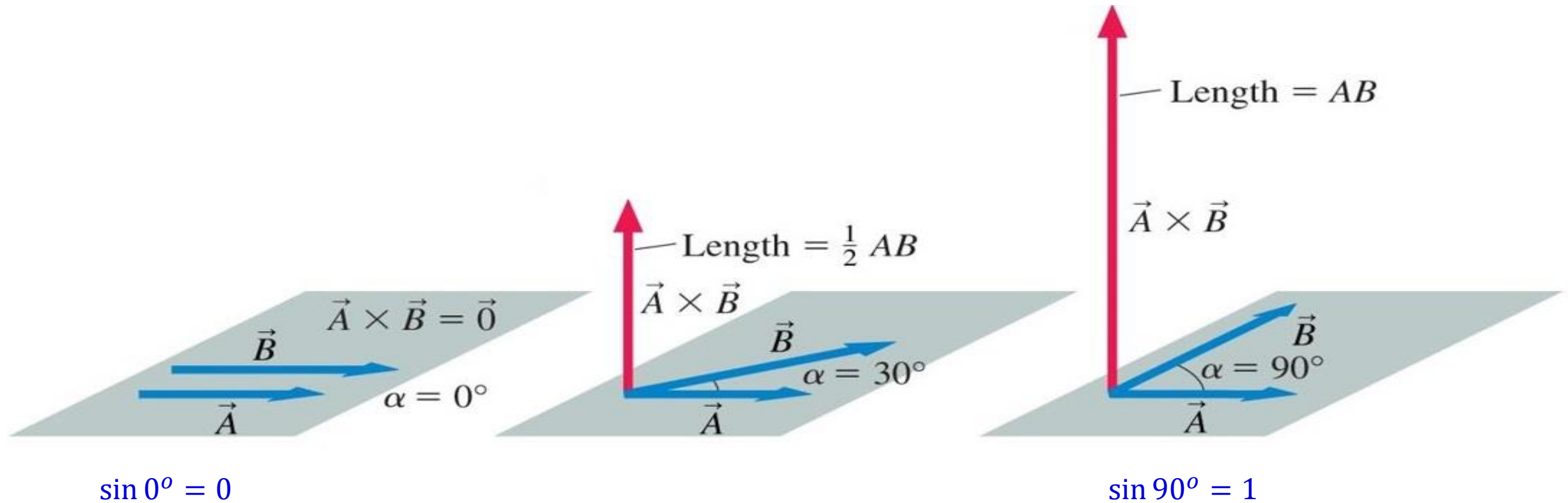


$$\vec{A} \times \vec{B} = \text{vector}$$

For comparison:  $\vec{A} \cdot \vec{B} = \text{scalar}$

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

- **Magnitude:**  $|\vec{A} \times \vec{B}| = A B \sin \theta$
- **Direction:** 1) perpendicular to both  $\vec{A}$  and  $\vec{B}$   
2) right-hand rule, to choose out of two possible directions

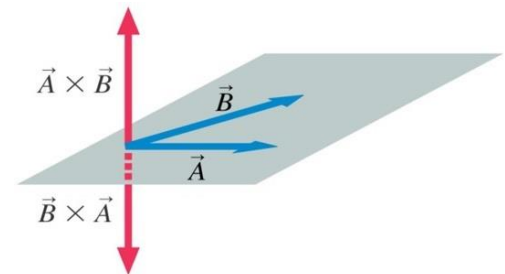


## Direction of the Vector (Cross) Product: The Right-Hand Rule (“open-palm version”)

$$\begin{array}{ccccc} \vec{A} & \times & \vec{B} & = & \vec{R} \\ \text{First} & & \text{Second} & & \text{Result} \end{array}$$

Rule #0: In a vector product, each of these vectors has its role. In the next slide, by  $\vec{A}$  we denote the **first vector**, by  $\vec{B}$  the **second vector**, by  $\vec{R}$  the **resulting vector**.

