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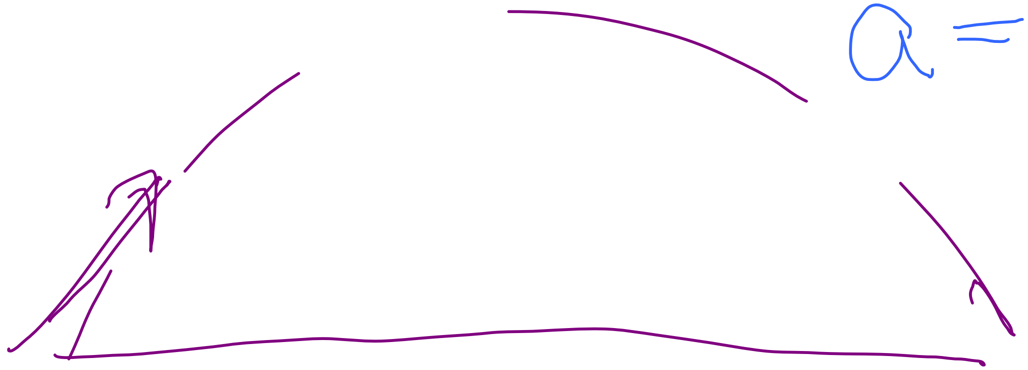

$\vec{a} = \left(0, -9.8\frac{m}{s^2} \right)$

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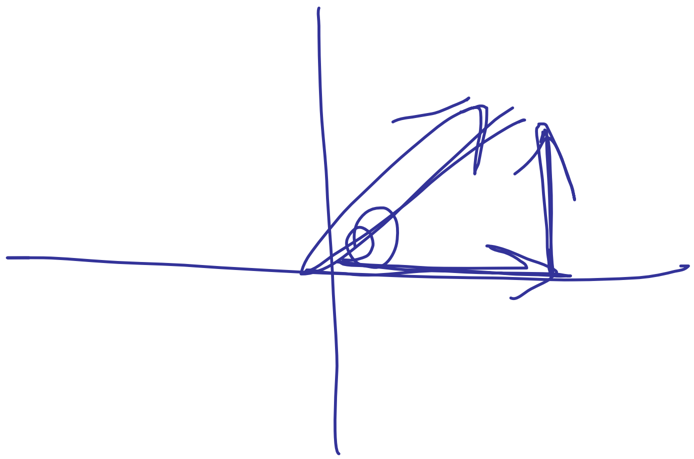
$v = \sqrt{v_x^2 + v_y^2} = 2.63 \frac{m}{s}$

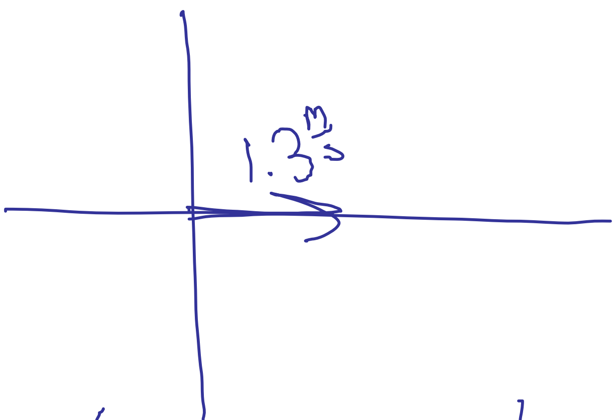
speed

$\theta = 60.4°$



3.25 An object is moving in the x-direction at $1.3\,\frac{m}{s}$ when it undergoes accel $\vec{a} = 0.52\,\hat{j}\,\frac{m}{s^2}$

Find velocity vector at 4.4 s.



