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PH108 : Electricity & Magnetism

Weekly Quiz 3 - Finding the Levi-Civita Symbol

7 February, 2018

Instructions: Read these before beginning!

1) Fill out the details carefully & correctly, else the quiz will NOT fetch you marks or attendance.

2) You have **5 min** to fill all the answer(s) at the specified location(s), for a total of **1 mark**.

3) There will be NO partial marking. Only answer(s) at specified location(s) will be considered.

4) Any sort of malpractice will be strongly penalised!

All the Best! Use the backside for rough work.

Question

Consider $\mathbf{c} = \mathbf{a} \times \mathbf{b}$. The ith component of $\mathbf{c}$, $\mathbf{c_i} = [\mathbf{a} \times \mathbf{b}]_i = \epsilon_{ijk} a_j b_k$.

This can also be written as $\mathbf{c_i} = M_{ij} b_j$, where M_{ij} is a 3x3 matrix (using vectors a 3x1 column matrices). Einstein notation is used here (implied summation over j).

Find $M_{ij} \forall i, j \in \{x, y, z\}$ or $\{1, 2, 3\}$, that is find all the elements of the 3x3 matrix.

$$M_{ij} = \begin{matrix} \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \end{matrix}$$

[$\frac{1}{2}$ **mark**]

The origin of Levi-Civita symbol should be more apparent from this matrix M, which is officially called $a_\times$.

Thus, $\mathbf{a} \times \mathbf{b}$ (vector form) $= a_\times b$ (matrix form).

Also, find $|M_{ij}| = |a_\times|$. Hint: what type of matrix is it...?

$|a_\times| =$ [$\frac{1}{2}$ **mark**]

————————Question Ends Here————————

P.S.: For more information, read about 'Matrix multiplication form of Cross product'.