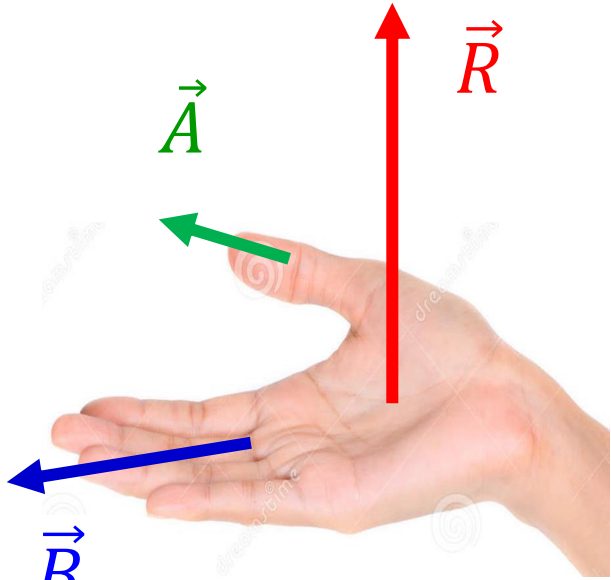
Note that  $\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$  -- hence interchanging the “first” and the “second” vectors will flip the sign of your result!



# Direction of the Vector (Cross) Product: The Right-Hand Rule (“vector product version”)

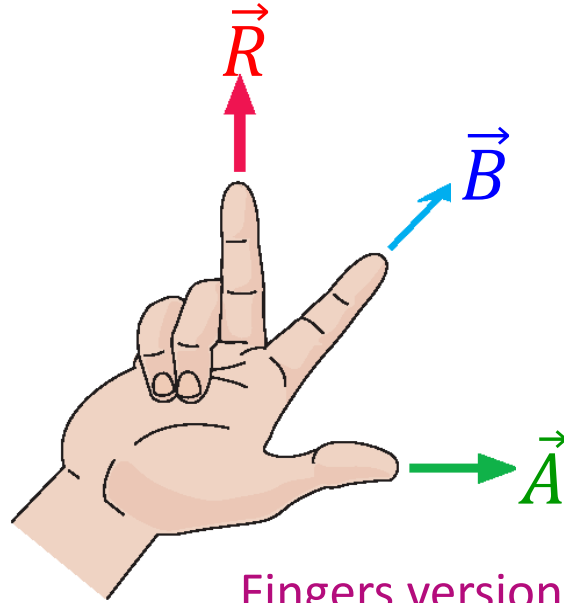
$$\vec{A} \times \vec{B} = \vec{R}$$

First Second Result

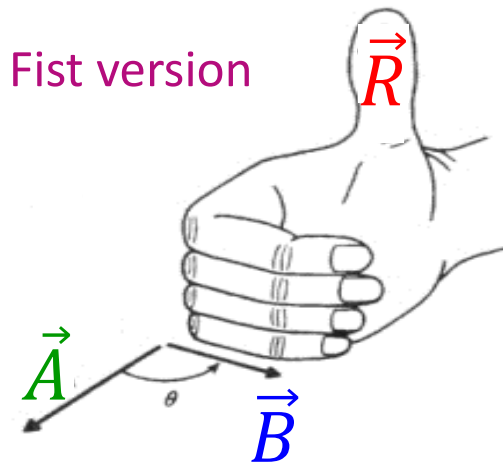


Open-palm version (my favorite)

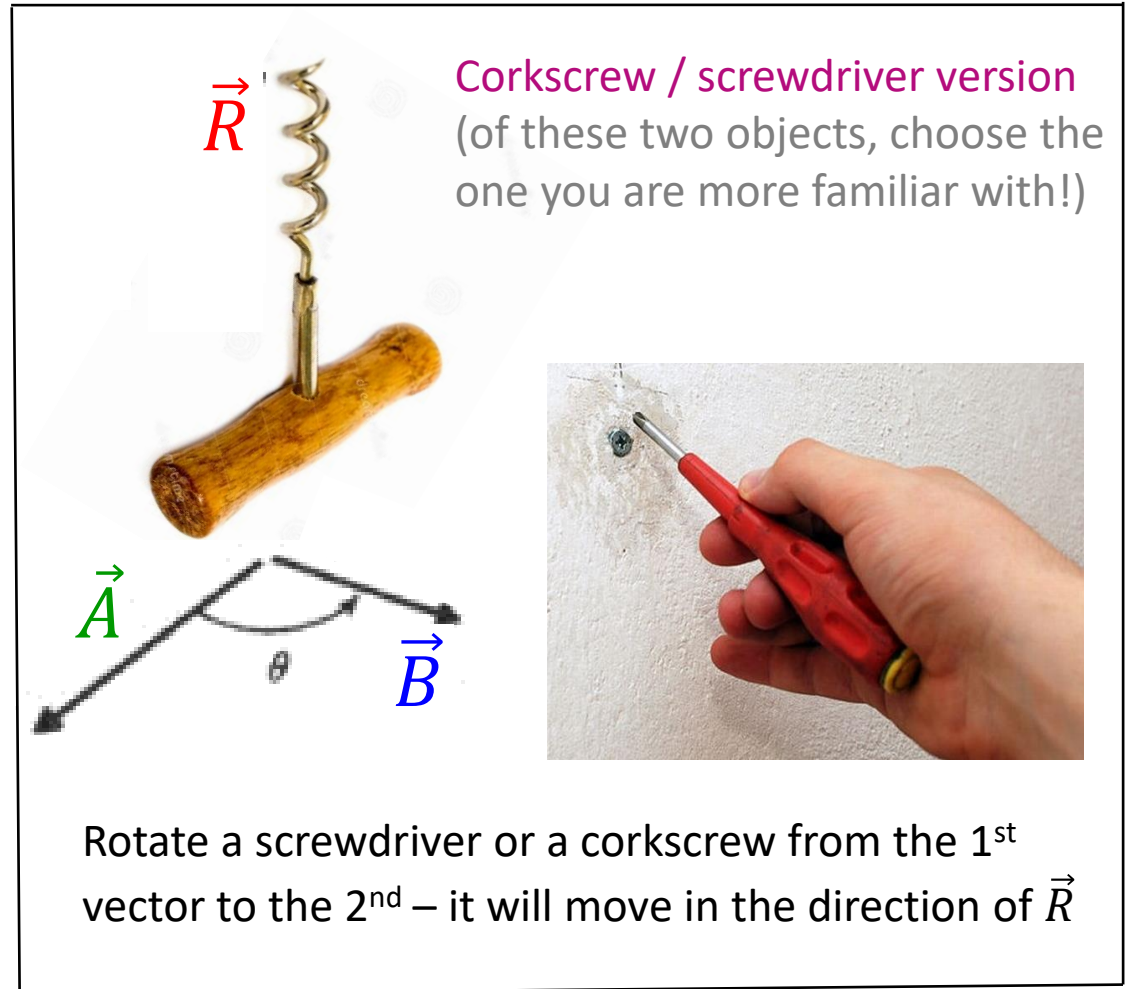
Use your right hand  
for these  
configurations!



Fingers version



Fist version

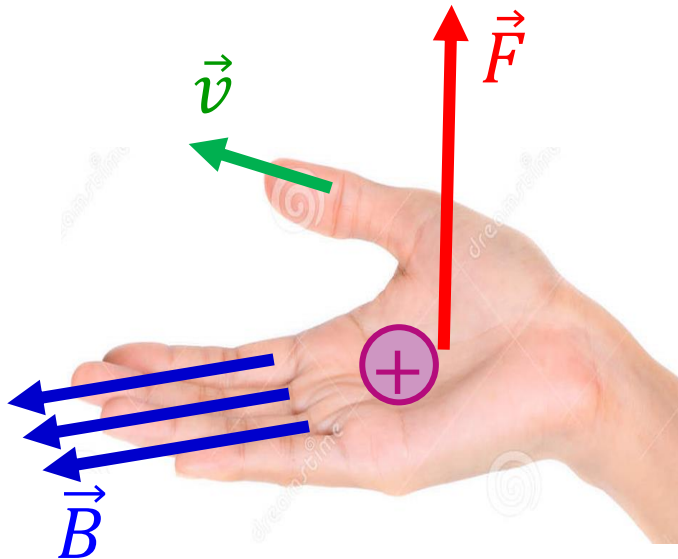


(...not your pencil-free hand!)

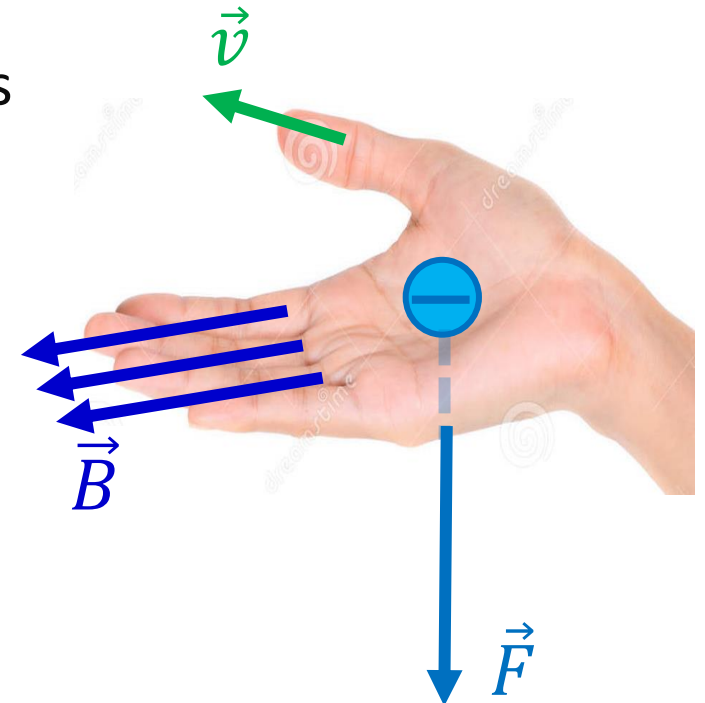
## Magnetic force on a moving charge:

$$\vec{F}_{B \text{ on } q} = q_{\pm} \vec{v} \times \vec{B}$$

- **Magnitude:**  $qvB \sin \theta$
- **Direction:** Right-hand rule



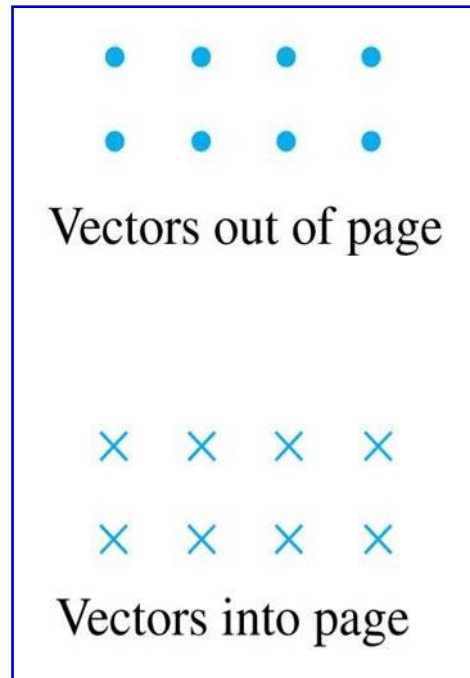
Note  $q_{\pm}$ : direction depends on the sign of the charge!



Notations “into the page” and “out of the page”:

Mnemonic rule:

Notations:



- When it flies towards you (“out of the page”), you see its tip (a point)
- When it flies away from you (“into the page”), you see its tail (a cross)

Think about a dart arrow flying between you and the page:

