Newton's Laws

1. Obj at rest remains at rest.....

2. $\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a}$

3. Action - Reaction

$\vec{F}_{NET}$

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

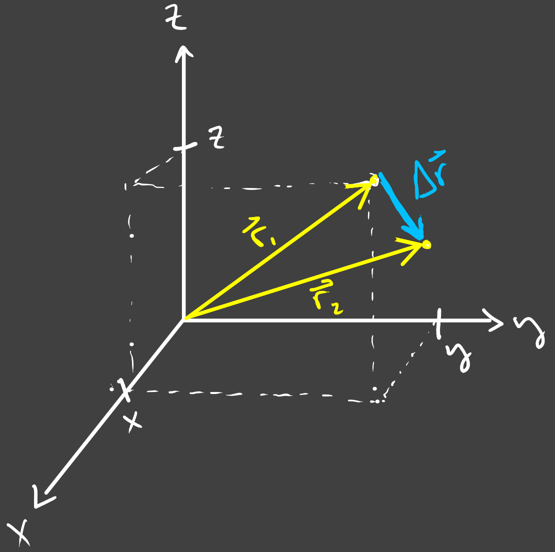
velocity

$\vec{a} = \frac{d\vec{v}}{dt} \approx \frac{\Delta\vec{v}}{\Delta t}$

$\frac{d\vec{x}}{dt} \approx \frac{\Delta\vec{x}}{\Delta t}$

$x \Rightarrow$ position

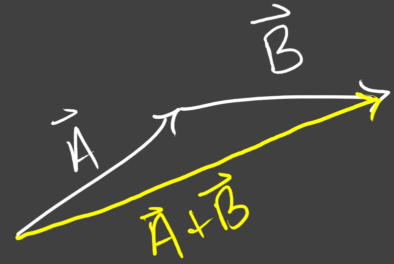
jerk $= \frac{da}{dt}$

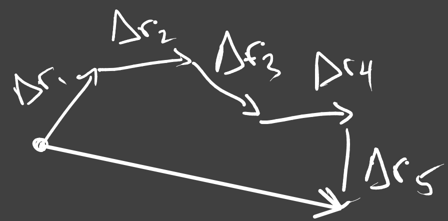


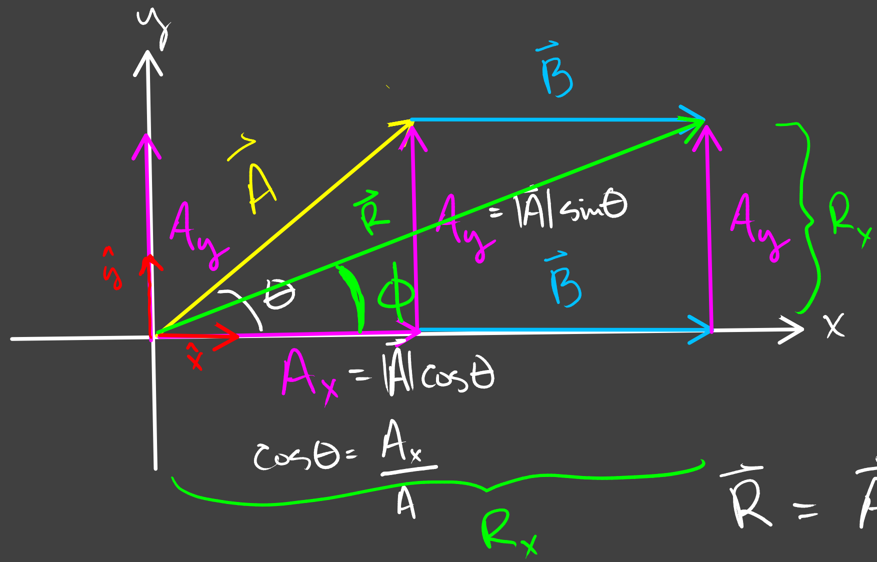
$$\vec r_1 + \Delta\vec r = \vec r_2$$

position

displacement







$$\vec A = A_x\hat x + A_y\hat y$$

$$\vec B = B_x\hat x + B_y\hat y$$

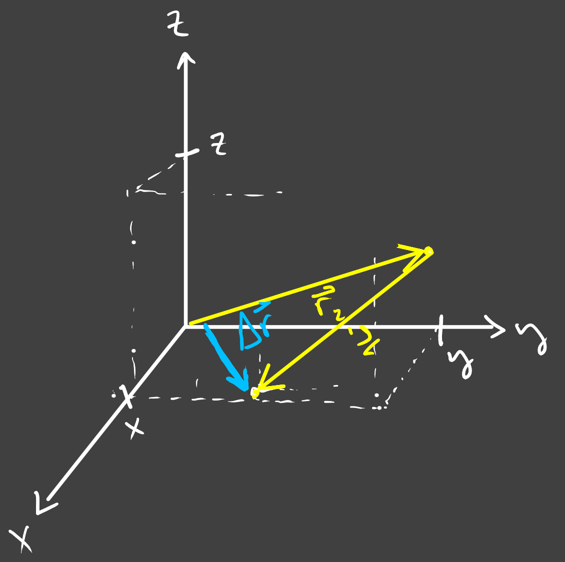
$$\vec R = \vec A + \vec B = \overbrace{(A_x + B_x)}^{R_x}\hat x + \overbrace{(A_y + B_y)}^{R_x}\hat y$$

$$|\vec R| = \sqrt{R_x^2 + R_y^2}$$

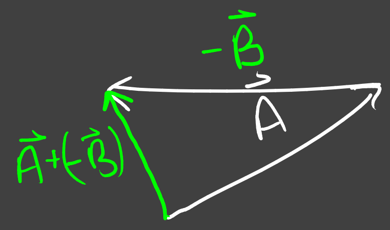
$$\tan\phi = \frac{R_y}{R_x} \sim \phi = \tan^{-1}\left(\frac{R_y}{R_x}\right)$$

	x	y
A:	A_x	A_y
B:	B_x	B_y
R:	R_x	R_y

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



$$\vec{A} - \vec{B}$$



$$\vec{A} - \vec{B} = (A_x - B_x)\hat{x} + (A_y - B_y)\hat{y}$$

- scalar multiplication

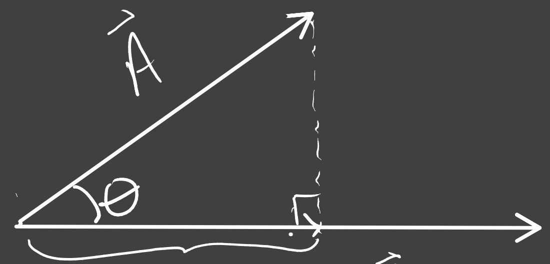
$$c\vec{A} = cA_x\hat{x} + cA_y\hat{y} + cA_z\hat{z}$$

HW: 9, 23, 24, 26, 27, 30, 46, 48

Friday

- dot product / scalar product

$$\vec{A}\cdot\vec{B} = \vec{B}\cdot\vec{A}$$



$proj(\vec{A}) = |A|\cos\theta$ $\vec{B}$

