### Ch 17 - Thermochemistry

[**http://www.dpi.state.nc.us/accountability/common-exams/released-forms/high?grades=High School&&category=Science**](http://www.dpi.state.nc.us/accountability/common-exams/released-forms/high?grades=High%20School&&category=Science)

17.1 The Flow of Energy—Heat and Work

**First Law of Thermodynamics (The Law of Conservation of Energy):**

Energy is never created or destroyed; it can only change forms.

**ENERGY LOST = ENERGY GAINED (-qlost)= (+qgain)**

**Temperature**

* Measure of the **Average Kinetic Energy** (average energy in motion)
* ⭡ T = ⭡ KE
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* Indicates the direction of heat flow
  + - * Units: Kelvin (K), Celsius (°C)

**Heat (q)**

* Heat = Energy
* A substance loses or gains heat because of a temperature difference
* Heat travels - always flows from a warmer object to a cooler object.
  + - * Units: Joules (J), calories (cal) 4.184 J = 1 cal   1 J = 0.2390 cal

Potential Energy Diagrams and Enthalpy [(Video)](https://www.youtube.com/watch?v=GqtUWyDR1fg&list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr&index=17)

Enthalpy (**ΔH)**- amount of energy (heat) in a reaction (absorbed or released)

* [**Exothermic-**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%2017-%20thermochemistry\Exo%20vs.%20Endothermic%20reactions.flipchart) system loses heat (energy), surroundings heat up=heat released

(q, ΔH < 0; - value); ex. Hot hands

* [**Endothermic**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%2017-%20thermochemistry\Exo%20vs.%20Endothermic%20reactions.flipchart)- system gains heat(energy), surroundings cool down=heat absorbed

(q, ΔH > 0; + value); ex. Cold pack

**Specific Heat capacity:**

* + Amount of heat it takes to raise the temp. of 1g 1° C

q = mCpΔT

* + - * q = heat in J
      * m = mass in g
      * Cp = specific heat capacity in J/g°C
      * ΔT = change in temperature in °C or K

ex. 1 If you drink a cold glass of water (250 g) at 0° C, how much heat is transferred to

the water as it warms to 37° C. The specific heat of water is 4.187 J/g°C

q= ?

m = 250 g

Cp = 4.187 J/g°C

ΔT = 37 – 0 = 37 °C

q= (250 g) (4.187 J/g°C) (37°C) = 3.87 x 104 J

ex 2. The temp. of a 95.4 g piece of Cu increases from 25°C to 48.0°C when the Cu absorbs

849 J of heat. What is the specific heat of Cu?

q= 849 J

m = 95.4g

Cp = ?

ΔT = 48-25 = 23 °C

849 J = (95.4 g) Cp (23.0 °C)

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(95.4 g)(23.0 °C)

Cp  = .387 J/g°C

17.3 Heat in Changes of State

**Latent Heat**:

* Heat (energy) absorbed or released to change **the state of matter**, at a

constant temperature and pressure

**Latent heat of fusion (Hf):**

* Heat required (absorbed) to melt (endothermic)

q = mHf (heating curve)

ex. How many grams of ice at O °C will melt if 2.25 kJ of heat is added?

q= 2250J 2250 J = m 334 J/g

m= ? 334 J/g 334 J/g

Hf= 334J/g m = 6.74 g

Latent heat of solidification (exothermic)

q= m **–**Hf (cooling curve)

**Latent heat of vaporization (Hv)**

* Heat required (absorbed) to vaporize (endothermic)

q= mHv (heating curve)

ex. How much heat is absorbed (in J) when 24.8 g water at 100 °C and 101.3 kPa

is converted to steam at 100 °C

q= ? q= (24.8g) (2260J/g)

m= 24.8 g q= 56048 J

Hv= 2260J/g

Latent heat of condensation (exothermic)

q= m **–**Hv (cooling curve)

**Heating/Cooling Curve:**

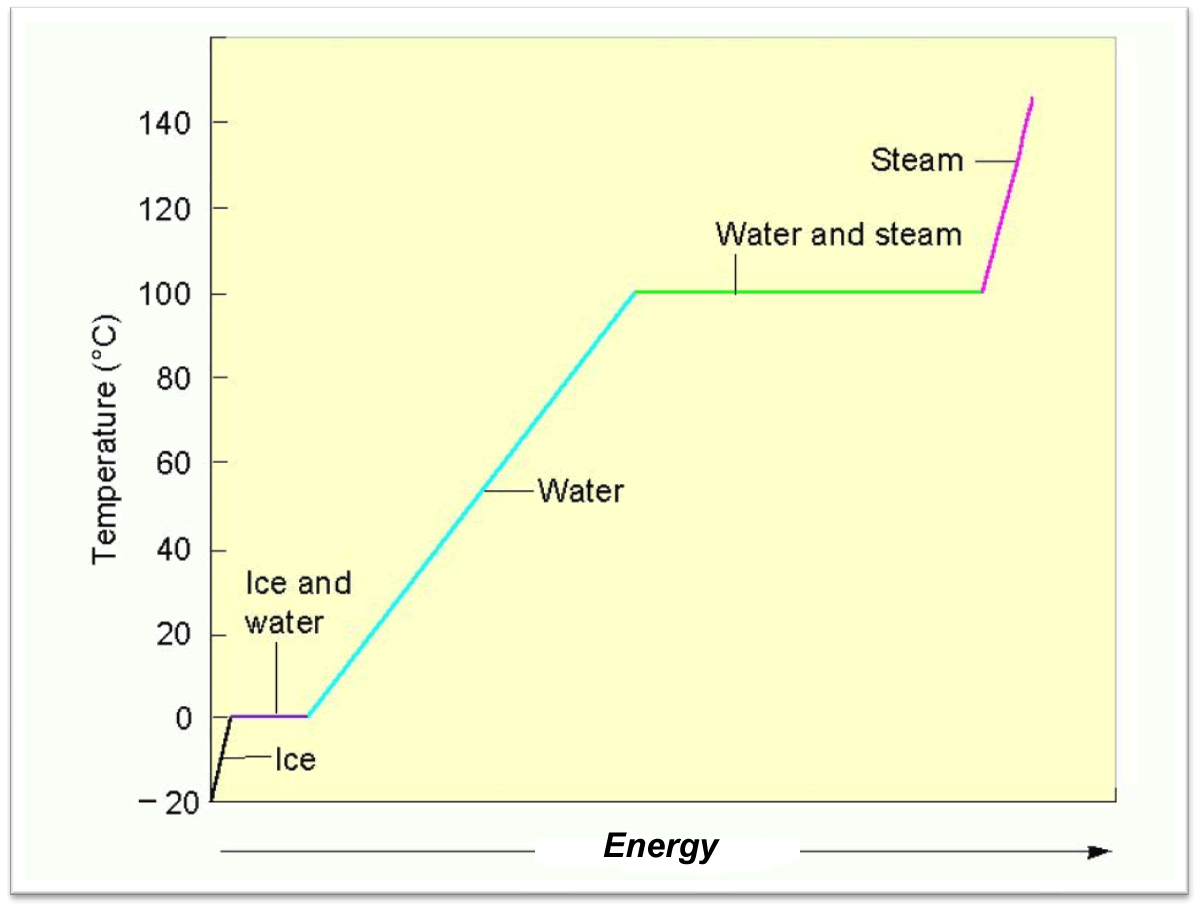
* Shows phase changes:
  + **flat spots**- change in state of matter and potential energy; no change in

temperature or kinetic energy

* + **slopes**- no change in state of matter; change in temperature and kinetic energy

* Heating Curves- absorb heat/energy (endothermic, + value); melting, vaporization
* Cooling Curves- release heat/energy (exothermic, -value); freezing, condensation
* Heat energy and temperature proportional EXCEPT during state of matter changes

Heating Curve



**Summary of Heat Calculations:**

1. Heat required/exchanged to change temperature; Specific Heat q = m Cp ΔT
2. Change of state: Solid 🡪 liquid (melting) q = mHf

Liquid 🡪 solid (freezing) q = m**-**Hf

1. Change of state: Liquid 🡪 gas (boiling) q= mHv

Gas 🡪 Liquid (condensing) q= m**-**Hv