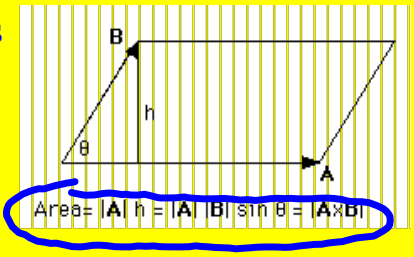
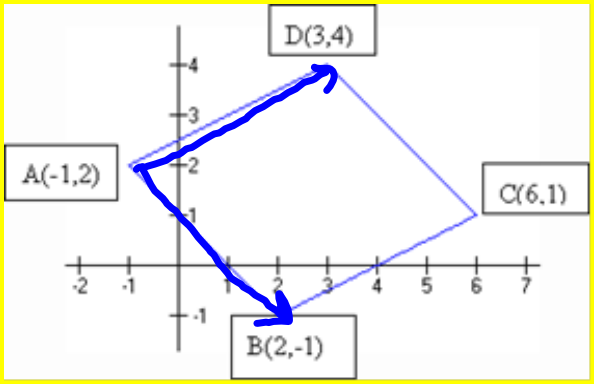
Lesson 9: Vector Cross Product Applications



A) Area of a Parallelogram

$$\text{Area} = |A| \cdot h = |A||B|\sin\theta = |A \times B|$$

Example A: Find the area of the parallelogram defined by the four points.



$\vec{AD} = \langle 4, 2, 0 \rangle$

$\vec{AB} = \langle 3, -3, 0 \rangle$

$$|\vec{AD} \times \vec{AB}| \Rightarrow \begin{vmatrix} i & j & k \\ 4 & 2 & 0 \\ 3 & -3 & 0 \end{vmatrix}$$

$$= |\langle 0, 0, -18 \rangle|$$

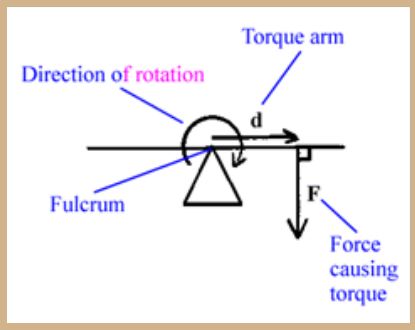
$$= \sqrt{0^2 + 0^2 + 18^2}$$

$$= 18 \text{ units}^2$$

B) Torque

(Do not copy; available http://www.physics.uoguelph.ca/tutorials/torque/Q.torque.intro.html)

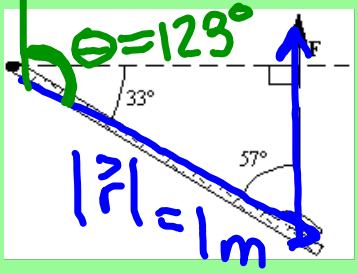
***Torque* is a measure of how much force acting on an object causes that object to rotate.** The object rotates about an axis, which we will call the **pivot point**, and will label 'O'. We will call the force '**F**'. The distance from the pivot point to the point where the force acts is called the **moment arm**, and is denoted by '**r**'. Note that this distance, '**r**', is also a vector, and points from the axis of rotation to the point where the force acts.



$$\tau = \vec{r} \times \vec{F}$$

Touch Here

Example B: You shut a door that is left slightly open. The force you exert on the door is 50N, applied 57° to the plane of the door. The door is 1.0m wide. Assuming you push the door at its edge, what is the torque on the door?



$$\tau = \vec{r} \times \vec{F}$$
$$= |\vec{r}||\vec{F}|\sin\theta$$
$$= (1)(50)(\sin 123°)$$
$$\doteq 41.9 \text{ N·m OUT}$$