$V_{x0} = 1.3\,\frac{m}{s}$ $\qquad V_{y0} = 0$

$a_x = 0$ $\qquad a_y = 0.52\,\frac{m}{s^2}$

$V_x = V_{x0} + a_x t = 1.3\,\frac{m}{s}$ $\qquad V_y = \overset{=0}{V_{y0}} + a_y t$

$\qquad\qquad = 2.29\,\frac{m}{s}$

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Special case

Constant acceleration

$a_x = \text{constant}$

$a_y = \text{constant}$

$$a_x = \frac{dv_x}{dt}$$

$$\boxed{v_x = a_x t + C = v_{x0} + a_x t}$$

$$a_y = \frac{dv_y}{dt}$$

$$\boxed{v_y = a_y t + C = v_{y0} + a_y t}$$

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3.30 Position of object is

$$\vec{r} = (3.2t + 1.8t^2)\hat{i} + (1.7t - 2.4t^2)\hat{j}$$

$$\vec{v} = (3.2 + 3.6t)\hat{i} + (1.7 - 4.8t)\hat{j} \quad \text{m}, \ t \text{ in sec.}$$

$$\vec{a} = 3.6\hat{i} - 4.8\hat{j}$$

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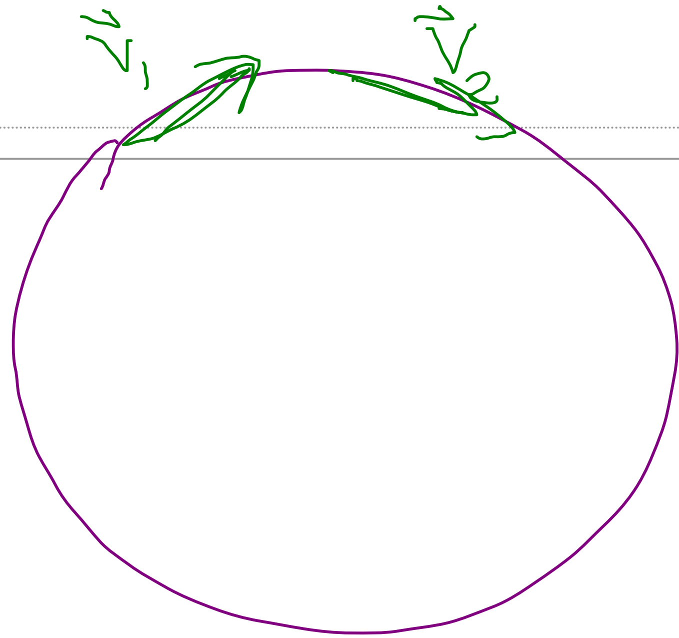
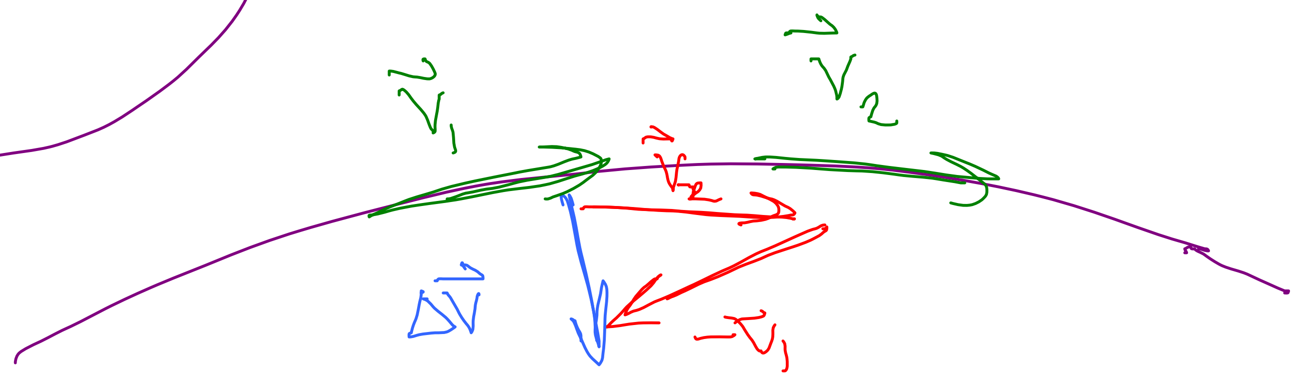


$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$



Uniform circular motion

Acceleration is inward.

