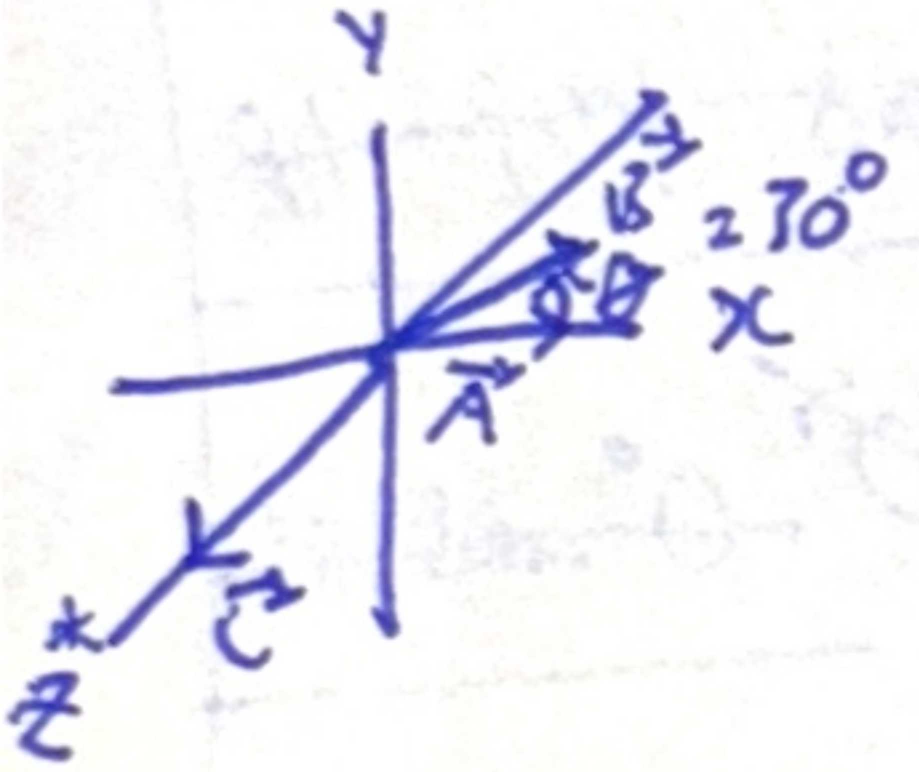
Example 1.11 Calculating a vector product

$|\vec{A}| = 6$ units (+ axis for x)

$|\vec{B}| = 4$ units (lies in <u>xy</u> plane), 30° angle w/t +x-axis.

Find $\vec{C} = \vec{A} \times \vec{B}$



* In this case, $\vec{C}$ is "coming" out of the page, in the + space of the z axis.

Given that the unit vectors are:
i ; x-axis
j ; y-axis
k ; z-axis.

① By right-hand-rule:

$$AB \sin\phi = (6)(4)\sin 30° = 12.$$

Then, direction of $\vec{A} \times \vec{B}$ is along + z-axis, hence $\vec{C} = 12\hat{k}$.

② By components.

$A_x = 6$ $\quad B_x = 4\cos 30° = 2\sqrt{3}$ $\quad \cancel{A_z = 0}$

$A_y = 0$ $\quad \cancel{B_z = 0}$

$A_z = 0$ $\quad B_y = 4\sin 30° = 2$

$B_z = 0$

$\cancel{C_x = (6)(2\sqrt{3})}$

$\cancel{C_y = (6)(2)}$

$\cancel{C_z = (0)(0)}$

$\cancel{C_x = A_zB_z - A_yB_y}$

$\cancel{C_y = A_yB_y -}$

$C_x = A_yB_z - A_zB_y = 0$

$C_y = -(A_xB_z - A_zB_x) = 0$

$C_z = A_xB_y - A_yB_x = 12$

Hence, $\vec{C} = 12\hat{k}$.

Test your understanding of section 1.10

$A = 2$, $B = 3$, Assuming ϕ between $\vec{A}$ and $\vec{B}$ for the following situations: ~~0° 90° 180°~~

$\vec{A} \cdot \vec{B} = 0$	$\phi =$ ~~0° and 180°~~ 90°
$\vec{A} \times \vec{B} = 0$	$\phi =$ 0° and 180° ~~90°~~
$\vec{A} \cdot \vec{B} = 6$	$\phi =$ ~~90°~~ 0° ~~0° and 180°~~
$\vec{A} \cdot \vec{B} = -6$	$\phi =$ 90° ~~0° and 180°~~
magnitude of $\vec{A} \times \vec{B} = 6$	$\phi =$ 90° ~~0° and 180°~~

$$AB \cos\phi = (2)(3)\cos\phi$$
$$= 6 \cos\phi$$

if $\phi = 0$; $|AB| = 6$

$= 90°$; $|AB| =$ ~~...~~ 0

$= 180$; ~~-6~~ $|AB| = -6. = 6$

90°: Scalar product $= 0$ iff $\vec{A} \perp \vec{B}$

0° or 180°: iff $\vec{A} \parallel \vec{B}$ or $\vec{A} \uparrow\downarrow \vec{B}$

0°: Scalar product = magnitude product iff $\vec{A} \parallel \vec{B}$

180°: Scalar product = −(magnitude product) iff $\vec{A} \uparrow\downarrow \vec{B}$

90°: ~~Scalar product~~ = vector product magnitude = product of magnitudes iff $\vec{A} \perp \vec{B}$.

Chapter 1 Key Concepts:

1. Physical quantities & units
2. Significant figures
3. Scalars, vectors and vector addition
4. Unit vectors
5. Scalar product
6. Vector product.