Maths Formula Sheet

Chapter by chapter, topic by topic. Written by the PadhoNa team for quick revision.

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CHAPTER 28

Vector Algebra

Vectors, addition and section formula

MAGNITUDE AND UNIT VECTOR

$$\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}, \qquad |\vec{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}, \qquad \hat{a} = \frac{\vec{a}}{|\vec{a}|}$$

SECTION FORMULA

$$\vec{r} = \frac{m\vec{b} + n\vec{a}}{m+n} \text{ (internal)}$$

COLLINEAR

$$\vec{a} = \lambda\vec{b}; \qquad \text{points collinear} \iff \overrightarrow{AB} = \lambda\overrightarrow{AC}$$

Scalar (dot) product

$$\vec{a}\cdot\vec{b} = |\vec{a}||\vec{b}|\cos\theta = a_1b_1 + a_2b_2 + a_3b_3$$

PROJECTION

$$\text{projection of } \vec{a} \text{ on } \vec{b} = \frac{\vec{a}\cdot\vec{b}}{|\vec{b}|}$$

$$\vec{a} \perp \vec{b} \iff \vec{a}\cdot\vec{b} = 0; \qquad |\vec{a}+\vec{b}|^2 = |\vec{a}|^2 + |\vec{b}|^2 + 2\,\vec{a}\cdot\vec{b}$$

Vector (cross) product

$$\vec{a}\times\vec{b} = |\vec{a}||\vec{b}|\sin\theta\,\hat{n} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$$

AREA

$$\text{parallelogram } |\vec{a}\times\vec{b}|; \qquad \text{triangle } \tfrac{1}{2}|\vec{a}\times\vec{b}|$$

LAGRANGE'S IDENTITY

$$|\vec{a}\times\vec{b}|^2 + (\vec{a}\cdot\vec{b})^2 = |\vec{a}|^2|\vec{b}|^2$$

Triple products

SCALAR TRIPLE PRODUCT

$$[\vec{a}\,\vec{b}\,\vec{c}] = \vec{a}\cdot(\vec{b}\times\vec{c}) = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

Volume of the parallelepiped; zero iff the vectors are coplanar. Tetrahedron volume is $\frac{1}{6}[\vec{a}\,\vec{b}\,\vec{c}]$.

VECTOR TRIPLE PRODUCT

$$\vec{a}\times(\vec{b}\times\vec{c}) = (\vec{a}\cdot\vec{c})\,\vec{b} - (\vec{a}\cdot\vec{b})\,\vec{c}$$

$$[\vec{a}\times\vec{b}\;\;\vec{b}\times\vec{c}\;\;\vec{c}\times\vec{a}] = [\vec{a}\,\vec{b}\,\vec{c}]^2$$

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