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$$\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\Delta v_x}{\Delta t}\hat{i} + \frac{\Delta v_y}{\Delta t}\hat{j}$$

Instantaneous accel

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j}$$

$$a_x = \frac{dv_x}{dt} \qquad a_y = \frac{dv_y}{dt}$$

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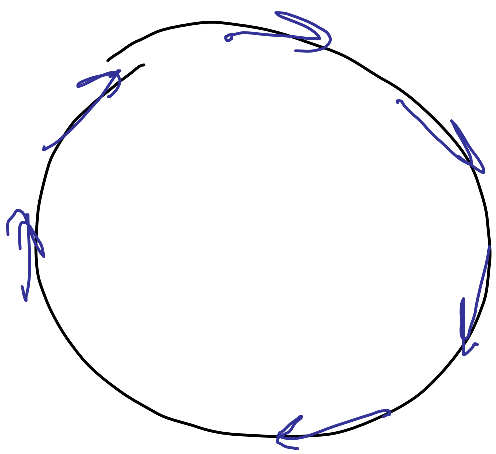
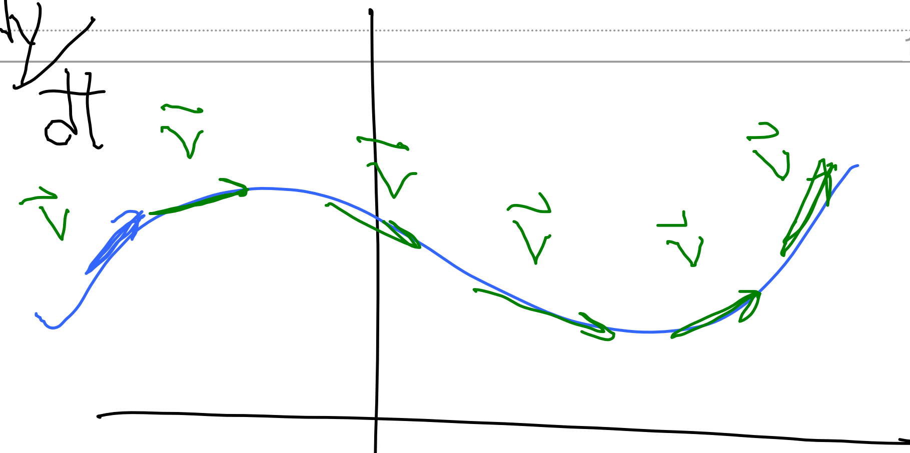
$$v_x = \frac{dx}{dt} \qquad v_y = \frac{dy}{dt}$$





$\vec{v}$ not constant

speed $= |\vec{v}|$

Acceleration

How fast is velocity vector changing? $\vec{a}$

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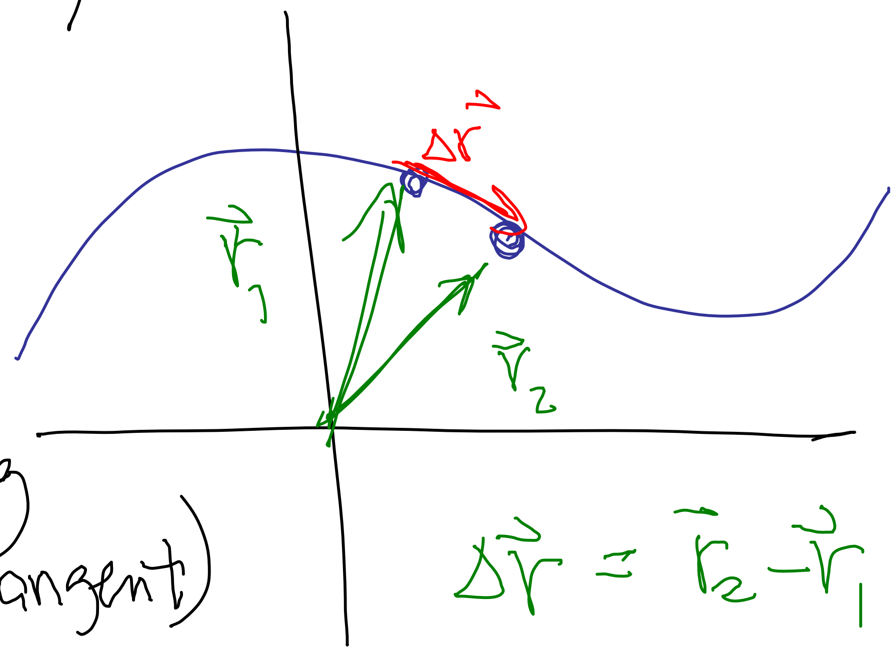
Instantaneous velocity

