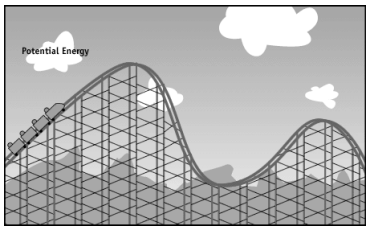
Energy



Energy

- _____ – the ability to do work or produce heat
- _____ **energy** – energy due to composition or position of an object
- _____ **energy** – the energy of motion

Energy

- _____ - SI unit for energy
  - 1 J = 1 Kgm^2 / s^2
- _____– amount of energy required to raise 1 g of water 1°C
- 1 cal = 4.18 J
- 1000 calories = 1 Kilocalorie = 1 Calorie

Energy Conversions

- Convert 15,500 joules into Calories

Formulas – Kinetic Energy

- $KE = \frac{1}{2} mv^2$
- KE = kinetic energy (joules)
- m = mass (must be in Kg)
- V = velocity (must be in m/s)

Formulas – Potential Energy

- $PE = mgh$
- PE = Potential Energy (J)
- m = mass (Kg)
- g = gravitational constant = 9.8 m/s^2
- h = height (m)

Formulas - Work

- _____– the energy used to move an object against a force
- _____– a push or pull on an object
- W = mgd = fd = PE

Examples

- A bowler lifts a 5.4 kg bowling ball 1.6m and then drops it to the ground.
- How much work was required to raise the ball?

Examples

- How much potential energy does that ball have at this height?

Examples

- If the ball is dropped and we assume that all of the potential energy is turned into kinetic energy, at what velocity will the bowling ball hit the ground?

More examples

- What is the kinetic energy of 1 atom of Ar moving at 650 m/s?

1st Law of Thermodynamics

- 1st Law of Thermodynamics – energy is conserved

ΔE

- ΔE has 3 parts:
  1. A # indicating the magnitude
  2. A sign (+/-) indicating the direction
  3. A unit

Thermochemistry

- _____ - study of heat changes that accompany chemical reactions and phase changes.

Relating ΔE to heat & work

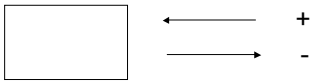
- The system can exchange energy with its surroundings in 2 ways: as heat or work
- ΔE = q + w
- ΔE = change in energy
- q = heat
- w = work

q & w

- Don't forget q & w must have signs
- In order to get the sign you must look at the system as a box and the surroundings as everything else

q & w

- Anything going INTO the box will be +
- Anything going OUT of the box will be –



Examples

- A system absorbs 140 J of heat from the surroundings and does 85 J of work on the surroundings. Calculate ΔE.

Endothermic & Exothermic

- _____
  - system absorbs heat
  - Heat flows into the system
  - Temperature goes down
- _____
  - Heat flows out of the system and into the surroundings
  - Temperature goes up
- Only look at heat (q) to determine if the system is endo or exo

Specific Heat

- _____– the amount of heat required to raise the temperature of 1 g of a substance 1 °C
- The units for specific heat are ____
- The specific heat of water (in a liquid form is 4.18 J/g°C)
- All substances have a particular specific heat

Specific heat equation

- $q = mc\Delta T$
- q = heat gained or lost (J)
- m = mass (grams) note that this is different than the energy calculations
- c = specific heat (J/g°C)
- ΔT = change in temperature (°C) = $T_f - T_i$

Specific heat calculations

- How much heat is required to raise 250 g of water from 22°C to 98°C?

Specific heat calculations

- A piece of metal with a mass of 4.68 g absorbs 256 J of heat when its temperature is increased by 182°C. What is its specific heat?

Specific heat calculations

- 60.0 J of heat are applied to a 5.00 g sample of calcium (c = 0.647J/g°C). If the final temperature is 51.1°C, calculate the original temperature.

Calorimetry

- _____ **- i**nsulated device used for measuring the amount of heat absorbed or released during a chemical or physical process.

Calorimetry

- When using calorimetry, you are usually trying to determine the identity of an unknown metal by finding its specific heat
- The heat lost from the metal will be gained by the water
- $-q_{metal} = q_{water}$

Calorimetry

- $- q_{metal} = q_{water}$
- $- (m_{metal})(c_{metal})(\Delta T_{metal}) = (m_{water})(c_{water})(\Delta T_{water})$

Calorimetry Examples

- A 58.0 g sample of a metal at 100.0 °C is placed in a calorimeter containing 60.0 g of water at 18.0 °C. The temperature of that water increases to 22.0 °C. Calculate the specific heat of the metal.

Calorimetry Examples

- A piece of metal with a mass of 4.68 g at 135°C is placed in a calorimeter with 25.0 g of water at 20.0 °C. The temperature rises to 35.0 °C. What is the specific heat of the metal?

More calorimetry

- 3.25 g Mg is placed into 125 mL of HCl. The initial temperature of the calorimeter is 18.5°C & the final temperature is 26.6°C. If the heat capacity of the calorimeter is 4.86 J/g°C, calculate the enthalpy of the reaction.