$$\vec{A}\cdot\vec{B} = |\vec{A}|\cos\theta \cdot |\vec{B}|$$

$$\vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta$$

$$\vec{A} = A_x\hat{x} + A_y\hat{y} + A_z\hat{z}$$

$$\vec{A}\cdot\vec{B} = A_xB_x + A_y\cdot B_y + A_z\cdot B_z = \vec{B}\cdot\vec{A}$$

$$|\vec{r}| = \sqrt{\vec{r}\cdot\vec{r}} \qquad \vec{r}^2 = \vec{r}\cdot\vec{r}$$

- cross product

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

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$$= (A_yB_z - B_yA_z)\hat{x} - (A_xB_z - B_xA_z)\hat{y} + (A_xB_y - B_xA_y)\hat{z}$$

$$\vec{A}\times\vec{B} = -\vec{B}\times\vec{A}$$

Derivative of Vectors

$$\frac{dx}{dt} = \lim_{\Delta t \to 0} \frac{x(t+\Delta t) - x(t)}{\Delta t}$$

$$\frac{d\vec{r}}{dt} = \lim_{\Delta t \to 0} \frac{\vec{r}(t+\Delta t) - \vec{r}(t)}{\Delta t}$$

$$\frac{d(\vec{r}+\vec{s})}{dt} = \frac{d\vec{r}}{dt} + \frac{d\vec{s}}{dt}$$

$$\frac{d(f\vec{r})}{dt} = \vec{r}\,\frac{df}{dt} + f \cdot \frac{d\vec{r}}{dt}$$

$$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$$

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\hat{x} + \frac{dy}{dt}\hat{y} + \frac{dz}{dt}\hat{z} + x\cancelto{0}{\frac{d\hat{x}}{dt}} + y\cancelto{0}{\frac{d\hat{y}}{dt}} + z\cancelto{0}{\frac{d\hat{z}}{dt}}$$

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\hat{x} + \frac{dy}{dt}\hat{y} + \frac{dz}{dt}\hat{z}$$

$$\vec{V} = V_x\hat{x} + V_y\hat{y} + V_z\hat{z}$$

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