

Thermochemistry

Intro to Energy

Thermochemistry

The Basics

- Thermochemistry
 - The study of energy changes as they affect chemical reactions
- Energy
 - The ability to make a change
 - The ability to do work or transfer heat
- Energy Types
 - Kinetic Energy
 - The energy of motion
 - $E_k = \frac{1}{2} mv^2$

Thermochemistry

The Basics

- Energy Types
 - Potential Energy
 - Stored energy
 - The energy of position
 - Energy stored relative to an object's attraction for other objects
 - Types of potential energy
 - Gravitational
 - Depends on mass, position, and gravitational pull
 - Electrostatic
 - The attraction between charged particles
 - Protons and electrons - covalent bonding
 - Ions - ionic bonding
 - Polar molecules - IMF's
 - Total Internal Energy
 - The sum of the kinetic and potential energy a system contains

Thermochemistry

Units of Energy

- The joule
 - The amount of energy a 2 kg mass possesses when traveling 1 m/s
 - A very small amount of energy - we will often use kJ
- The calorie
 - The amount of energy needed to raise 1 gram of water's temperature 1°C
 - 1 calorie = 4.184 joules (exact)
 - The dietary calorie
 - 1 C = 1000 c

Thermochemistry

Defining Our Frame of Reference

- System
 - The portion of the universe we single out for study
- Surroundings
 - Everything else
- Important points
 - In a **closed system**
 - Energy can be exchanged
 - Matter cannot be exchanged

Thermochemistry

Work and Heat - Transferring Energy

- There are two ways to affect the total internal energy of a system
 - Work (w)
 - Heat (q)
- Work (w)
 - Energy used to cause an object to move against a force
 - Force
 - Any kind of push or pull exerted on a object
 - $w = F \times d$
- Heat (q)
 - Kinetic energy transferred from a hot to a cold object

Thermochemistry

The Falling Mass

- When considering this object, what is the system?
- What are the surroundings?
- Where do you fit in?
- What happens to the potential energy of the object as it is lifted?
- At what point is the potential energy the greatest?
- At what point is the kinetic energy the greatest?
- When the mass is released, what happens to the potential energy it possesses?
- What happens to this energy when the mass hits the floor?

Thermochemistry

Summary

- Energy can be converted between one form and another
 - Kinetic to Potential and vice-versa
 - What happens to the total internal energy of the system?
- Energy can be transferred back and forth between a system and its surroundings in the form of work and/or heat.

Thermochemistry

Homework

- 5.1 - Imagine a book that is falling from a shelf. At a particular moment during its fall, the book has a kinetic energy of 24J and a potential energy with respect to the floor of 47J. (a) How does the book's kinetic energy and its potential energy change as it continues to fall? (b) What is its total kinetic energy at the instant just before it strikes the floor? (c) If a heavier book fell from the same shelf, would it have the same kinetic energy when it strikes the floor?
- 5.3 - From the book
- 5.4 - From the book
- 5.13 - In what two ways can an object possess energy? How do these two ways differ from one another?
- 5.14 a&b - Suppose you toss a tennis ball upward. (a) Does the kinetic energy of the ball increase or decrease as it moves higher? (b) What happens to the potential energy of the ball as it moves higher?
- 5.19 - (a) What is meant by the term system in thermodynamics? (b) What is a closed system? (c) What do we call the part of the universe that is not part of the system?
- 5.21 - (a) What is work? (b) How do we determine the amount of work done, given the force associated with the work?