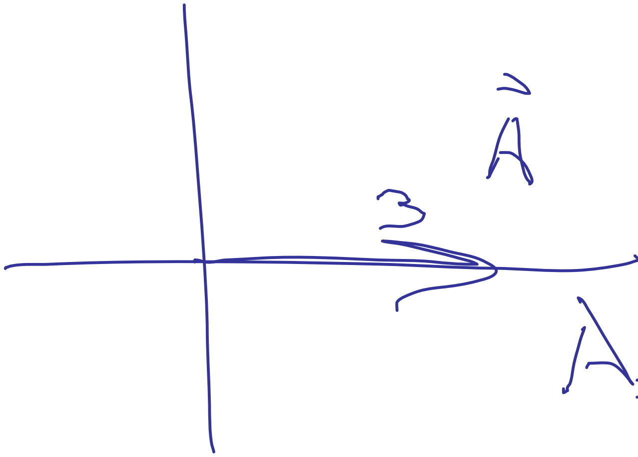
$\Longrightarrow A_x, B_x$

A_y, B_y

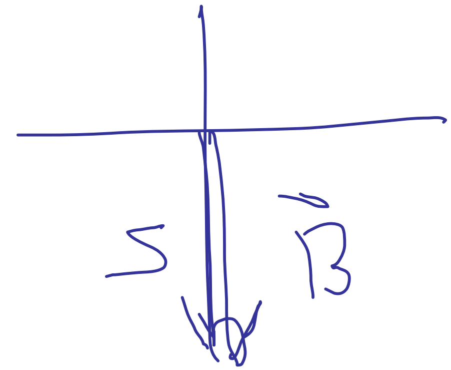
;

