

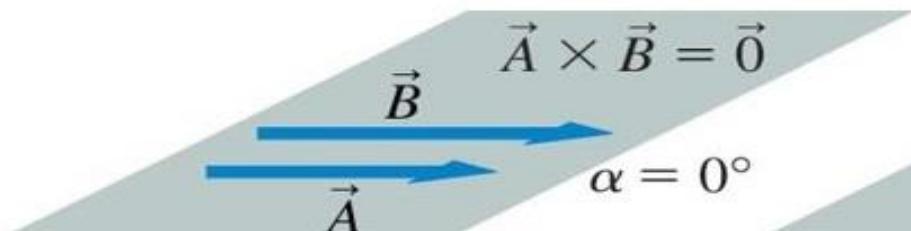
$$\vec{A} \times \vec{B} = \text{vector}$$

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

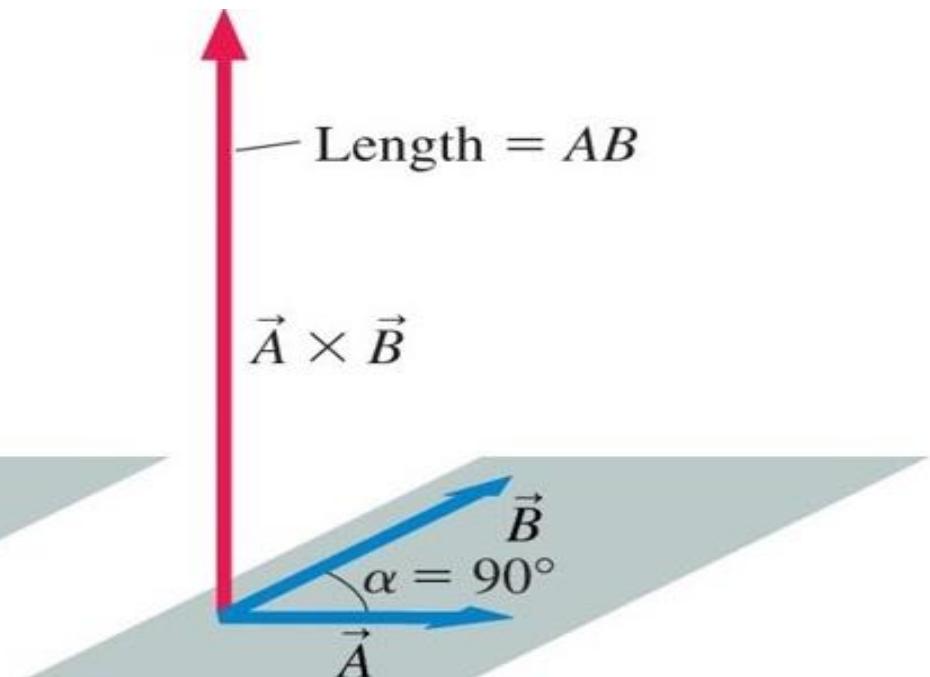
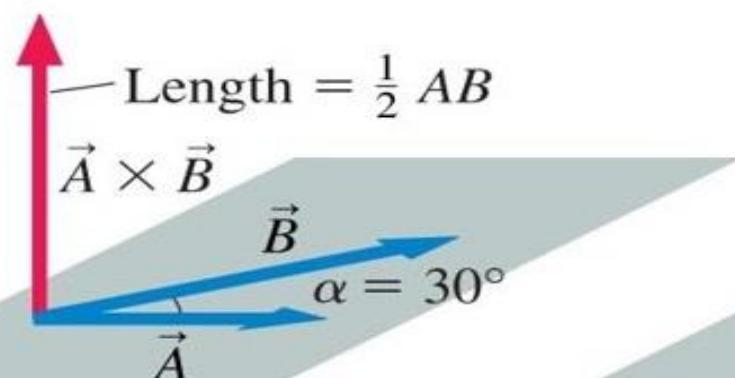
- Magnitude: $|\vec{A} \times \vec{B}| = A B \sin \theta$

