Thermochemistry – Heat and Chemical Change

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The Flow of Energy – Heat

- Thermochemistry: heat changes that occur during chemical reactions

- Energy: capacity for doing work or supplyong heat

- Different from “Matter”
  weightless, tasteless, odorless
  detected only by its effects

Chemical Potential Energy

- Energy stored in chemical bonds holding substances together
- Gasoline, for example, contains high amounts of chemical potential energy

Heat “q”

- Energy transferred between one object to another because of differences in temperature
- We measure changes caused by heat – objects become warmer when they gain heat and cooler when they lose heat

“Universe, system, surroundings”

- “Universe” = everything
- “System” = the part being studied/focused on
- “Surroundings” = everything else in the universe, but usually considered what is immediately next to the system

LAW OF CONSERVATION OF ENERGY

- In any chemical or physical process, energy cannot be created or destroyed
- All energy involved is “work,” “stored energy,” or “heat”

Exothermic vs Endothermic

- Direction of heat flow from the point of view of the system

- +q : heat flows into the system
  Endothermic
  system gets warmer

- -q : heat flows out of the system
  Exothermic
  system gets cooler

calorie and Calorie

- "calorie" : quantity of heat needs to raise temperature of 1 g of liquid water by 1 ^{o} C
- "Calorie" : unit used to describe energy available in foods, equal to 1000 cal or 1 kcal

- 1 cal = 4.184 Joule
- 1 J = 0.2390 cal

Heat Capacity

- Heat capacity = amount of heat needed to raise the temperature of a substance by 1 ^{o} C
- Depends on mass, chemical composition
- Explains why different objects can receive the same amount of energy and change temperatures by different amounts

Specific Heat (C)

- Amount of energy needed to raise temperature of 1 g of a substance by 1 ^{o} C
- Common values provided in tables (such as on p. 296)
- For common reference, $H_2O_{(l)}$ has

  C = 1.00 cal/g-^{o} C or

  C = 4.18 J//g-^{o} C

Calculating heat gained or lost

$$q = C \times m \times \Delta T$$

q = quantity of heat (cal)

C = specific heat (from table, in cal/g-^{o} C)

m = mass of substance (g)

ΔT = change in temperature (^{o} C)

Can also be done with J

Calculating specific heat of an object

If you know the mass, amount of heat added or lost, and the change in temperature, you can calculate the specific heat.

$$C = (q) / (m \times \Delta T)$$