$$\frac{\Delta \vec{r}}{\Delta t}$$

$\Delta t \to$ small

$\to \frac{\Delta \vec{r}}{\Delta t}$ points along path (tangent)



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

$$\vec{v} = \frac{\Delta \vec{r}}{\Delta t} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} = v_x \hat{i} + v_y \hat{j}$$

$\Delta t \to$ small

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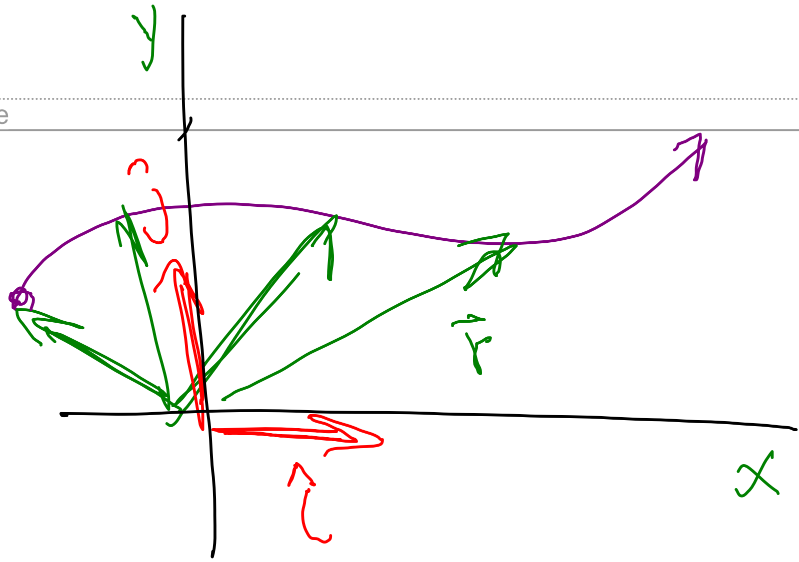

$\vec{r}$ gives location.

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

$\vec{r}$ changes with time $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j}$

How rapidly is $\vec{r}$ changing?