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

- Direction: 1) perpendicular to both \vec{A} and \vec{B}
2) right-hand rule, to choose out of two possible directions



$$\sin 0^\circ = 0$$



$$\sin 90^\circ = 1$$

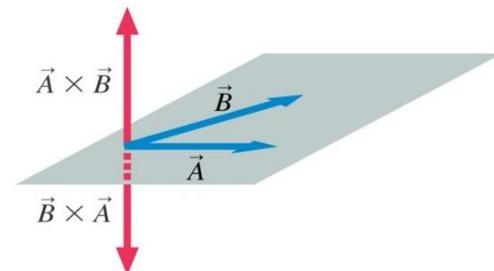
Direction of the Vector (Cross) Product: The Right-Hand Rule (“open-palm version”)

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

First Second Result

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**.

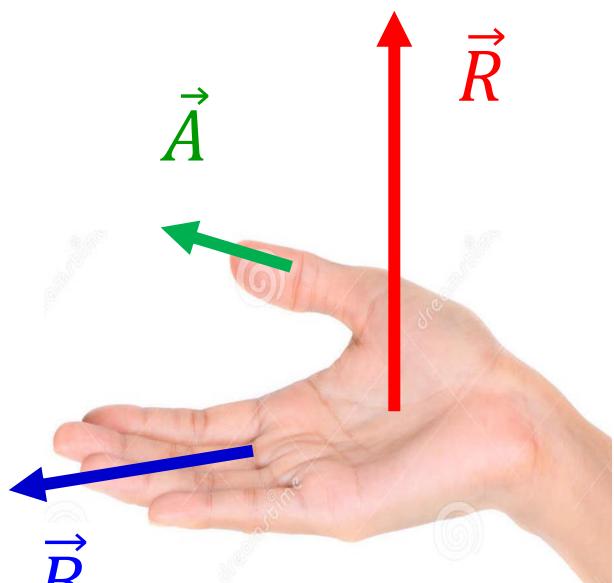
Note that $\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$ -- hence interchanging the “first” and the “second” vectors will flip the sign of your result!



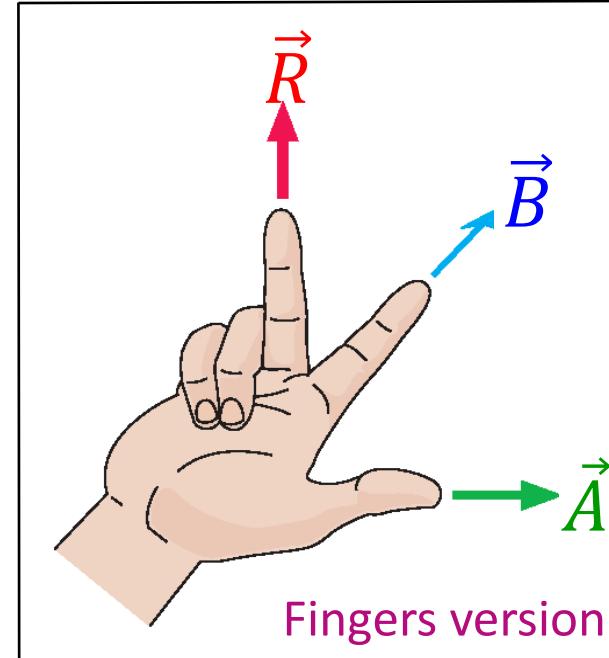
Direction of the Vector (Cross) Product: The Right-Hand Rule (“vector product version”)

