



## Introduction to Heat

Chapter 6 – Zumdahl  
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## Types of Chemical Reactions

- Acid-Base (Neutralization) Reaction
- Precipitation Reaction
- Oxidation-Reduction Reaction
- Combustion Reaction
  
- What do all of these have in common?

**Energy  
Changes!!!**

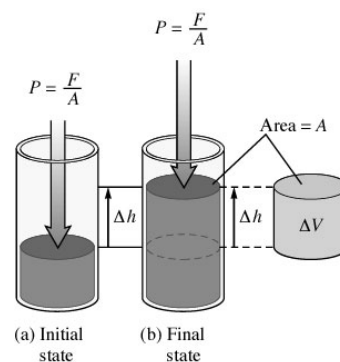
## What is Energy?

- Energy – the capacity to do work ( $w$ ) or transfer heat ( $q$ ).
  
- Work – Force x Distance moved ( $F\Delta x$ )

## Example of Work

The expansion or  
compression of a  
gas is work.

$$w = -P\Delta V$$



## Forms of Energy

- Potential
- Kinetic
- Heat/Thermal
- Radiant
- Electrical
- Chemical



## Units of Energy

- calories (cal)
- Dietary calories (Cal or kcal)
- joules (J)
- 1000 cal = 1Cal
- 4.184 J = 1 cal

Note:  
**The joule is the SI unit for  
energy!**  
 $1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2} = 1 \text{ N m}$

## Thermodynamics

- What is it?
- What are some examples?

## Several Facts about Energy Flow

1. Energy is conserved
2. Energy moves “naturally” in one direction.
3. Many energy changes are “state functions”.

## Movement of Energy

- What happens when energy is moved between objects?
- Energy Gain?
- Energy Loss?

## What is Heat Capacity?

- Heat capacity
- Specific Heat Capacity
- Molar Heat Capacity

## Heat Change and Temperature

- $q$  = heat change
- $q = mC\Delta T$ ,  $q = nC\Delta T$ ,  $q = C\Delta T$

## Comparison of $q$ and $\Delta T$

What if 900. J of heat were absorbed by 150.g of:

- A. Lead Pipe (0.129 J/g°C)
- B. Rock (0.820 J/g°C)
- C. Liquid Water (4.184 J/g°C)

What would the temperature change be?

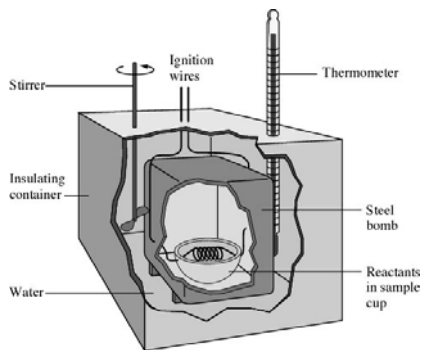
The following information was taken from a McDonald's Nutritional Website

Item	Calories	Calories from Fat	Fat Grams
Cheeseburger	320	130	14
McChicken Sandwich	510	270	30
Big Mac	530	250	28
Large Fries	450	200	22
SuperSize Fries	540	230	26
Baked Apple Pie	260	120	13
Diet Coke	0	0	0

### Caloric Energy

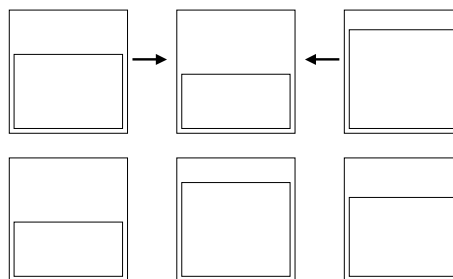
- Calculate the amount of energy in joules (J) in the following meal:  
A Big Mac, Super-size Fries, Hot Apple Pie and a Diet Coke (i.e. being calorie conscious).
- How much water (grams) could be warmed from room temperature (25.0°C) to its boiling point (100.0°C) with this amount of energy?

### Bomb Calorimeter



(Zumdahl Figure 6.6)

### First Law of Thermodynamics



### Coffee Cup Calorimeter

(Zumdahl Figure 6.5)

