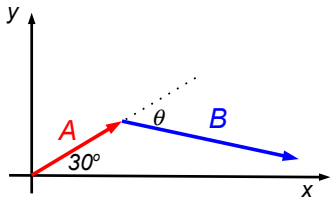
Chapter 11 Problem 30 †



Given
$|B| = 2|A|$
$|\vec{A} \times \vec{B}| = A^2$

Solution
Find the direction of vector B.

Since the cross product points in the negative z direction, the vector B must lie in the xy plane along with vector A. A negative z-direction corresponds to a clockwise rotation. Therefore, vector B must be pointed to the right of the direction of vector A as illustrated in the diagram. Finally we need to find the angle that B makes with respect to A.
The magnitude of a cross product is equal to

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

Substitute in the values for the magnitude of B and of the cross product

$$A^2 = A(2A)\sin\theta$$

Solve for theta

$$1 = 2\sin\theta$$

$$\theta = \sin^{-1}\left(\tfrac{1}{2}\right) = 30^\circ$$

Since θ is 30°, B must be parallel to the x-axis.

†Problem from Essential University Physics, Wolfson