

UG - Semester - I - MJC - Physics

Vector Triple Product and their significance :-

For three vectors \vec{A} , \vec{B} and \vec{C} , the vector triple product is written as

$$\vec{A} \times (\vec{B} \times \vec{C})$$

Significance :-

The main significance of the vector triple product lies in its result and the ability to simplify complex vector expressions :-

(1) Result is a vector -

Unlike the scalar triple product the vector triple product results in a vector.

(2) Vector in the plane - The resultant vector $\vec{A} \times (\vec{B} \times \vec{C})$ always lies in the plane formed by vectors \vec{B} and \vec{C} and is perpendicular to vector \vec{A} .

(3) BAC - CAB - Rule -

The vector triple product can be expanded using the formula known as the BAC-CAB rule -

$$\vec{A} \times (\vec{B} \times \vec{C}) = (\vec{A} \cdot \vec{C}) \vec{B} - (\vec{A} \cdot \vec{B}) \vec{C}$$

This rule is a powerful tool for simplifying vector equations in three dimensional space.

Application - The vector triple product finds extensive use in various fields, particularly in physics and engineering -

Physics - It is frequently used in

- Classical mechanics - calculating forces and torque, particularly in rotational dynamics.
- Astronomy - It is used in applications like deriving Kepler's First Law of Planetary Motion.

→ Electromagnetism -
Simplifying expressions
involving curl of the magnetic
field, often appearing
in Maxwell's equations and
the Lorentz force.

