Moment of a Force : Vector Formulation

6. Direction of the moment of a force.

$\vec{M}_o = \vec{r} \times \vec{F}$

$\vec{M}_o$ is **NOT** $\vec{F} \times \vec{r}$

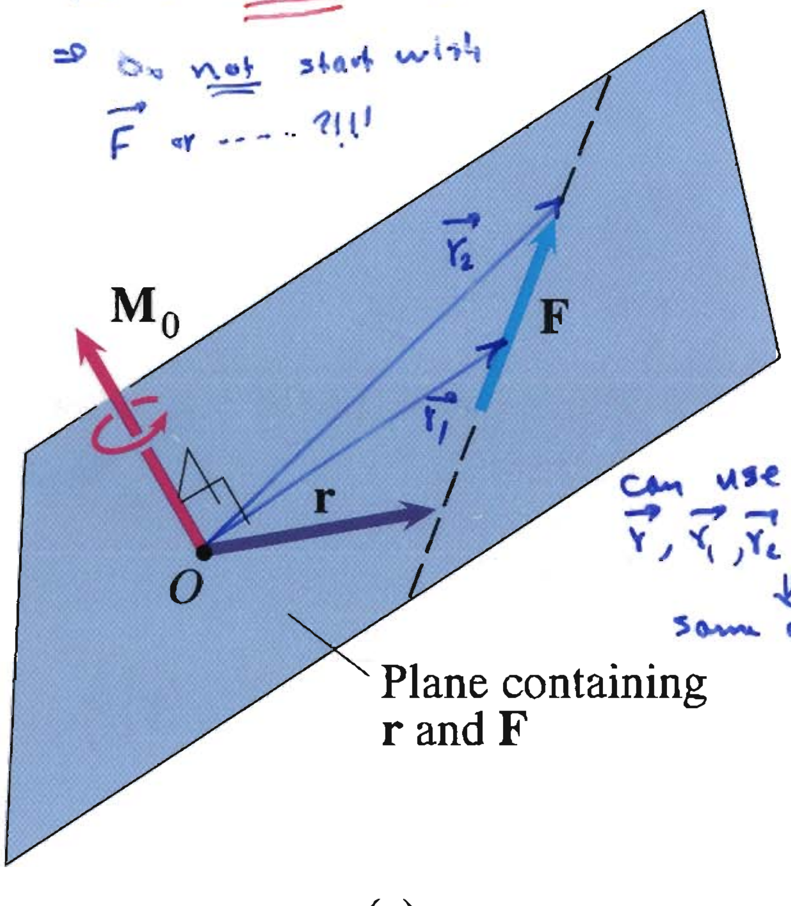
$\Rightarrow$ Do not start with $\vec{F}$ or ..... ?!!!

$\vec{M}_o = \vec{r} \times \vec{F}$

$M_o = r F \sin\theta$

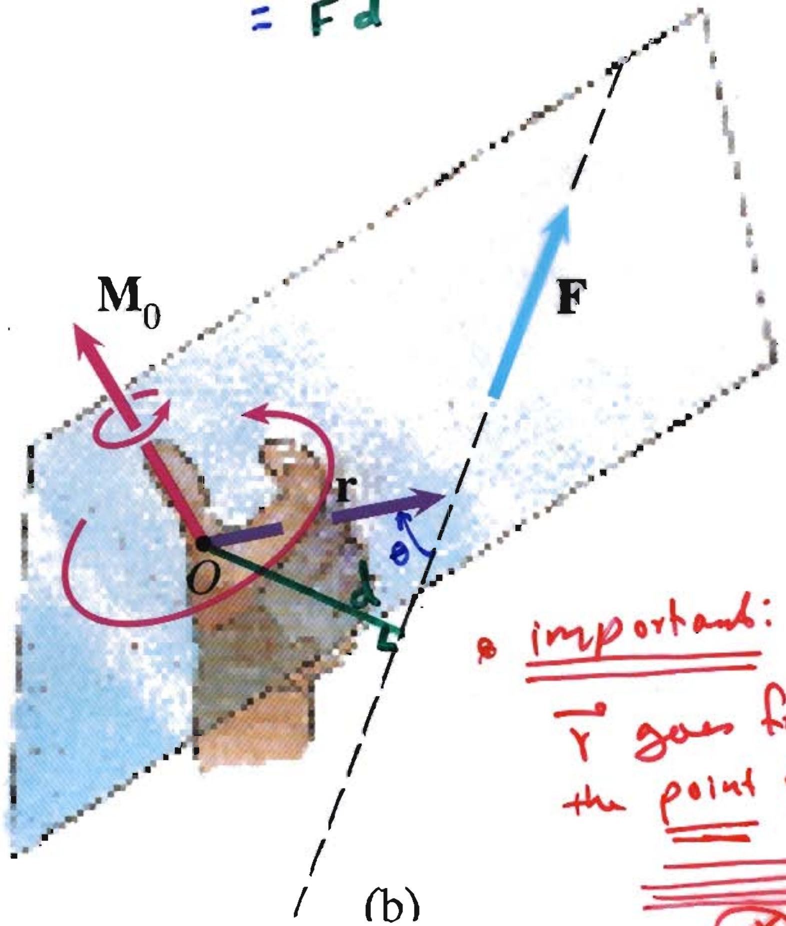
$= F (r \sin\theta)$

$= F d$



(a)

Can use $\vec{r}, \vec{r}_1, \vec{r}_2$ ....etc.
$\Downarrow$
same answer !!



(b)

* important: $\vec{r}$ goes from the point to $\vec{F}$ (*)

Principle of Transmissibility:

The force can be slided along its line of action.

The same moment is obtained $\Rightarrow$ Force is a sliding vector.

$$\vec{M} = \vec{r} \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

$$= \text{-------}$$

2-D is a special case of 3-D $\Rightarrow$

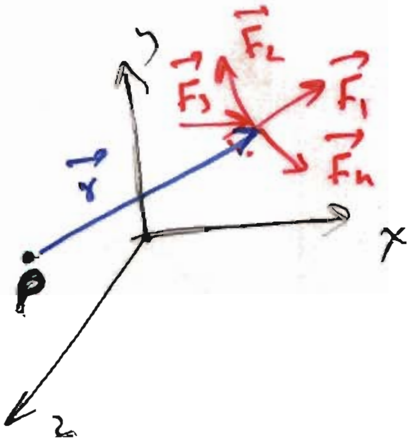
$M_x = 0$
$M_y = 0$
$M_z \neq 0$ $\Leftarrow$ The only component in 2-D ((x-y))

$$\vec{M}_R = \sum (\vec{r}_i \times F_i)$$

Principle of Moments [Varignon's theorem] :
↳ French mathematician

For concurrent forces,

$$\vec{M} = \vec{r} \times \vec{F}_1 + \vec{r} \times \vec{F}_2 + \cdots + \vec{r} \times \vec{F}_n$$
$$= \vec{r} \times (\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \cdots + \vec{F}_n)$$
$$= \vec{r} \times \vec{R}$$



* Very important :

$\vec{r}$ is directed from the point the moment is taken about to any point on the line of action of $\vec{F}$.