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Disc. TA: Andrea Silvestri

Disc. Day: Wednesday Hour: 8:00 - 12:50

Date: 01/09/2008

Physics 3B

Week 1: Vectors

1) Which way does this vector point?

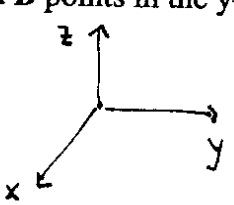
inward
or into the page

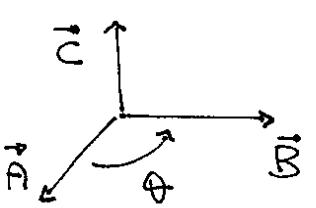
2) Which way does this vector point?

outward
or out of the page

3) Which way does the cross product vector **C = A x B** point if **A** points in the x-direction and **B** points in the y-direction?

Define a Cartesian coordinate system



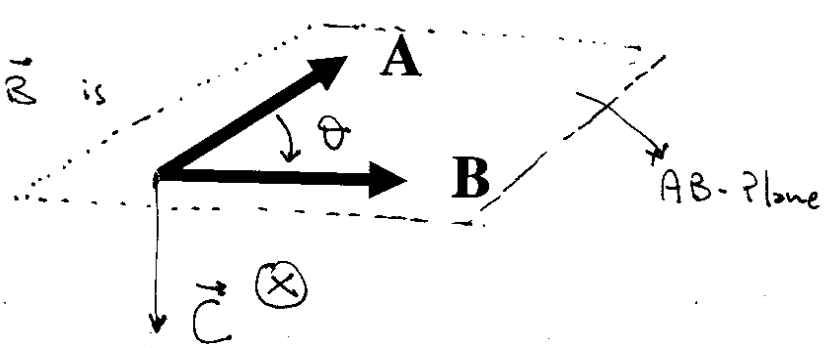


$\vec{C} \perp$ AB-plane

$\vec{A}$ overlaps to $\vec{B}$ counterclockwise

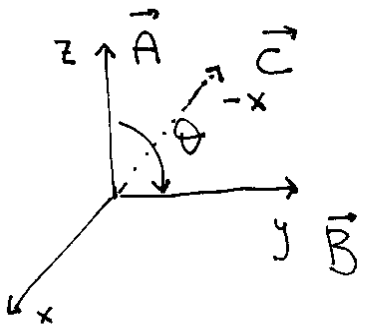
4) Which way does the cross product **C = A x B** point?

θ angle, where $\vec{A}$ overlaps to $\vec{B}$ is clockwise



$\vec{C}$ is $\perp$ AB-plane

inward / into the page



θ is clockwise

⇒ $\vec{C}$ points in the negative x-direction

5) Which way does the cross product vector **C = A x B** point if **A** points in the z-direction and **B** points in the y-direction?

Def. Dot-product of $\vec{A}$, $\vec{B}$ vectors

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

$|A|$ and $|B|$ are the magnitudes of $\vec{A}$, $\vec{B}$ and θ the angle in between.

6) Let **A = 5 i + 3 j + k** and **B = 2 i + 2 j + 2 k.**

a) What is the dot product **A · B**?

If θ not available, then use vector-components:

in 3D-space: $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z = (5\cdot 2) + (3\cdot 2) + (1\cdot 2) =$

$= 10 + 6 + 2 = 18.$

b) What is the cross product **C = A x B** ?

Def. Cross product $|\vec{A}\times\vec{B}| = |A||B|\sin\theta$ [keep in mind the alterning sign]

if θ not available use the determinant:

$$\vec{A}\times\vec{B} = \begin{vmatrix} i & j & k \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} \begin{matrix} i & j \\ A_x & A_y \\ B_x & B_y \end{matrix} = \begin{cases} \hat{i}(A_yB_z - A_zB_y) = \hat{i}(6-2) \\ -\hat{j}(A_xB_z - A_zB_x) = -\hat{j}(10-2) \\ +\hat{k}(A_xB_y - A_yB_x) = +\hat{k}(10-6) \end{cases}$$

7) Let **A = i + j + 2k** and **B = 4 i + 2 j + 2 k.**

a) What is the dot product **A · B**?

$\vec{C} = 4\hat{i} - 8\hat{j} + 4\hat{k}.$

$\vec{A}\cdot\vec{B} = (1\cdot 4) + (1\cdot 2) + (2\cdot 2) = 10.$

b) What is the cross product **C = A x B** ?

$$\vec{A}\times\vec{B} = \begin{vmatrix} i & j & k \\ 1 & 1 & 2 \\ 4 & 2 & 2 \end{vmatrix} \begin{matrix} i & j \\ 1 & 1 \\ 4 & 2 \end{matrix} = \begin{matrix} \hat{i}(2-4) \\ -\hat{j}(2-8) \\ +\hat{k}(2-4) \end{matrix}, \quad \vec{C} = -2\hat{i} + 6\hat{j} - 2\hat{k}$$