Sadiq Public School

Do the right, fear no man

Subject: Physics (Revision) **Class: I1** **Day: Saturday, November 16, 2024**

Lesson: [Chapter # 02] this lesson is about **Cross Product.**

A: Inquiry

How does the cross product differ from the dot product in terms of the result (scalar vs. vector)? When you calculate the cross product of two vectors, why does the resulting vector appear perpendicular to both original vectors? What factors affect the magnitude of the cross product of two vectors? If you were to calculate the cross product of two parallel vectors, what would the magnitude of the resulting vector be? Why? In what real-life situations might it be useful to calculate the cross product of two vectors? Can you think of examples in physics or engineering? The cross product is used to find the torque exerted on an object. How does the direction of the torque vector relate to the direction of the force and the lever arm?

B: Information:

Definition: If the product of two vectors results into a vector quantity then this product is called vector or cross product. $\vec{A}x\vec{B}=AB\sin\theta\hat{n}$.In this case AB sinθ give magnitude and $\hat{n}$ give direction, which is found by right hand rule

Right Hand Rule: Rotate the fingers of your right hand through some possible angle then erect thumb will show the direction of vector product.

Example: (1) Torque $\vec{\tau}=\vec{r}*\vec{F}=rF\sin\theta\hat{n}$. (2) Angular momentum $\vec{L}=\vec{r}*\vec{P}=rP\sin\theta\hat{n}$

Characteristics: Properties of Vector/ cross product are as follows.

(1) Vector product is not commutative as $\vec{A}x\vec{B}\neq\vec{B}x\vec{A}$ but $\vec{A}x\vec{B}=-\vec{B}x\vec{A}$

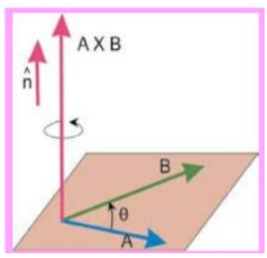
(2) Vector product of two mutually perpendicular vector has maximum value Θ=90°, $\vec{A}x\vec{B}=AB\sin\theta 90°\hat{n}=AB\hat{n}$,
$\hat{i}x\hat{j}=\hat{k},\quad \hat{j}x\hat{k}=\hat{i}\ ,\quad \hat{k}x\hat{i}=\hat{j}$, where in reverse $\hat{j}x\hat{i}=-\hat{k},\quad \hat{k}x\hat{j}=-\hat{i}\ ,\ \hat{i}x\hat{k}=-\hat{j}$ unit vector case
$\text{Proof}:\hat{i}x\hat{j}=(1)(1)\sin90^{\circ}\hat{k}=(1)(1)(1)\hat{k}=\hat{k}$

(3) Vector/Cross product two parallel or anti-parallel vector is null vector i.e. Θ=0°,180°, $\vec{A}x\vec{B}=AB\sin\theta 0°\hat{n}=\vec{0}$
$\hat{i}x\hat{i}=\hat{j}x\hat{j}=\hat{k}x\hat{k}=\vec{0}$ as $\hat{i}x\hat{i}=(1)(1)\sin0^{\circ}=\vec{0}$

(4) Cross product in terms of rectangular components is expressed in determinant form

$$\vec{A}x\vec{B}=\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\Ax&Ay&Az\\Bx&By&Bz\end{vmatrix}=\hat{i}\begin{vmatrix}Ay&Az\\By&Bz\end{vmatrix}-\hat{j}\begin{vmatrix}Ax&Az\\Bx&Bz\end{vmatrix}+\hat{k}\begin{vmatrix}Ax&Ay\\Bx&By\end{vmatrix}$$

$$\vec{A}x\vec{B}=(AyBz-AzBy)\hat{i}+(AzBx-AxBz)\hat{j}+(AxBy-AyBx)\hat{k}$$



(5) The magnitude of $\vec{A}x\vec{B}$ is equal to area of parallelogram with two A and B adjacent sides.

C: Synthesising/absorbing the information:

- What is Vector/Cross product? Explain its characteristics.
- Two vectors have unequal magnitudes. Can their sum be zero? Explain.
- Name the three different conditions that could make $A_1\times A_2=0$.
- If all the components of the vectors A_1andA_2 were reversed, how would this alter $A_1\times A_2$?

For reference Book page no. 32

D: Practising

- Write the answers in your notebook, and prepare them well for the exams.

E: Feedback

- Students please if you have any questions at all about the topics, any word you did not understand, anything at all, please send your concerned teacher an email and you will get a reply ASAP.

Class	Teachers' Names	Teachers' Abbreviations	Teachers' Email Addresses	Instructions
I1 A	Muhammad Jahanzeb Ashraf	MJA	Jahanzeb_MJA_sadiq@protonmail.com	I1 A students will send their home assignments to their subject teacher (MJA) for checking and getting feedback.
I1 B	Muhammad Saleem Nawaz	MSN	Saleemnawaz_msn_sadiq@protonmail.com	I1 B students will send their home assignments to their subject teacher (MSN) for checking and getting feedback.
I1 C	Zain ul Abideen	ZA	Zain.abdein2301@gmail.com	I1 C students will send their home assignments to their subject teacher (ZA) for checking and getting feedback.
I1 D	Rao Ali Ayub	RAA	raoaliayub_RAA_sadiq@protonmail.com	I1 D students will send their home assignments to their subject teacher (RAA) for checking and getting feedback.
I1 GA	Mehboob Alam	MA	Mahboobalam_MA_sadiq@protonmail.com	I1 GA students will send their home assignments to their subject teacher (MA) for checking and getting feedback.
I1 GB	Nighat Zahoor	NZ	Zahoor_NZ_sadiq@protonmail.com	I1 GB students will send their home assignments to their subject teacher (NZ) for checking and getting feedback.