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Review for Final Exam

Comprehensive: Refer back to Reviews for Ex's I, II, & III.

Coverage: Exams I, II, III & Work Energy Principle

Today: Review & discuss work/energy Principle

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For particles (Chapter 14)

For a single ptcle:

$$T_1 + U_{1-2} = T_2 \quad , \quad T = \frac{1}{2} m v^2$$

"1", "2" are two geometrical configurations

U_{1-2} = Work done by external forces on the ptcle

$$U_{1-2} = \int_{s_1}^{s_2} \vec{F}(s) \cdot dr$$

When the external force $\vec{F}(s)$ is gravity.

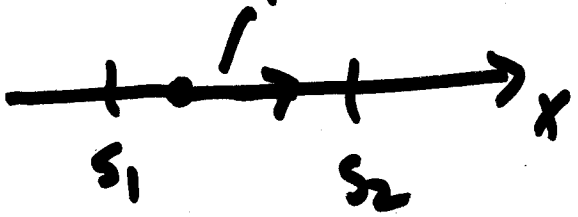
$$U_{1-2} = -W(y_2 - y_1)$$

University of Idaho When the external force $\vec{F}(s)$ is a spring

$$U_{1-2} = -\frac{1}{2}k(x_2^2 - x_1^2)$$

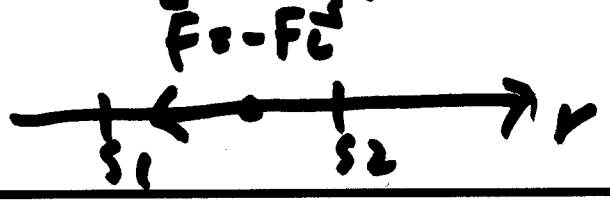
$x=0$ located at unstretched position of spring

When the force is externally applied, in direction of motion $\vec{F} = F\vec{i}$



$$U_{1-2} = F(s_2 - s_1)$$

When opposite direction of motion:



$$U_{1-2} = -F(s_2 - s_1)$$

University of Idaho Summarizing

$T_1 + U_{1-2} = T_2$, $T = \frac{1}{2}mv^2$

For many situations: $U_{1-2} = -W(y_2 - y_1)$, $U_{1-2} = -\frac{1}{2}k(x_2^2 - x_1^2)$

$U_{1-2} = F(s_2 - s_1)$, $U_{1-2} = -F(s_2 - s_1)$, $U_{1-2} = F\cos\theta(s_2 - s_1)$

otherwise $U_{1-2} = \int_{s_1}^{s_2} \vec{F}(s) \cdot d\vec{s}$

<u>Conservation of Energy</u>: If the only external forces acting on a particle between 1-2 are gravity and spring(s):

$T_1 + V_1 = T_2 + V_2$ $\quad V = V_e + V_g = \frac{1}{2}ks^2 + Wy$

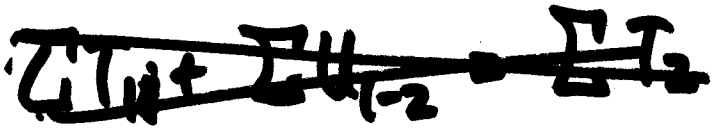
University of Idaho $V_1 = \frac{1}{2}ks_1^2 + Wy_1$ (k)

$V_2 = \frac{1}{2}ks_2^2 + Wy_2$

$T_1 + \frac{1}{2}ks_1^2 + Wy_1 = T_2 + \frac{1}{2}ks_2^2 + Wy_2$

$T_1 - \frac{1}{2}k(s_2^2 - s_1^2) - W(y_2 - y_1) = T_2$

Work Energy Applied to a system of particles i



$$\sum_i \frac{1}{2}mv_{i1}^2 + \sum_i U_{1-2,i} = \sum_i \frac{1}{2}mv_{i2}^2$$

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$U_{1\to 2,i}$ = Work done by <u>external</u> forces on ptcle i.

Does not include equal & opposite internal forces between ptcles in system.

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Work Energy Principle For Rigid Bodies

For one body

$$T_1 + U_{1-2} = T_2 \qquad T = \frac{1}{2}mv^2 + \frac{1}{2}I_G\omega^2$$

$$U_{1-2} = \begin{cases} \int_{s_1}^{s_2} \vec{F}(s)\cdot d\vec{s} \rightarrow \text{same case as for ptcles.} \\ \int_{\theta_1}^{\theta_1} M\,d\theta \quad \text{(Moments caused by external forces)} \end{cases}$$

Like for ptcles, we can also apply the work-energy principle to systems of rigid bodies