$\frac{\Delta x}{\Delta t} = \bar{v}_x$

$\frac{\Delta y}{\Delta t} = \bar{v}_y$

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

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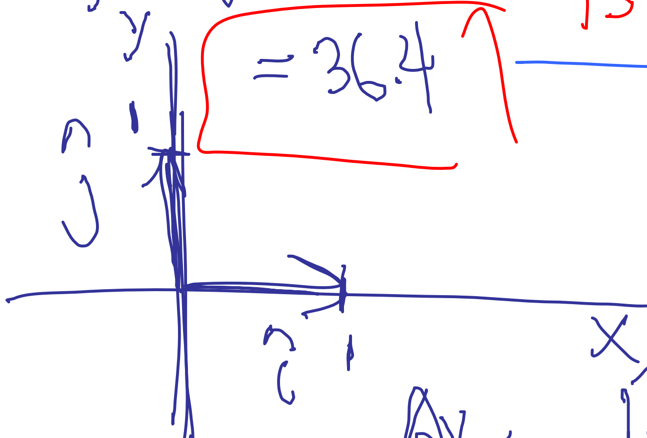
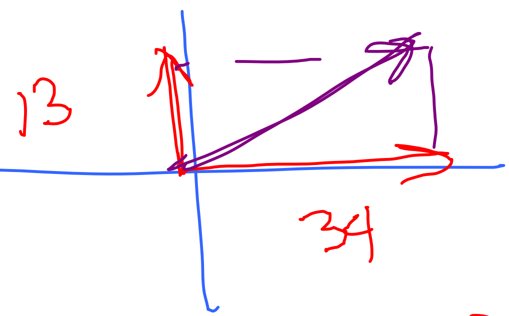
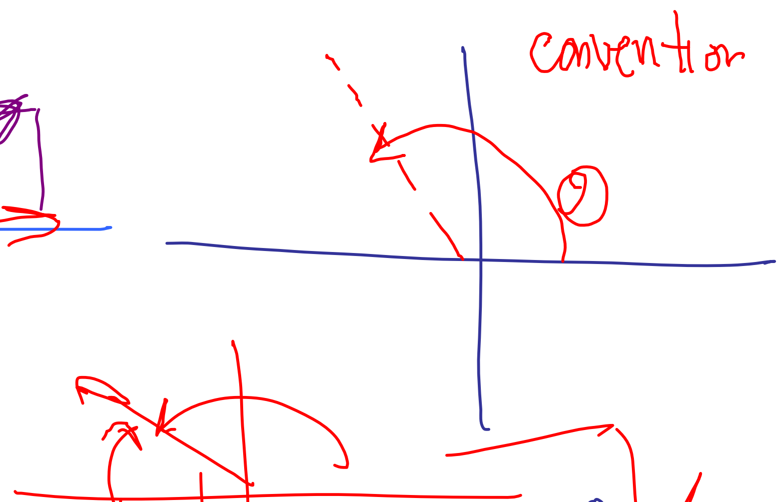
3.16 Find magnitude of $(34\hat{i}+13\hat{j})\,m$ and determine its angle to x axis

$$\text{Mag} = \sqrt{(34)^2+(13)^2}$$

$$\boxed{= 36.4}$$







$$A_y/A_x = 13/34 = \tan\theta$$

$$\boxed{\theta = 20.9^\circ}$$ ✓

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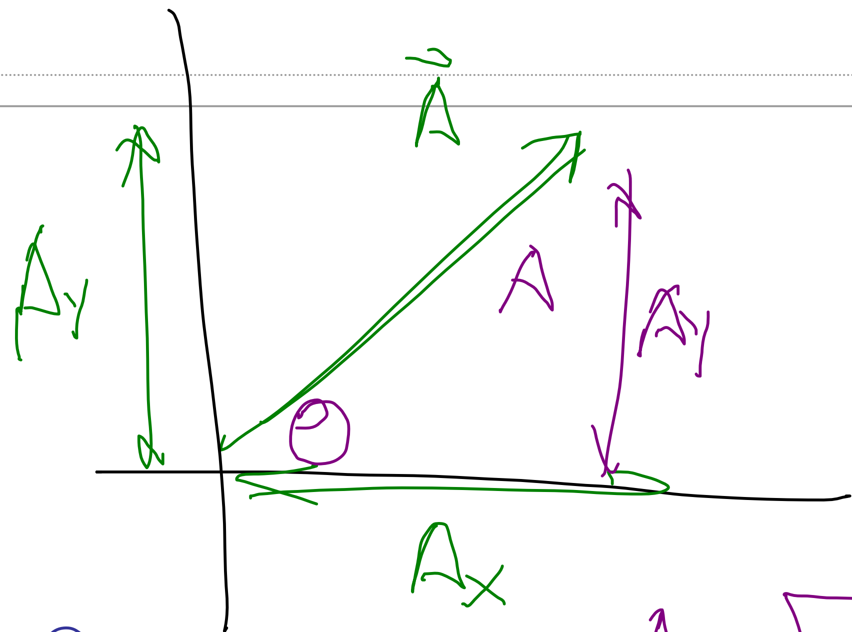