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

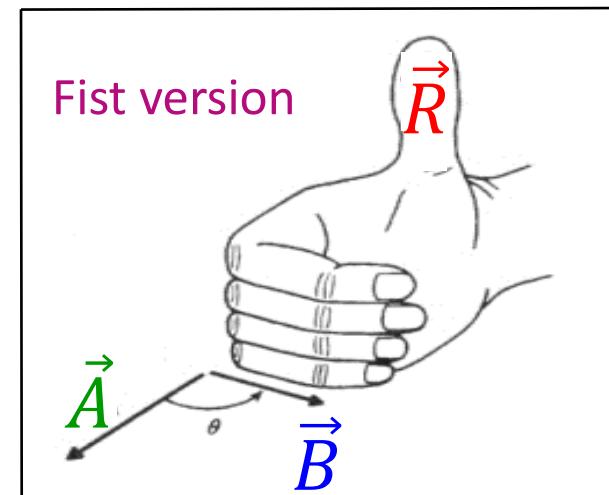
First Second Result



Open-palm version (my favorite)

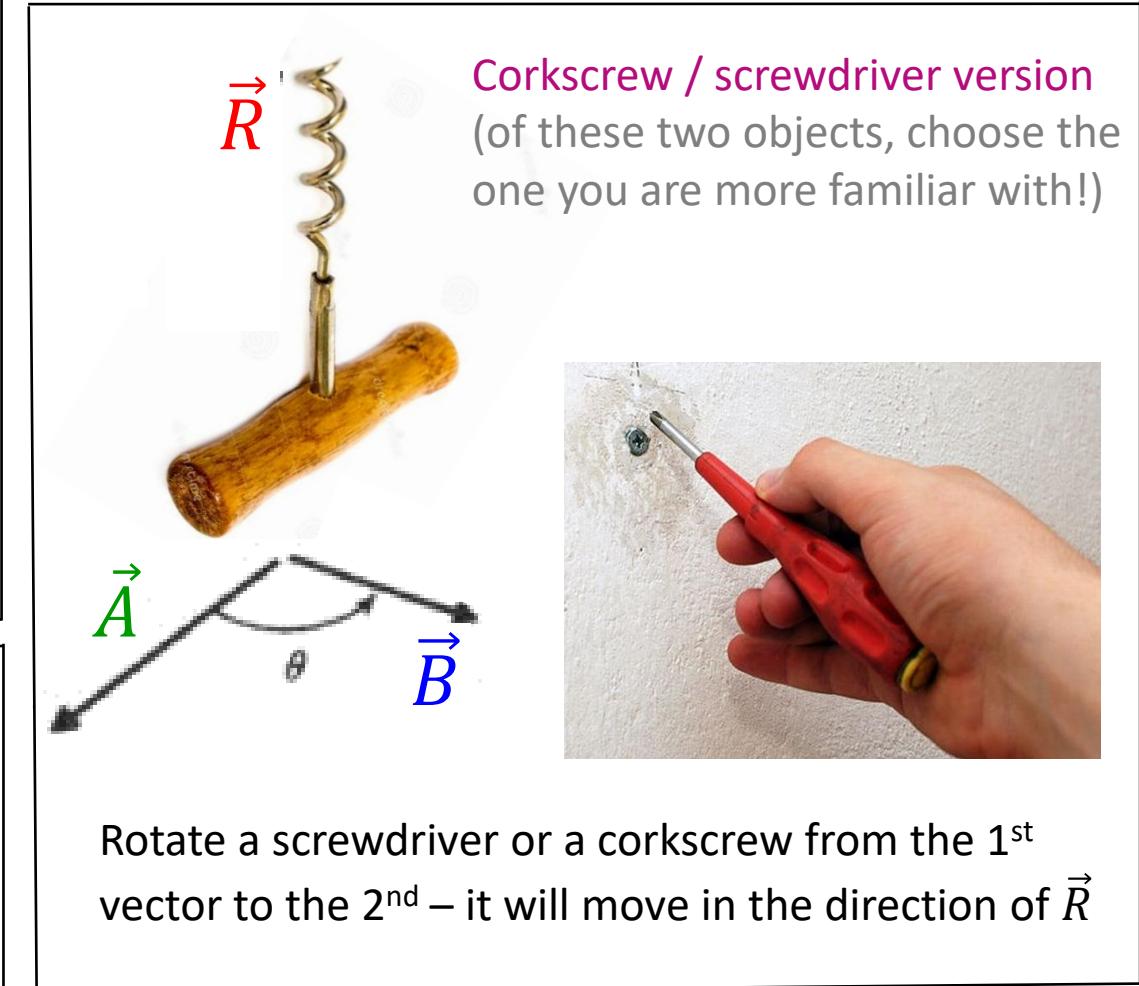


Fingers version



Fist version

Use your right hand
for these
configurations!



