Conservation of Energy

- Work-Energy Principle
- Power

Conservation of Energy

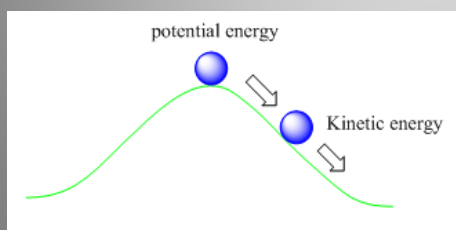
- Energy cannot be created or destroyed, but only changed from one form to another. It transforms without net loss or gain
  - When we say that some is conserved, we mean that it remains constant

2 types of Energy

1. **Mechanical Energy** –kinetic, gravitational Potential, elastic potential, and chemical potential energy
2. **Nonmechanical energy** – Nuclear, chemical, internal, and electrical

Conservation of Energy

Energy conservation is an idea that applies to all sciences: Energy cannot be created or destroyed, only transferred from one form into another.



In physics, we often describe the law of conservation of energy by saying “The total energy of a closed, isolated system must remain constant”

If we choose a system that doesn’t interact with anything outside the system, its total energy must remain constant:

$$E_{initial} = E_{final}$$

Conservation of Energy

- **Mechanical Energy** is the sum of KE and U present in a situation

$$ME = \sum KE + \sum U$$

- Mechanical Energy is also conserved

$$ME_i = Me_f$$

$$U_i + KE_i = U_f + KE_f$$

energy = final mechanical energy
(in the absence of friction)

Conservation of Energy and Work

Realistically, it's difficult to find a completely isolated system

To accurately express how energy is conserved, we need to account for the work done on the system:

$$E_{initial} + W_{external} = E_{final}$$

We often expand this to include kinetic and potential energy:

$$(K_i + U_i) + W_{ext} = (K_f + U_f)$$

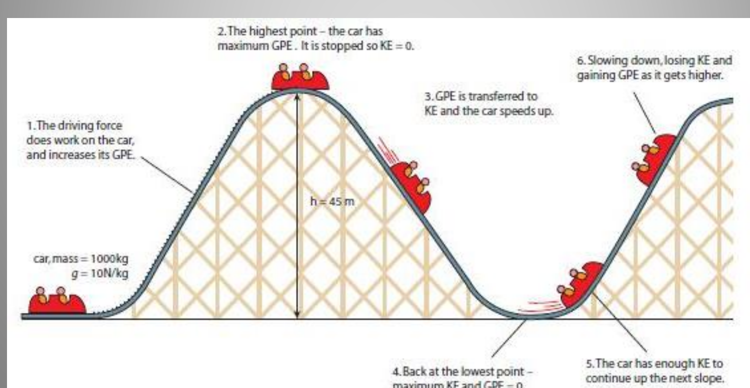
In essence, this equation says: The energy of a system is conserved, unless an external force does work on the system, causing it to change its energy

If no external forces do work on the system, we get the more traditional expression of energy conservation:

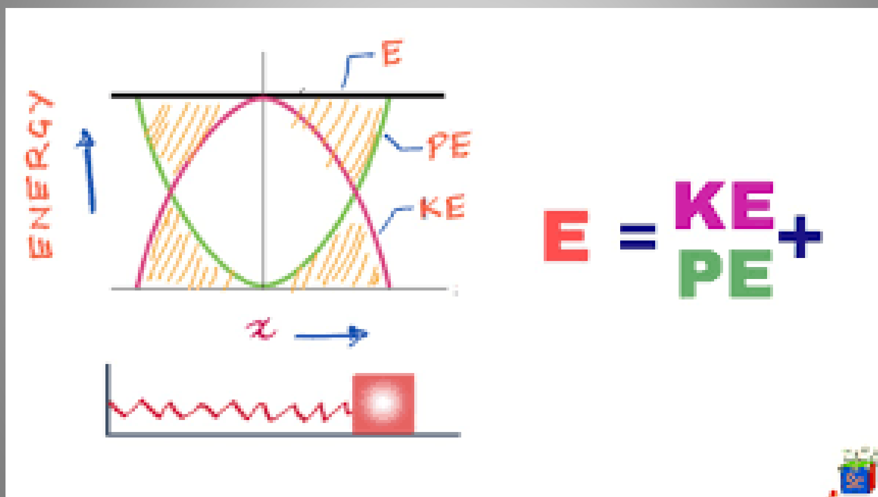
$$(K_i + U_i) = (K_f + U_f)$$

Conservation of Energy

- An object has the MOST KE when it's movement is the Greatest
- When an object has the LEAST U, it has the most KE

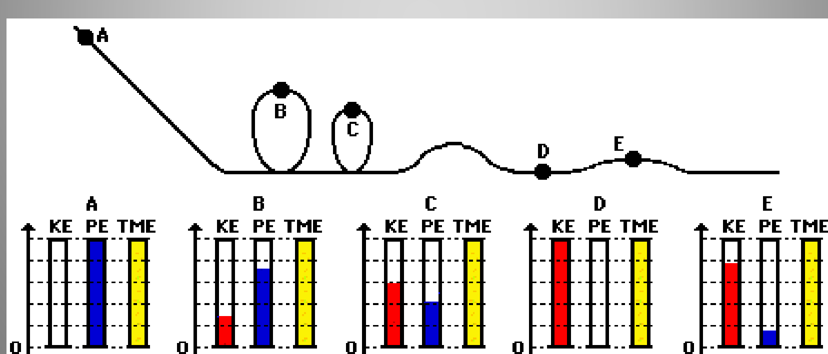


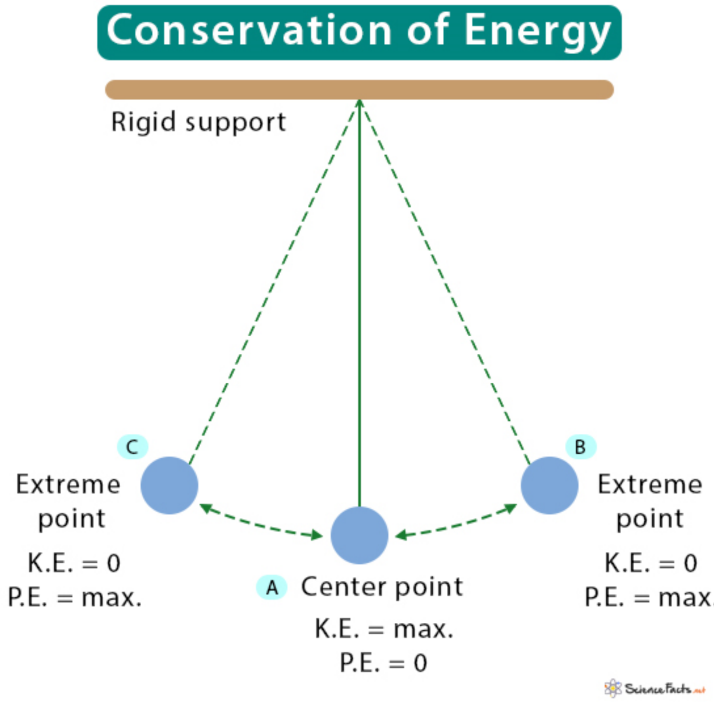
Conservation of energy



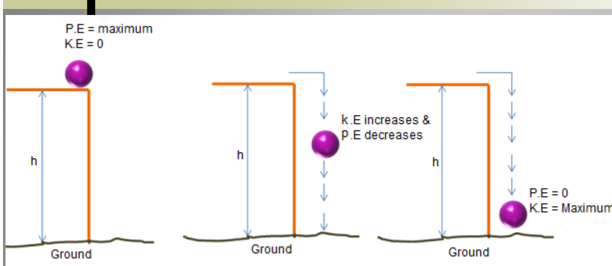
Work-Energy Bar Chart

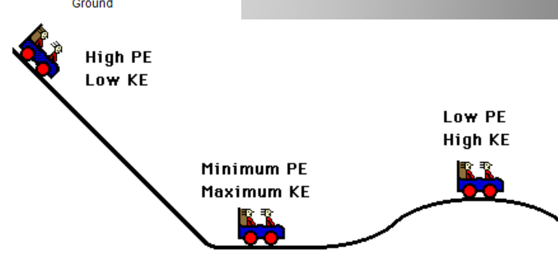
- Conceptual tool that is used to indicate the amount of energy, the form the energy has, and the manner in which the amount of and the form change over time.





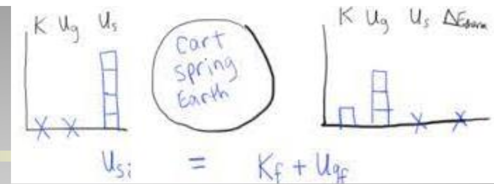
Conservation of Energy





As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

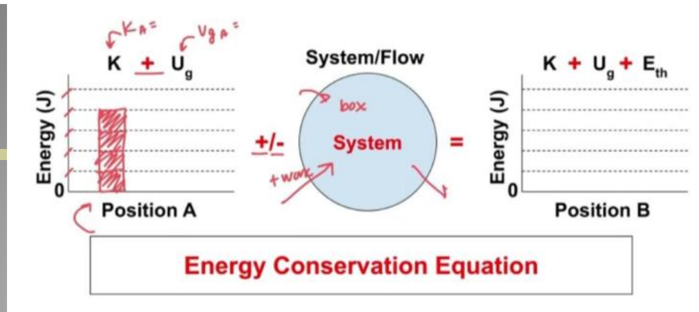
LOL Diagrams



- A way to represent how the energy is stored in the chosen system during various snapshots
- Represents any changes in total energy for the system.
- Each “L” represents how the energy is stored during a particular snapshot (instant).
- The “O” shows the objects inside and outside the system
  - If there are any objects outside the system doing work that object is written outside of the “O” with an arrow connecting it to the system and showing the direction of energy transfer.
  - The arrow is labeled with the type of interaction that is causing that transfer of energy

LOL Diagrams

- ALWAYS write in your system. Try to do it first, before drawing any of the bars.
- ALWAYS label the arrow as an object exerting a force on the system when there is work being done
- ALWAYS draw the LOL before jumping into equations



Steps

1. In the system chose what your analyzing. Indicate what is included in the system in the circle. If the system gains or looses energy via work by nonconservative forces, indicate that energy flow into or out of circle

2. Find the potential and kinetic energy at each point
   - Determine at each point of interest
   - KE – moving? fast?
   - U_g – Height
   - U_s – Stretched or compressed?

3. Use these relationships to solve for missing variables