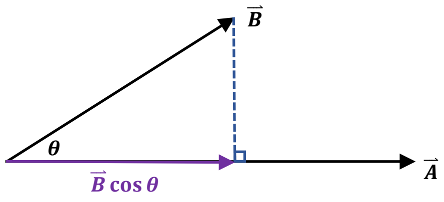
Vector

Dot Product



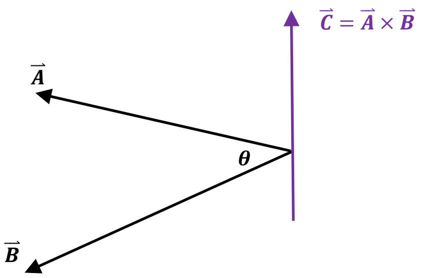
$\boxed{\vec{A}\cdot\vec{B} = AB\cos\theta}$

the result of dot product is a scalar
the physical meaning of dot product is vector projection

for 2-D system: $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y$

for 2-D system: $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$

Cross Product



$\boxed{\left|\vec{A}\times\vec{B}\right| = AB\sin\theta}$

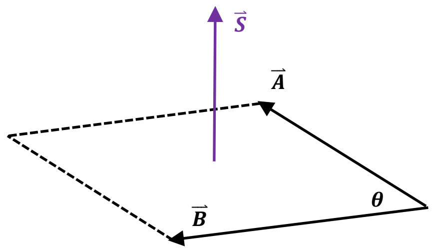
the result of a dot product is a vector perpendicular to $\vec{A}$ and $\vec{B}$ according to right hand rule

the physical meaning of cross product is the area of parallelogram formed by $\vec{A}$ and $\vec{B}$

for 2-D system: $\vec{A}\times\vec{B} = \begin{vmatrix} A_x & A_y \\ B_x & B_y \end{vmatrix} = A_xB_y - A_yB_x$

for 3-D system: $\vec{A}\times\vec{B} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} = \left(A_yB_z - A_zB_y\right)\hat{x} - \left(A_xB_z - A_zB_x\right)\hat{y} + \left(A_xB_y - A_yB_x\right)\hat{z}$

Vector of surface



for the surface formed by $\vec{A}$ and $\vec{B}$

$$\vec{S} = S\hat{n} = \vec{A} \times \vec{B}$$
$$\hat{n} = \frac{\vec{A} \times \vec{B}}{|\vec{A} \times \vec{B}|}$$

the angle θ between two surface can be calculated by surface vectors $\hat{n}_1$ and $\hat{n}_2$

$$\cos\theta = \frac{\hat{n}_1 \cdot \hat{n}_2}{|\hat{n}_1||\hat{n}_2|} \Rightarrow \theta = \cos^{-1}\left(\frac{\hat{n}_1 \cdot \hat{n}_2}{|\hat{n}_1||\hat{n}_2|}\right)$$

two surface vector should not point to the same clockwise direction