Work, Energy & Power

Work

$W \equiv \int_C \vec{F} \cdot d\vec{s}$ *Work done by Force $\vec{F}$ with point of application P with displacement $d\vec{s}$ as P moves along the curve C*

Work Done by an Action Reaction Pair

$dW = F dr_{AB}$ *Net work done by an action-reaction pair $(\vec{F}, -\vec{F})$ depends only on the change of distance r_{AB} between the particles A and B*

Work Done by Internal forces in a Rigid Body

$dW = 0$

Kinetic Energy & Work Energy Theorem: WET

$K \equiv \frac{1}{2}mv^2$ *Kinetic Energy K*

$W_{net} = \Delta K$ *Work Energy Theorem*

Conservative Forces

Conservative Force: *An internal force (pair) such that work done between two configurations of the system is dependent only on the initial and final configurations and not on the path taken or orientation of the configurations*

Potential Energy

$\Delta U \equiv -W_c$ *Definition of Potential Energy*

$\mathcal{M} \equiv K + U$ *Mechanical Energy*

$U = \frac{1}{2}kx^2$ *Spring Elastic PE*

$\Delta U = mg\Delta h$ *Change in Terrestrial Gravitational PE*

Work Mechanical Energy Theorem: WMET

$K_i + U_i + W_{ext} + W_{nc} = K_f + U_f$

Principle of Conservation of Mechanical Energy: PCME

$K_i + U_i = K_f + U_f$ *if* $W_{ext} = W_{nc} = 0$

$\mathcal{M}_i = \mathcal{M}_f$ *Mechanical Energy $\mathcal{M}$*

Power

$\mathcal{P} \equiv \frac{dW}{dt} = \vec{F} \cdot \vec{v}$

$\mathcal{P}_{net} \equiv \frac{dW_{net}}{dt} = \frac{dK}{dt} = mv\frac{dv}{dt} = m\,\vec{a} \cdot \vec{v}$

1 HP ≅ 745.7 Wt *Mechanical Horsepower*

Law of Conservation of Energy

Total Energy of an isolated system is always conserved