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6.6 Vector Product

587. Vector Product of Vectors $\vec{u}$ and $\vec{v}$
$\vec{u}\times\vec{v}=\vec{w}$, where

- $|\vec{w}|=|\vec{u}|\cdot|\vec{v}|\cdot\sin\theta$, where $0\le\theta\le\frac{\pi}{2}$;
- $\vec{w}\perp\vec{u}$ and $\vec{w}\perp\vec{v}$;
- Vectors $\vec{u}$, $\vec{v}$, $\vec{w}$ form a right-handed screw.

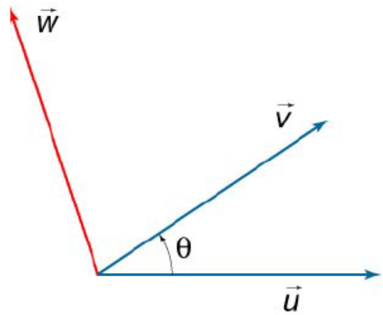

Figure 83.

588. $\vec{w}=\vec{u}\times\vec{v}=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ X_1 & Y_1 & Z_1\\ X_2 & Y_2 & Z_2\end{vmatrix}$

589. $\vec{w}=\vec{u}\times\vec{v}=\left(\begin{vmatrix}Y_1 & Z_1\\ Y_2 & Z_2\end{vmatrix}, -\begin{vmatrix}X_1 & Z_1\\ X_2 & Z_2\end{vmatrix}, \begin{vmatrix}X_1 & Y_1\\ X_2 & Y_2\end{vmatrix}\right)$

590. $S=|\vec{u}\times\vec{v}|=|\vec{u}|\cdot|\vec{v}|\cdot\sin\theta$ (Fig.83)

591. Angle Between Two Vectors (Fig.83)
$\sin\theta=\frac{\vec{u}\times\vec{v}}{|\vec{u}|\cdot|\vec{v}|}$

592. Noncommutative Property
$\vec{u}\times\vec{v}=-(\vec{v}\times\vec{u})$

593. Associative Property
$(\lambda\vec{u})\times(\mu\vec{v})=\lambda\mu\vec{u}\times\vec{v}$

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594. Distributive Property
$\vec{u}\times(\vec{v}+\vec{w})=\vec{u}\times\vec{v}+\vec{u}\times\vec{w}$

595. $\vec{u}\times\vec{v}=\vec{0}$ if $\vec{u}$ and $\vec{v}$ are parallel ($\theta=0$).

596. $\vec{i}\times\vec{i}=\vec{j}\times\vec{j}=\vec{k}\times\vec{k}=\vec{0}$

597. $\vec{i}\times\vec{j}=\vec{k}$, $\vec{j}\times\vec{k}=\vec{i}$, $\vec{k}\times\vec{i}=\vec{j}$