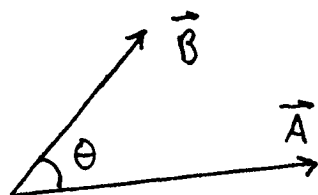


Why does Right Hand Rule for  $\vec{A} \times \vec{B}$  work?

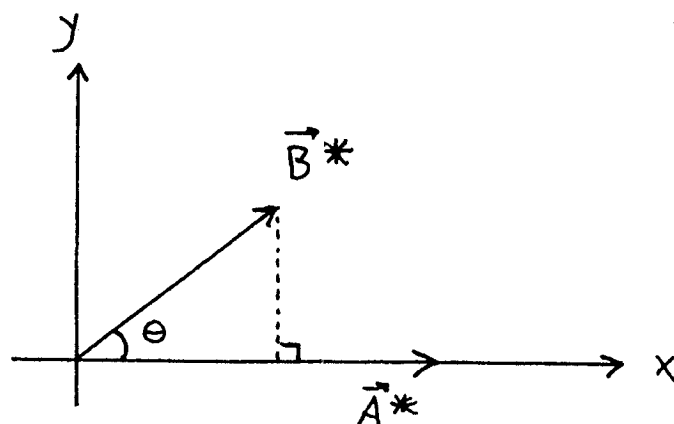
Justification: Let  $\vec{A} = \overrightarrow{(a_1, a_2, a_3)}$  and  $\vec{B} = \overrightarrow{(b_1, b_2, b_3)}$  and let  $0 < \theta < 180^\circ$  be the angle between them.



"Translate" vectors  $\vec{A}$  and  $\vec{B}$  to the  $xy$ -plane in such a way that:

- i.) their tails are at the origin,
- ii.)  $\vec{A}$  points in the direction of  $\vec{i}$ ,
- iii.) their lengths are preserved,
- and iv.) the angle between them remains  $\theta$ .

Call the translated vectors  $\vec{A}^*$  and  $\vec{B}^*$ .



It follows that  $\vec{A}^* = \overrightarrow{(a, 0, 0)}$  and  $\vec{B}^* = \overrightarrow{(b \cos \theta, b \sin \theta, 0)}$  where  $a > 0$  and  $b = |\vec{B}^*| = |\vec{B}|$ . Then

$$\vec{A}^* \times \vec{B}^* = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ a & 0 & 0 \\ b \cos \theta & b \sin \theta & 0 \end{vmatrix} = (ab \sin \theta) \vec{k}$$

where  $ab \sin \theta > 0$ . This vector points in the direction of the positive  $z$ -axis, consistent with the Right Hand Rule.