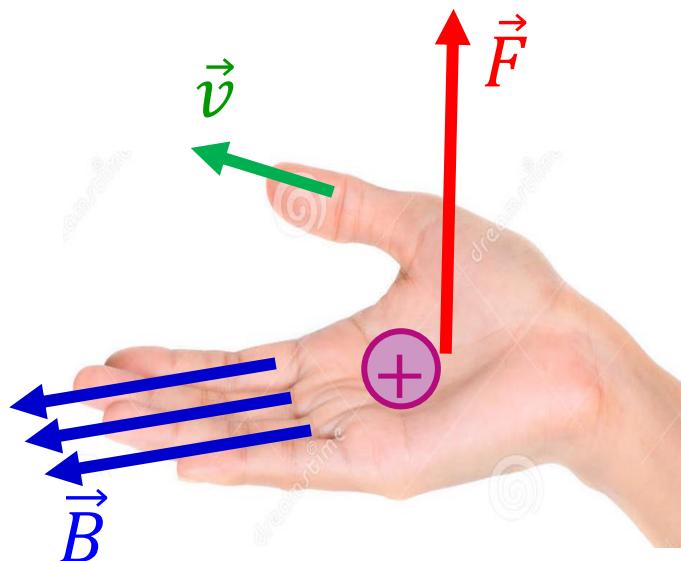
Rotate a screwdriver or a corkscrew from the 1st vector to the 2nd – it will move in the direction of \vec{R}

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

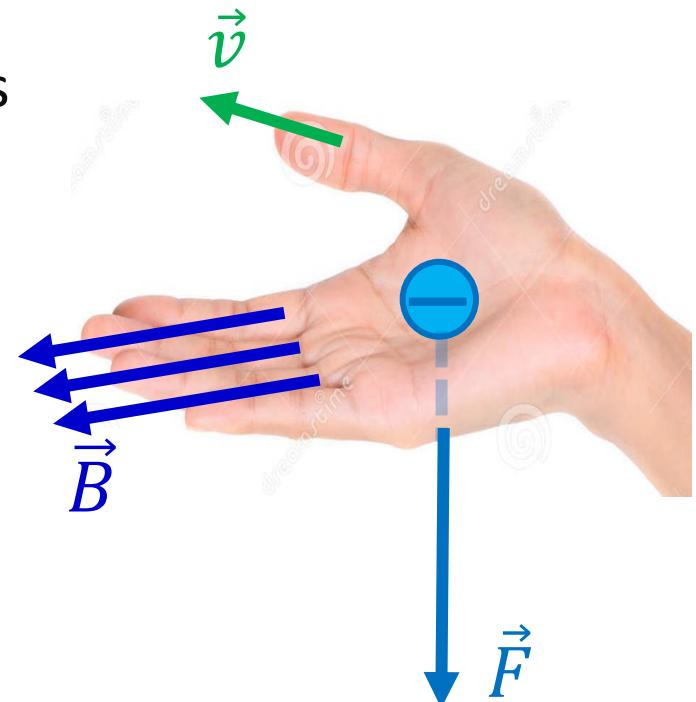
Magnetic force on a moving charge:

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

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



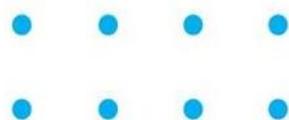
Note q_{\pm} : direction depends on the sign of the charge!



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

Mnemonic rule:

Notations:



Vectors out of page



Vectors into page

- 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:

