Work and Energy

Work

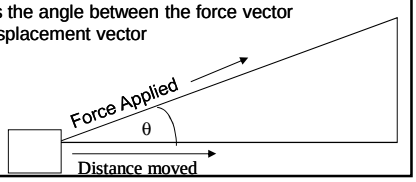
- **Definition**
  - **force applied over a distance**
  - **distance must be in the same direction as the force**
  - **SI Unit of Joules**
- **Equation (Linear)**
  - **Work = Force x Distance**
  - **W = F x D**

Work and Direction of Force

- **Work is only done if the force is exerted in the direction of motion.**
- **Force applied at an angle:**

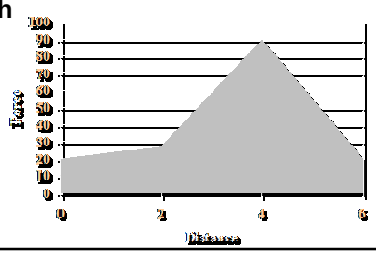
$$W = (F_A \cos\theta)d$$

Where θ is the angle between the force vector and the displacement vector



Varying Forces

- **Work can be found by finding the area under a Force vs. Distance graph**



Varying Forces - Springs

- **Any object that has an elastic property can have elastic potential energy.**
- **The force felt is directly proportional to the distance the object is stretched.**
- **This proportionality is dependent on the object itself, defined as the force constant, k.**

$$F_{spring} = -k\Delta x \quad \text{(Hook's Law)}$$

$$W_{spring} = \frac{1}{2}k(\Delta x)^2$$

Energy

- **Definition**
  - **The ability to do work**
- **Relation of energy and work**
  - **When you work, you are transferring energy to the object that you are working on.**
- **Unit of Measure**
  - **Joule (J)**

Mechanical Energy

- **(Gravitational) Potential Energy-**
  - **energy of vertical position** $U_g = mgh$
- **Kinetic Energy**
  - **Object's energy due to velocity** $K = \frac{1}{2}mv^2$
- **Potential Energy in a spring-**
  - **energy of a spring based on the amount of compression or stretch** $U_{spring} = \frac{1}{2}k\Delta x^2$

Work-Energy Theorem

- **The net work done on an object is equal to the change in its energy**

$$W = \Delta K$$

Law of Conservation of Energy

- **Within a closed and isolated system, energy can change form; but the total amount of energy is constant.**
- **Energy cannot be created or destroyed.**

$$K_i + U_i = K_f + U_f$$

Classifying Forces

- **Conservative**
  - **those forces that conform the law of conservation of energy**
  - **Ex: Gravitational, Elastic**
- **Dissipative**
  - **forces that produce deviations from the law of conservation of energy**
  - **produce forms of energy other than mechanical**