Name: _____ Unit 1: Force & Motion NOTES: 2.04

FOCUS: Energy

ESSENTIAL QUESTION: Can you explain what it means for energy to be transferred between systems? Can you state the Law of Conservation of Energy and explain what it means?

What do we already know?

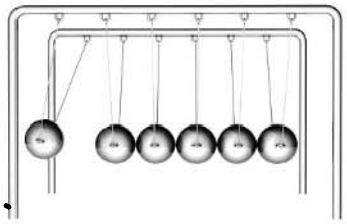
- The mechanical energy of an object is the sum of the object's kinetic and potential energies, or the sum total of all of its ability to do work.
- In a mechanical system such as a rollercoaster, elevator, or pendulum, as the kinetic energy increases, potential energy must decrease and vice versa.
- A mechanical system is a system of parts that interact to use a power source in order to accomplish a task using force and motion.

The Law of Conservation of Energy

- Energy within and between mechanical systems is governed by the Law of Conservation of Energy. which says:
  - "Energy can never be created or destroyed. It is simply transferred from one object to another or transformed from one form to another."
  - "The TOTAL Energy of a closed system is constant."
- What is a "closed system"?
  - Closed System: an isolated system in which no energy can enter or leave

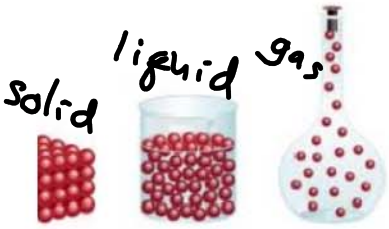
Name: _____ Unit 1: Force & Motion NOTES: 2.04

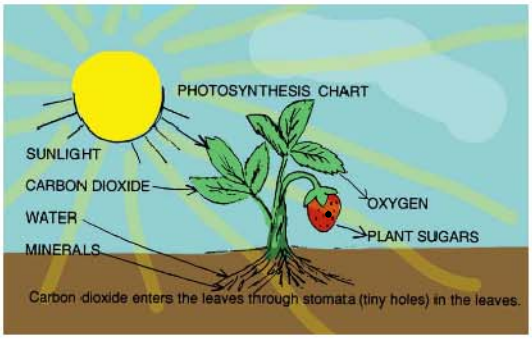
- Example: Newton's Cradle
  - The potential energy given to the first sphere by lifting it is transferred through all the other spheres when it is dropped.
  - In the absence of friction, the spheres would continue rocking forever as energy is transferred back and forth.
  - In reality, friction causes some of the energy to be lost into heat and sound.



Types of Energy

- Energy can come in many forms, including:
  - **Kinetic Energy** – The energy of motion.
  - **Potential Energy** – The stored energy an object has due to its position
  - **Thermal Energy** – The heat energy that comes from the vibration of molecules within matter.
  - **Chemical Energy** – The energy stored within the bonds between atoms and molecules in food and fuel.



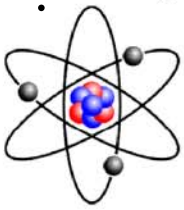


Name: _____ Unit 1: Force & Motion NOTES: 2.04

- **Electrical Energy** – The energy found in the movement of electrons between atoms in the presence of an electric field.
- **Electromagnetic Energy** – The energy of light traveling through space in the form of waves
  - Examples: radio waves, infrared (heat), visible light, Ultraviolet rays, X-rays, gamma rays

long wavelengths ROYGBIV shortest wavelengths

- **Sound Energy** – The oscillating potential and kinetic energy of sound waves moving through air.
- **Nuclear Energy** – The energy contained within the nucleus of an atom. It is released either when a nucleus is split (fission) or when nuclei are joined together (fusion).



Energy Transformations

- Energy can be transformed between any of these different forms, but it is never created or destroyed.
- Examples:
  - **Turning on a toaster oven:**

    electric Energy →
    thermal Energy (heat) +
    infrared (light)

+ visible light (orange) or red

Name: _____ Unit 1: Force & Motion NOTES: 2.04

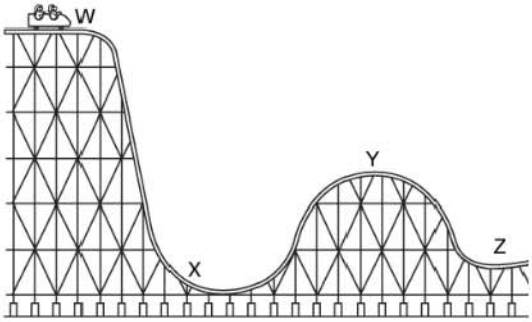
- **Eating your toast:** Electromagnetic Energy (sunlight) → chemical Energy (wheat) → Kinetic Energy (body movement) + thermal Energy (body heat)
- **Starting your car:** chemical Energy (gasoline) → Kinetic Energy (motion) + thermal Energy (heat) + sound Energy (motor noise)

What does the Law of Conservation of Energy mean?

- The energy that comes out of a system can never exceed (be greater than) the energy that goes into a system.
- Example: **Bouncing Ball**
  - *If you drop a ball from **1 meter high**, how high will it bounce?*
    - Hypothesis: 75cm
    - Result: 75cm
  - *If you drop a ball from **2 meters high**, how high will it bounce?*
    - Hypothesis: 140cm
    - Result: 143cm
  - WHY? some energy is transformed to sound energy, and thermal energy

Name: _____ Unit 1: Force & Motion NOTES: 2.04

- **Example: Rollercoaster**
  - The first hill on a rollercoaster is always the highest. Why?
    - The potential energy built up as the cars are pulled to the top of the first hill is converted to Kinetic energy as the cars drop.
    - BUT, some of the energy is transformed to thermal energy (heat) and sound energy (the roar of the wheels) due to friction.



How is the Law of Conservation of Energy useful to us?

- Energy enters Earth's atmosphere every day in the form of sunlight.
- If humans could efficiently transform the sun's electromagnetic energy into electrical energy, we'd have a lot more energy available to us.
  - How?
    - Solar Energy
    - wind Energy
    - hydroelectric Energy
    - ~~_____ Energy~~

2.01-2.04

2.01-2.02

100J

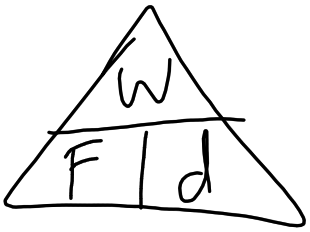
20N

$d = \frac{W}{F} = \frac{100J}{20N} = 5m$

100N

2m

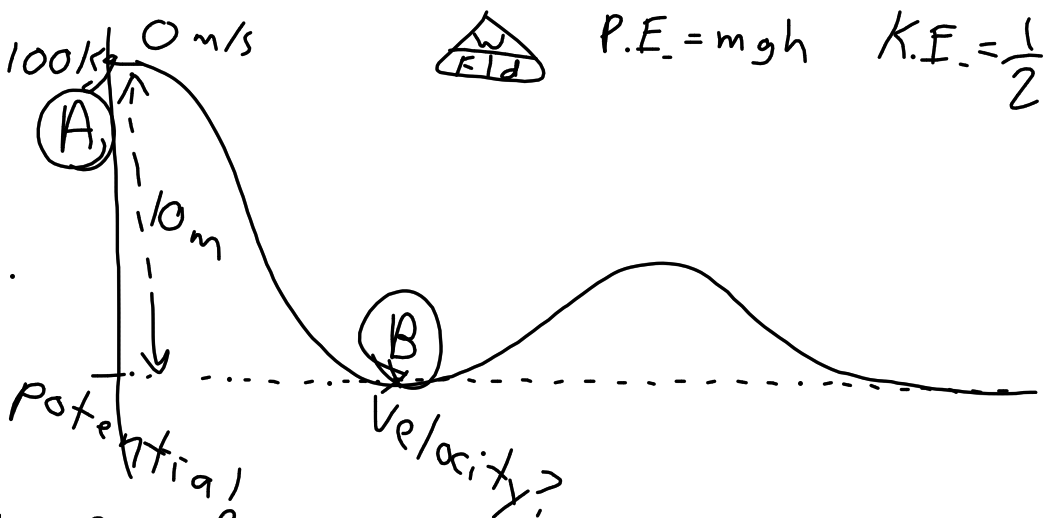
200J



$W = F \times d$

$F = \frac{W}{d}$

$d = \frac{W}{F}$



$P.E. = mgh$ $K.E. = \frac{1}{2}mv^2$

~~P.E. 9,800J~~ $P.E. = mgh = (100kg)(9.8 m/s^2)(10m)$

$= 9,800\ J$

9,800J

9,800J of K.E. at point B

$K.E. = \frac{1}{2}mv^2$

$9,800\ J = \frac{1}{2}(100kg)v^2$

$\frac{9,800J}{50kg} = \frac{50kg \times v^2}{50kg}$

$\sqrt{v^2} = \sqrt{196}$

$v = 14$