C, θ

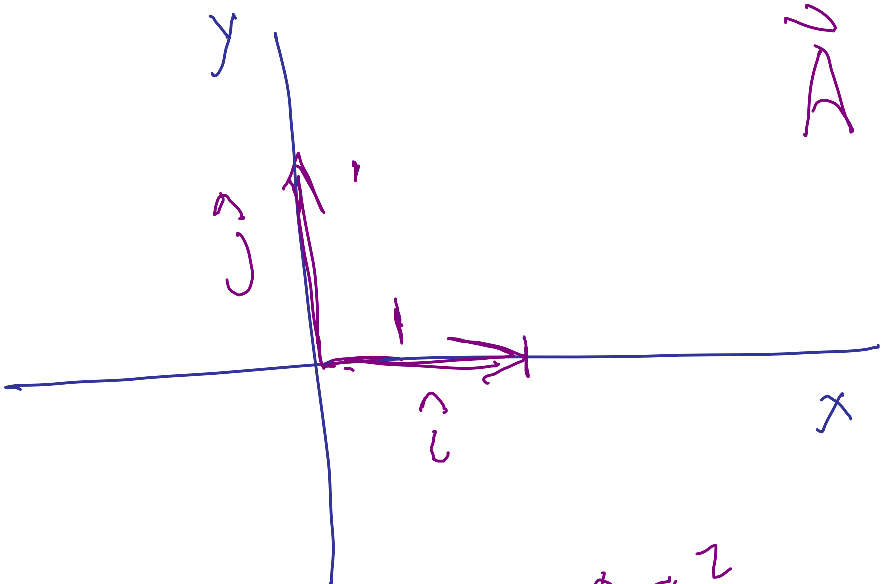
$C_x = A_x + B_x \quad C_y = A_y + B_y$



$A_x = 3 \quad A_y = 0$



$B_x = 0 \quad B_y = -5$



$\vec{A} \qquad A_x, A_y$

$\vec{A} = A_x\hat{i} + A_y\hat{j}$

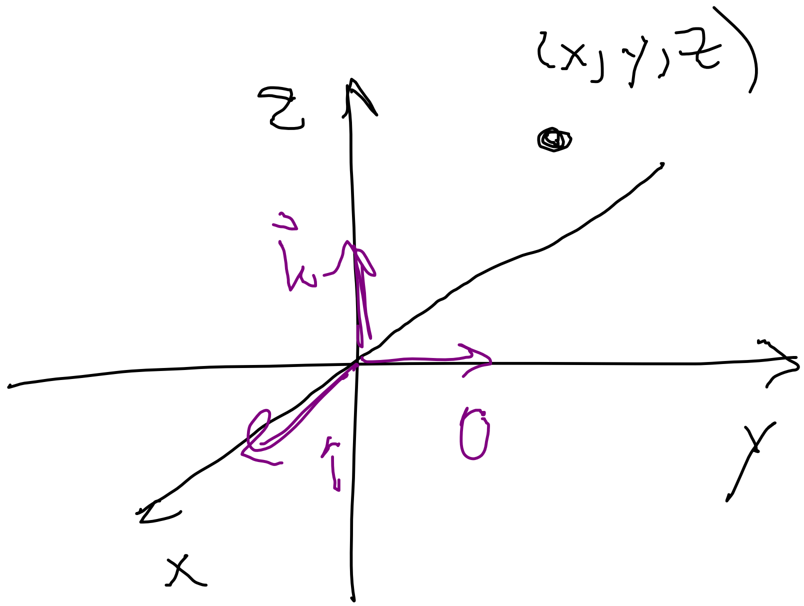
$= (2, 3)$

$A_x = 2$

$A_y = 3$

$\vec{A} = 2\hat{i} + 3\hat{j}$

3-Dimensions



Motion in 2D

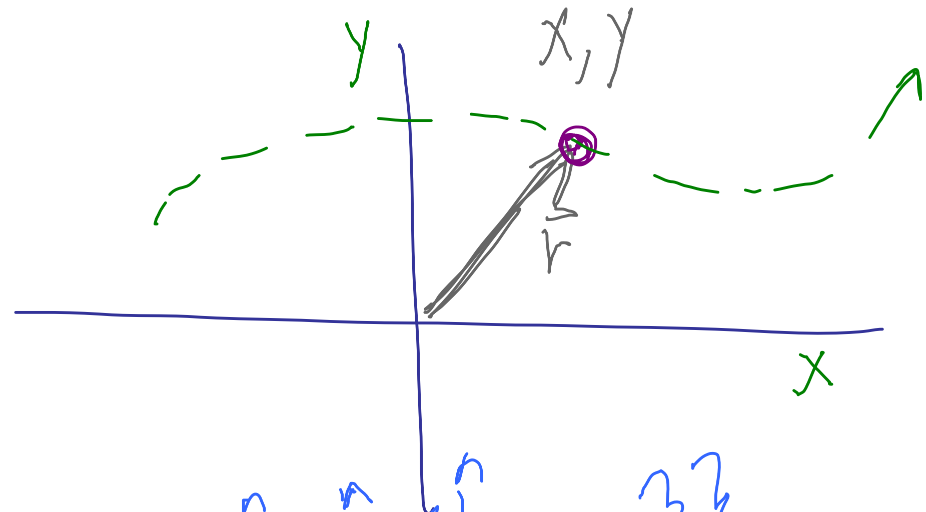
$$\vec{r} = x\hat{i} + y\hat{j}$$

Spring Attractions

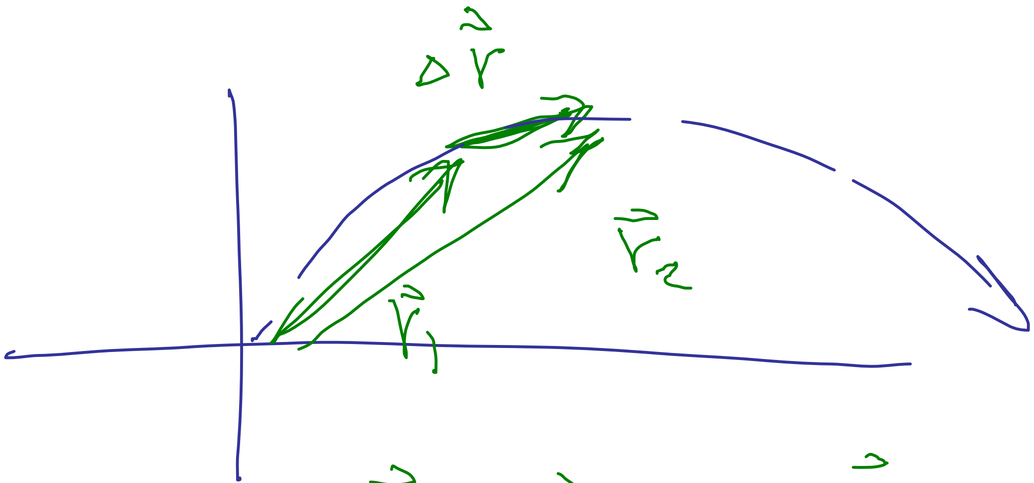
Dot Product

Cross Product

"small" particle.



$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ p. 33



How rapidly does position change?

<u>velocity!</u>

$$\vec{r}_2 - \vec{r}_1 = \Delta \vec{r}$$

$$\bar{\vec{v}} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\Delta x \hat{i} + \Delta y \hat{j}}{\Delta t}$$

$$= \left(\frac{\Delta x}{\Delta t}\right)\hat{i} + \left(\frac{\Delta y}{\Delta t}\right)\hat{j} = \bar{v}_x \hat{i} + \bar{v}_y \hat{j}$$

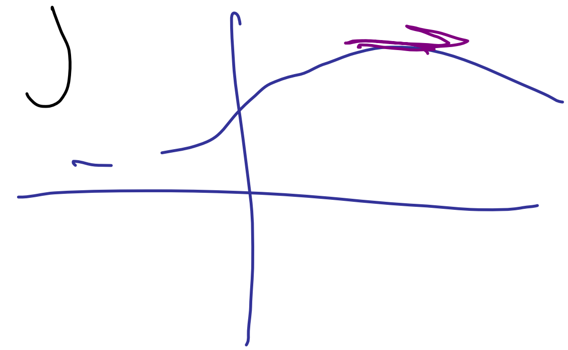
Instantaneous velocity.

$\Delta t \rightarrow$ verrrrrry small

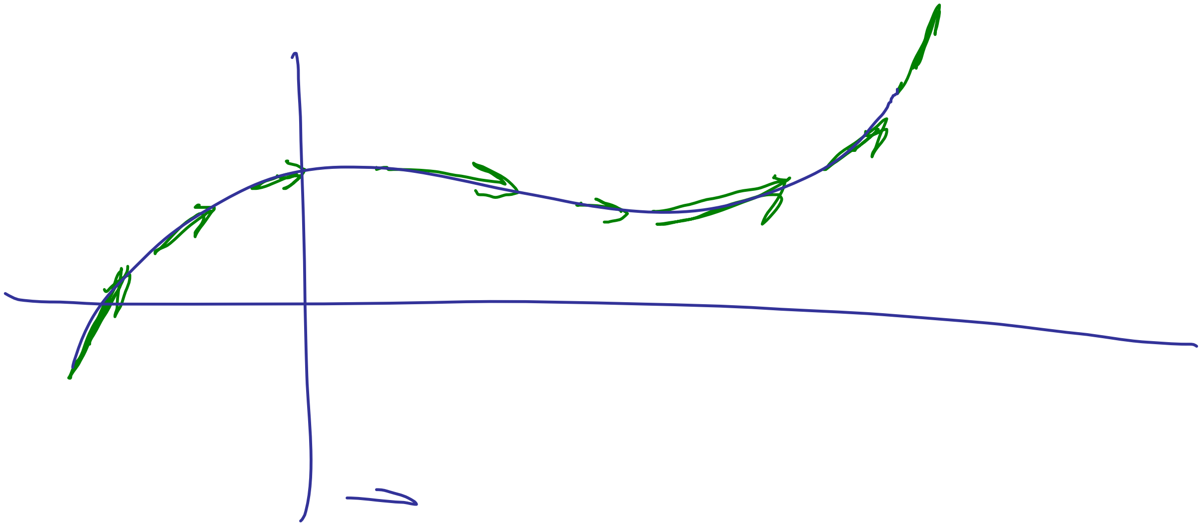
$$\lim_{\Delta t \to 0}$$

$$\vec{V} = \lim_{\Delta t \to 0} \frac{\Delta r}{\Delta t} = \left(\frac{dx}{dt}\right)\hat{i} + \left(\frac{dy}{dt}\right)\hat{j}$$

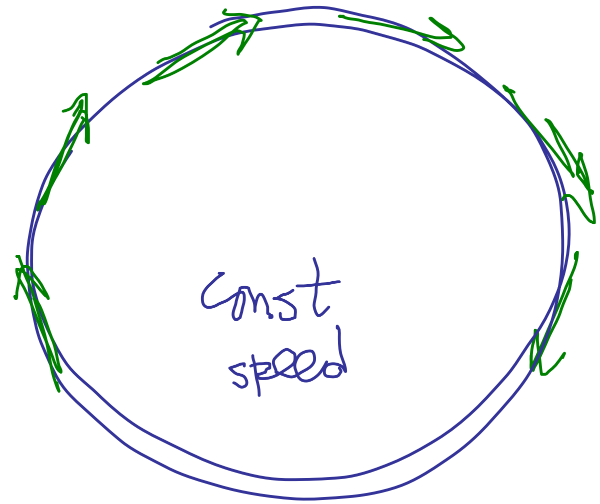
$$= V_x \hat{i} + V_y \hat{j}$$



$$V_x = \frac{dx}{dt} \qquad V_y = \frac{dy}{dt}$$

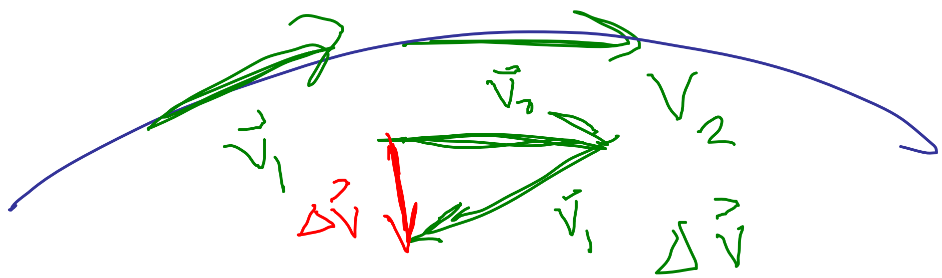


$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$



Velocity is changing

$\Delta \vec{v} \Rightarrow \vec{a}$ points inward



Velocity vector changes. $\longrightarrow$ Acceleration

$$\vec{a} = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$

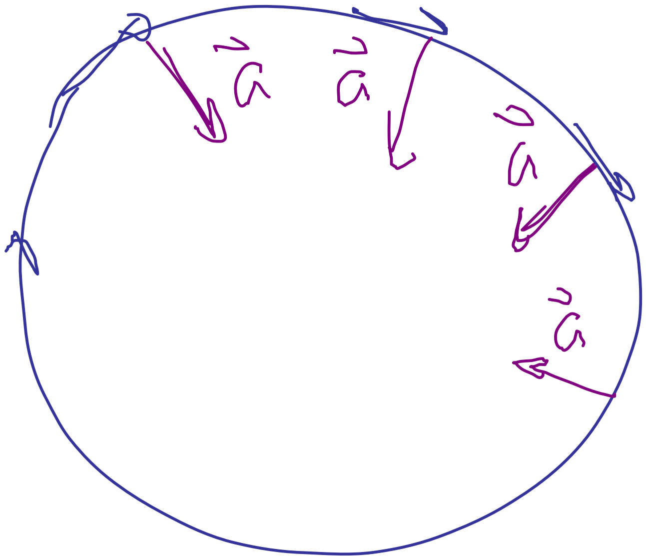
p. 33

$$\boxed{\vec{v} = \frac{d\vec{r}}{dt}}$$

$$= \frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j}$$

$$= a_x\hat{i} + a_y\hat{j}$$

$$\boxed{a_x = \frac{dv_x}{dt} \quad a_y = \frac{dv_y}{dt}}$$



Not constant acceleration.

$$v_x = \frac{dx}{dt} \qquad \frac{m}{s}$$

$$a_x = \frac{dv_x}{dt} \qquad \frac{m}{s^2}$$