

Power can also be expressed as rate at which total mechanical energy of a rigid body or system of such bodies is changing

$$P = \frac{dU'}{dt} = \dot{T} + \dot{V}_g + \dot{V}_e = \frac{d}{dt}(T + V)$$

i.e.

Power Developed
By active forces
& couples = Rate of change
of Mechanical
Energy.

Note:

$$\dot{T} = \frac{dT}{dt} = \frac{d}{dt} \left(\frac{1}{2} m \vec{v} \cdot \vec{v} + \frac{1}{2} I_G \omega^2 \right)$$

$$= \frac{1}{2} m (\vec{a} \cdot \vec{v} + \vec{v} \cdot \vec{a}) + I_G \omega \dot{\omega}$$

$$= m \vec{a}_G \cdot \vec{v}_G + I_G \alpha \omega$$

$$\dot{T} = \vec{R} \cdot \vec{v}_G + M_G \omega$$

\vec{R} is resultant ^{force} of ALL forces acting on body

\vec{M} is resultant moment about G of ALL forces.