

# PLANE Kinetics of Rigid Bodies

(G1)

## WORK and ENERGY

work done by a force  $\vec{F}$  is

$$U = \int \vec{F} \cdot d\vec{r} \quad \text{or} \quad U = \int F \cos(\phi) ds \quad \text{SCALAR}$$

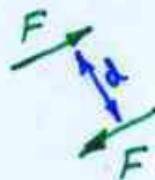
SCALAR-DOT PRODUCT

$\phi$  is angle between  $\vec{F}$  &  $d\vec{r}$

WORK DONE BY a COUPLE  $M$  is

$$U = \int M d\theta$$

RECALL, A COUPLE is 2 opposite forces  
 $M = Fd$



if we TRANSLATE A couple,  
 WORK DONE BY FORCES  
 CANCELS OUT (OR IS ZERO)

## Kinetic Energy:

TRANSLATION:

$$T = \frac{1}{2} m v^2$$

## FIXED Axis Rotation:

CONSIDER PARTICLE  $m_i$

$$v_i = r_i \omega$$

$$\text{K.E. of Particle is } T_i = \frac{1}{2} m_i r_i^2 \omega^2$$

FOR WHOLE BODY

$$T = \sum T_i = \sum \frac{1}{2} m_i r_i^2 \omega^2 = \frac{1}{2} \omega^2 \sum m_i r_i^2$$

$m_i \rightarrow dm \Rightarrow$  integration

$$T = \frac{1}{2} \omega^2 \underbrace{\int m_i r_i^2}_{I_0} \Rightarrow T = \frac{1}{2} I_0 \omega^2$$

