PLANAR MOTION OF RIGID BODIES WILL BE ANALYZED USING THE METHOD OF WORK AND ENERGY AND THE METHOD OF IMPULSE AND MOMENTUM.

WORK/ENERGY:
- WORK OF A FORCE
- WORK OF A COUPLE
- KINETIC ENERGY OF A RIGID BODY
- CONSERVATION OF ENERGY

IMPULSE/MOMENTUM:
- CONSERVATION OF ANGULAR MOMENTUM
- ECCENTRIC IMPACT OF RIGID BODIES

PRINCIPLE OF WORK AND ENERGY

$T_1 + U_{1-2} = T_2$

T_1 = INITIAL TOTAL KINETIC ENERGY OF RIGID BODY

T_2 = FINAL TOTAL K.E.

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U_{1-2} = WORK OF ALL FORCES ON BODY

TOTAL K.E.: $T = \frac{1}{2} \sum_{i=1}^{n} \Delta m_i v_i^2$

n = NUMBER OF PARTICLES MAKING UP BODY

Δm_i = MASS OF PARTICLES

v_i = VELOCITY OF PARTICLES

$$\mathcal{U}_{1-2} = \int \vec{F} \cdot d\vec{r} = \int_{s_1}^{s_2} (F \cos\alpha)\, ds$$

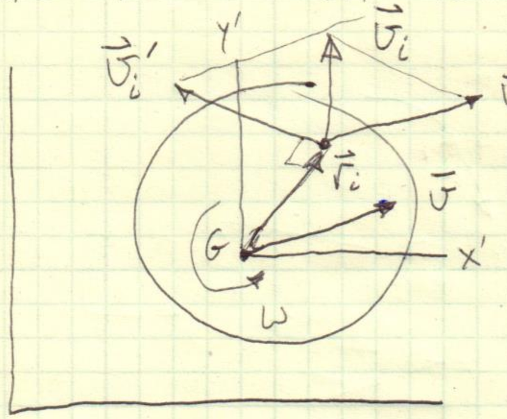
WORK OF A FORCE DURING DISPLACEMENT ALONG A PATH.

$$\mathcal{U}_{1-2} = \int_{\theta_1}^{\theta_2} M\, d\theta$$

WORK OF A COUPLE DURING ~~AN~~ A FINITE ROTATION OF THE BODY. IF THE MOMENT M IS CONSTANT,

$$\mathcal{U}_{1-2} = M(\theta_2 - \theta_1)$$

USING A CENTROIDAL REFERENCE FRAME, (SEC. 14.7):



$$v_i' = r_i \omega$$

$$T = \frac{1}{2} m \bar{v}^2 + \frac{1}{2} \sum_{i=1}^{n} \Delta m_i v_i'^2 = \frac{1}{2} m \bar{v}^2 + \frac{1}{2}\left(\sum_{i=1}^{n} r_i'^2 \Delta m_i\right)\omega^2$$

$$T = \underbrace{\frac{1}{2} m \bar{v}^2}_{\text{TRANSL.}} + \underbrace{\frac{1}{2} \bar{I} \omega^2}_{\text{ROTATION}}$$

$\bar{I}$ = MASS MOMENT OF INERTIA ABOUT MASS CENTER G

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~~FOR SYSTEMS OF RIGID BODIES, THE PRINCIPLE~~

OF WORK AND ENERGY IS

$T_1 + U_{1-2} = T_2$

T = KINETIC ENERGY OF ALL BODIES (TRANSL. + ROTATION)

~~U = WORK DONE BY FORCES ON BODIES~~

CONSERVATION OF ENERGY (NO FRICTION DISSIPATION)

FOR A SYSTEM OF RIGID BODIES:

$T_1 + V_1 = T_2 + V_2$ (KE + PE = CONSTANT)

POWER = TIME RATE AT WHICH WORK IS DONE

FOR A BODY ACTED ON BY A FORCE MOVING WITH A VELOCITY $\vec{v}$;

$$P = \vec{F} \cdot \vec{v} \quad (N)\left(\frac{m}{s}\right)$$

FOR A RIGID BODY ROTATING AT ANGULAR VELOCITY ω,

$$P = M\omega \quad (N \cdot m)\left(\frac{RAD}{s}\right) = \frac{N \cdot m}{s}$$

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