



Flipping Physics Lecture Notes: AP Physics 1 Review of *Work, Energy and Power*

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- $\Delta E = W = F_{\parallel} d = Fd \cos \theta$: In terms of an object or a group of objects which we call the system, the change in energy of the system equals the work done on the system which is equal to force times displacement times the angle between the force and the displacement. Work causes a change in energy of the system.
 - $F_{\parallel} = F \cos \theta$: The force parallel to the displacement is the force times the cosine of the angle between the force and the displacement of the object.
 - Identify which force you are using in the work equation.
 - Use the magnitude of the force and the displacement.
 - Dimensions for Work are Joules or Newtons times meters:
- Three types of mechanical energy:
 - *Kinetic Energy*: $KE = K = \frac{1}{2}mv^2$ (can't be negative)
 - Dimensions for energy are also Joules:

$$KE = \frac{1}{2}mv^2 \Rightarrow (kg) \left(\frac{m}{s} \right)^2 = \frac{kg \cdot m^2}{s^2} = \left(\frac{kg \cdot m}{s^2} \right) (m) = N \cdot m = J$$
 - *Elastic Potential Energy*: $PE_e = U_s = \frac{1}{2}kx^2$ (can't be negative)
 - *Gravitational Potential Energy*: $PE_g = mgh$ or $\Delta U_g = mg\Delta y$
 - PE_g **Can** be negative. If the object is below the horizontal zero line, then h, the vertical height above the zero, is line negative.
- Work and Energy are Scalars!
- Conservation of Mechanical Energy: $ME_i = ME_f$
 - Valid when there is no energy converted to heat, light or sound due to friction.
 - Identify the initial and final points. Identify the horizontal zero line.
 - Substitute in mechanical energies that are present.
- If there is friction & you need to use energy: $W_f = \Delta ME$ (Does not work when there is a force applied.)
- Power, the rate at which work is done or energy is transferred into or out of the system.
 - $P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t} = \frac{Fd \cos \theta}{\Delta t} = Fv \cos \theta$
 - Dimensions for Power are Watts which are Joules per second:
 - $P = \frac{\Delta E}{\Delta t} \Rightarrow \frac{J}{s} = \text{watts} \text{ \& } 746 \text{ watts} = 1 \text{ hp}$
- Hooke's Law: $|\vec{F}_s| = k|\vec{x}|$: The force of a spring is linearly proportional to the displacement from equilibrium position.
 - The slope of a graph of Force of a Spring vs. displacement from equilibrium position is the spring constant. $\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{F_s}{x} = k$
 - Typical dimensions for the spring constant are Newtons per meter: $\frac{F_s}{x} = k \Rightarrow \frac{N}{m}$