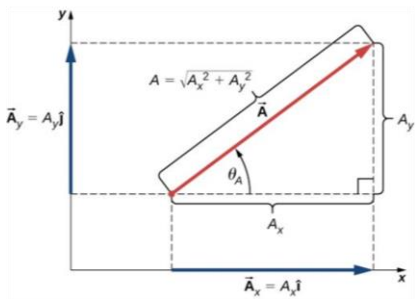
Exam I Review

Phys I

Chapter 1

- Vector components:

$$A_x = A\cos(\theta_A)$$
$$A_y = A\sin(\theta_A)$$



- Magnitude and Direction:

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

$$\theta_A = tan^{-1}\left(\frac{A_y}{A_x}\right)$$

- Scalar Dot Product:

$$\vec{A} \cdot \vec{B} = A_xB_x + A_yB_y + A_zB_z$$

- Vector Cross Product:

$$\vec{A} \times \vec{B} = \left(A_yB_z - A_zB_y\right)\hat{\imath} - \left(A_xB_z - A_zB_x\right)\hat{\jmath} + \left(A_xB_y - A_yB_x\right)\hat{k}$$

On the Vector Cross Product…

- To solve for the DETERMINANT => cross multiply the elements and then subtract the products…

$$\vec{A}\times\vec{B} = \begin{bmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{bmatrix} = \hat{\imath}\begin{bmatrix} A_y & A_z \\ B_y & B_z \end{bmatrix} - \hat{\jmath}\begin{bmatrix} A_x & A_z \\ B_x & B_z \end{bmatrix} + \hat{k}\begin{bmatrix} A_x & A_y \\ B_x & B_y \end{bmatrix}$$

$$\vec{A}\times\vec{B} = \left(A_yB_z - A_zB_y\right)\hat{\imath} - \left(A_xB_z - A_zB_x\right)\hat{\jmath} + \left(A_xB_y - A_yB_x\right)\hat{k}$$

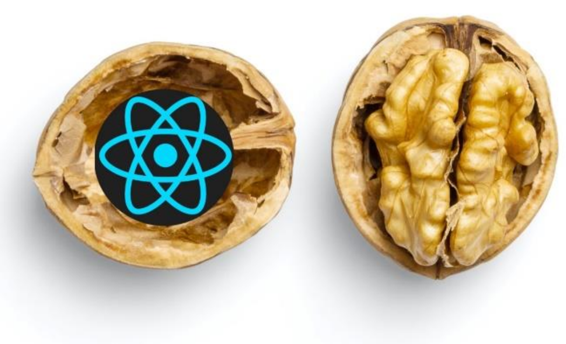
- Keep in mind the direction of unit vectors…

$$\hat{\imath} = \hat{\jmath}\times\hat{k} \qquad \hat{\jmath} = \hat{\imath}\times\hat{k} \qquad \hat{k} = \hat{\imath}\times\hat{\jmath}$$

$$-\hat{\imath} = \hat{k}\times\hat{\jmath} \qquad -\hat{\jmath} = \hat{k}\times\hat{\imath} \qquad -\hat{k} = \hat{\jmath}\times\hat{\imath}$$

CHAPTER 2 in a nutshell

- The 4 **Equations of Motion** apply to any straight-line motion with *"constant"* acceleration a_x:
  - i. $$x = x_o + v_o t + \frac{1}{2} a_x t^2$$
  - ii. $$v_x = v_o + a_x t$$
  - iii. $$v_x{}^2 = v_o{}^2 + 2a_x(x - x_o)$$
  - iv. $$x - x_o = \frac{1}{2}(v_o + v_x)\mathrm{t}$$



where: $\boldsymbol{x_o}$ is the initial displacement, $\boldsymbol{v_o}$ is the initial velocity, and $\boldsymbol{a_x}$ is the acceleration along the x-axis.

CH3 in a Nutshell

- Position, Velocity and Acceleration Vectors:

$$\vec{\boldsymbol{r}} = x\hat{\boldsymbol{\imath}} + y\hat{\boldsymbol{\jmath}} + z\widehat{\boldsymbol{k}} \qquad \vec{\boldsymbol{v}} = \frac{d\vec{\boldsymbol{r}}}{dt} \qquad \vec{\boldsymbol{a}} = \frac{d\vec{\boldsymbol{v}}}{dt}$$

- Projectile motion:

$$x = (v_o \cos\theta)\, t \quad \Rightarrow \quad v_x = \frac{dx}{dt} = v_o \cos\theta$$

$$y = (v_o \sin\theta)\, t - \frac{1}{2} g t^2 \quad \Rightarrow \quad v_y = \frac{dy}{dt} = v_o \sin\theta - gt$$

- Circular motion (radial velocity and acceleration):

$$v = \frac{2\pi R}{T} \qquad a_{rad} = \frac{v^2}{R} = \frac{4\pi^2 R}{T^2}$$