$A_x = A\cos\theta$

$A_y = A\sin\theta$

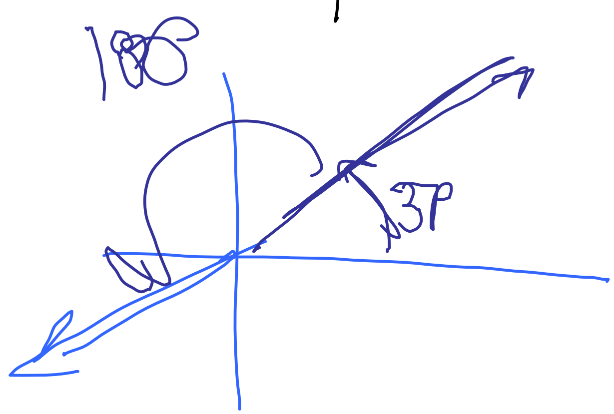
$A = \sqrt{A_x^2 + A_y^2}$ (magnitude

$\tan\theta = \dfrac{A_y}{A_x}$

can't simply say

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

Must think!



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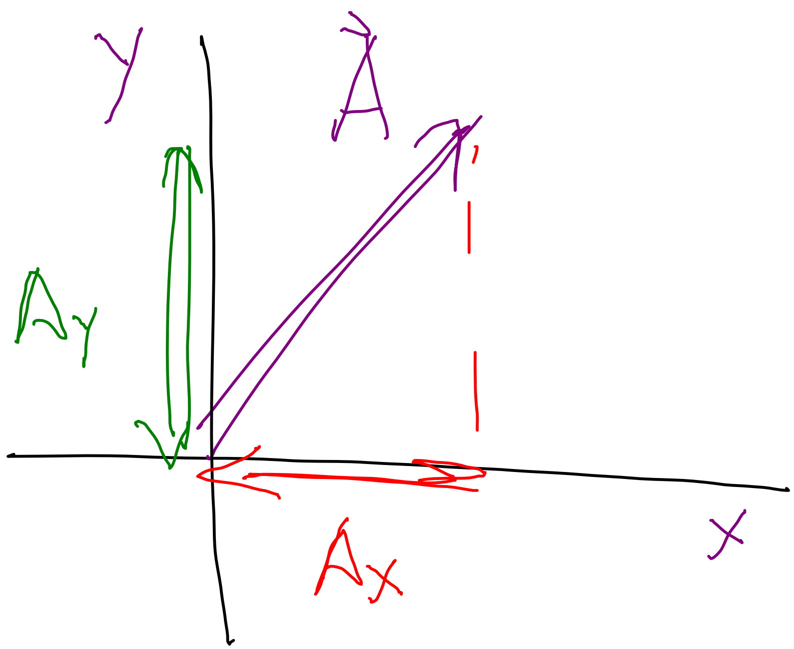
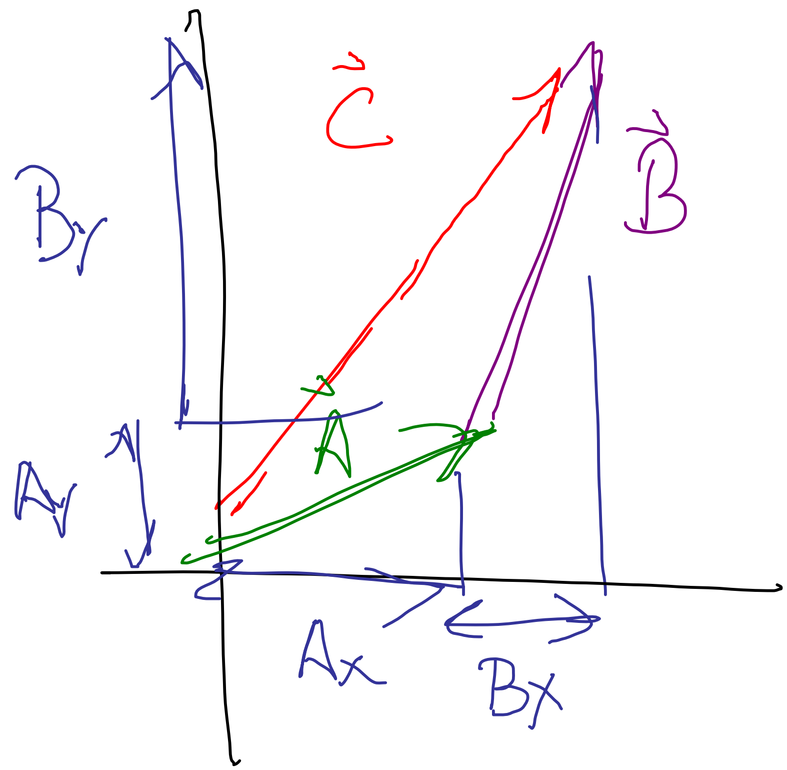
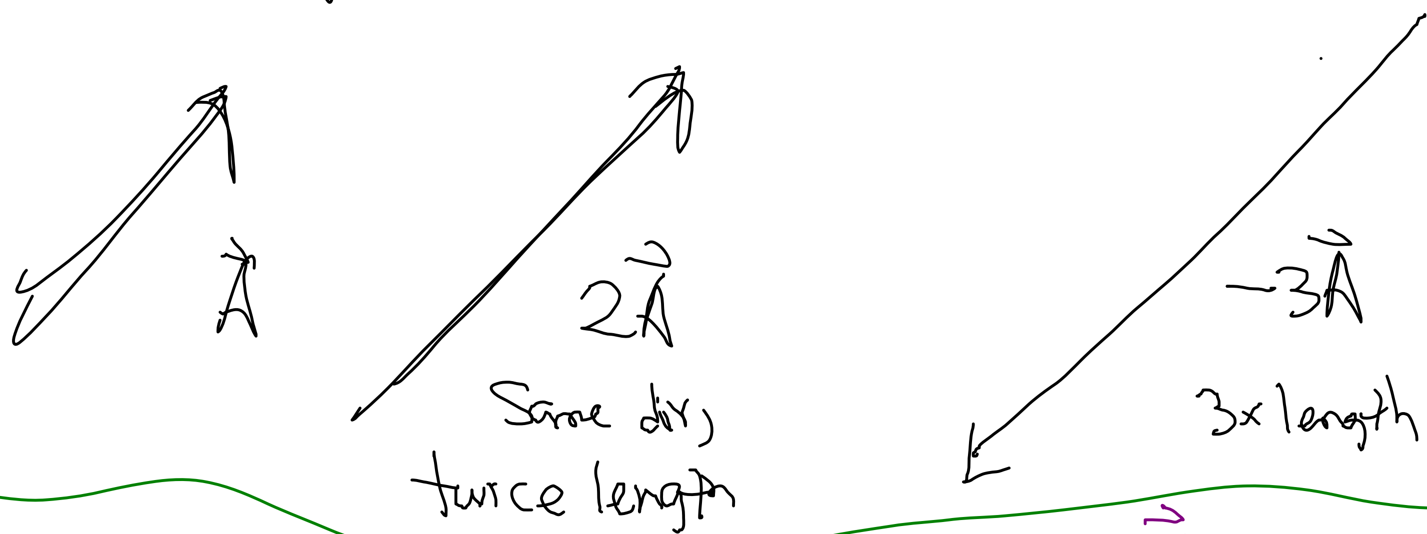
Components:

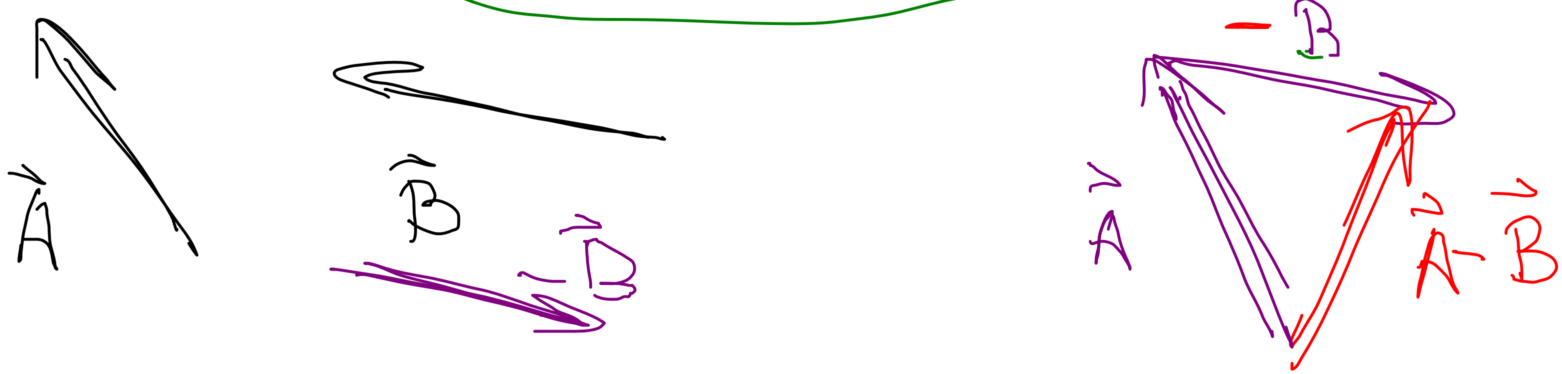




$$C_x = A_x + B_x$$
$$C_y = A_y + B_y$$

Multiply by scalar





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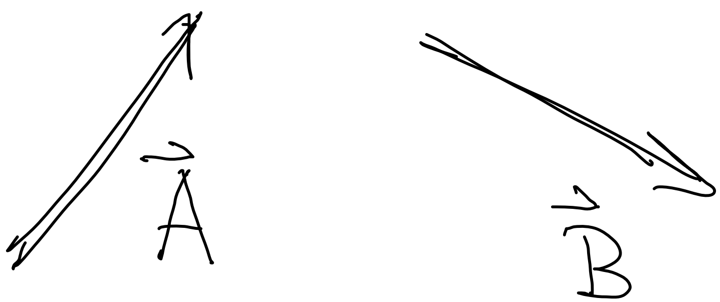
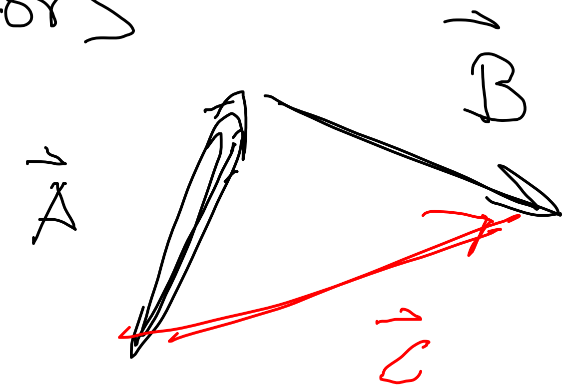
Represent Vectors w/ arrows



Length = magnitude

Direction

Add vectors



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

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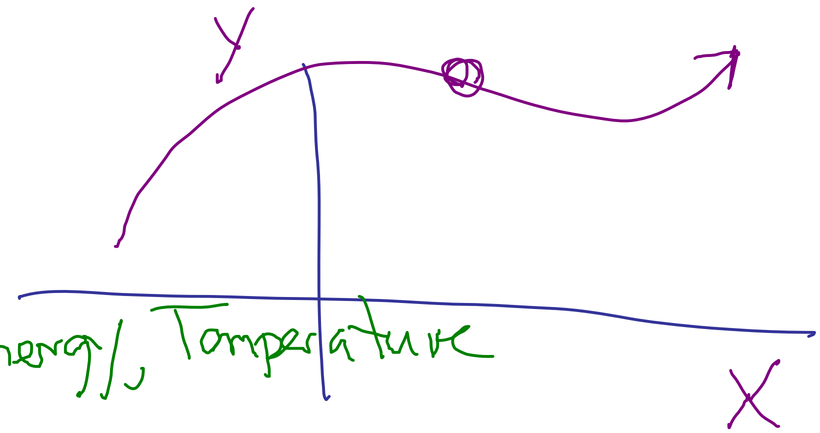
Two-Dim Motion

$x(t)$, $y(t)$



Magnitude: Scalar Energy, Temperature

Mag, Direction: Vector Position, Velocity, Acceleration

Force Momentum