

Thermodynamics – concerned with the energy changes that accompany chemical and physical processes

System – particular portion of the universe on which we wish to focus our attention

Surroundings – everything that's not the system

Adiabatic process – a change occurs so heat cannot be transferred between system/surroundings (bomb/thermos bottle)

Isothermal – keep the temperature of system at constant temp while the change takes place

State – some particular set of conditions of pressure, temperature, and number of moles of each component, and their phase

State variables – serves to determine the physical state of a given system. Does not depend on past history. Ex, P, V, T, Composition

Equation of state – interrelationships between the state functions expressed in equation form. Ex, $PV = nRT$

Heat Capacity – the amount of heat energy required to raise the temperature of a given amount of substance by 1 degree Celsius

Specific Heat - heat capacity per gram

Molar heat capacity – the heat necessary to raise the temperature of 1 mol of substance by 1 degree

1st Law of Thermodynamics – if a system undergoes some series of changes that ultimately brings it back to its original state, the net NRG change is 0. Proves why **Perpetual Motion Machines**, a device that creates energy, doesn't exist

Internal Energy, E – total energy of the system $\Delta E = E_{\text{final}} - E_{\text{initial}}$

Delta E = Heat absorbed from the surroundings – work done by the system on its surroundings

Heat added to a system and work done by system are positive values. Change of system is opposite of change of surroundings

When the system performs work, W is positive, energy is removed. When work is being done on system, energy put in, negative value

Work done by a system = Pressure * Change in Volume Constant temperature means no change in energy

WORK IS NOT A STATE FUNCTION **Reversible Process** – driving force equal to opposing force

The max work available from any change is obtained if the change occurs by a reversible process

Delta E = heat of reaction at constant volume. **Delta H** = heat of reaction at constant pressure, **ENTHALPY**

Watch for +/- signs, they mean exothermic/endothermic, sometimes they're not given, must find out yourself. **Read**

Ex 12.3, p456

Delta E = Delta H – P*Delta V **P * Delta V = Delta n * RT** **Delta n** = change in number of moles of gas

Hess's Law of Heat Summation – the net value of Delta H for the overall process is merely the sum of all the enthalpy values

Heat of Formation – enthalpy changes associated with forming 1 mol of substance from its elements

Delta H of Reaction = Sum of Delta H of Formation of products – Sum of Delta H of Formation of reactants

Standard State – 25C and 1atm **When writing equations, WATCH FOR MOLES. VALUES ARE FOR 1 MOL ONLY!!!**

Heats of reactions associated with PE to breaking/forming chemical bonds. However, not completely accurate cuz no pressure

Atomization energy – value is the sum of all the bond energies in the molecule. Read section 12.6 on Bond NRG's

Entropy – spreadioudness, S of solid is less than S of liquid is less than S of gas, gas is more "disordered" than solids

Entropy is proportional to the amount of heat added to system (more temp, higher KE, more randomness)

Entropy is inversely proportional to the temperature at which the heat is added (low temp, given amt of heat makes a large change in degree of disorder, at a high temp, it's disordered already, same given amount of NRG won't cause relatively as much change)

Read Example 12.10 on Page 472, very common problem.

Second Law of Thermodynamics – In any spontaneous process there is always an increase in the entropy of the universe

Delta G = Delta H of system – (Temperature in Kelvins * Delta S of system) Read p 474 for what happens w/ +/- values of S and H

Delta G must be negative for change to be spontaneous **Delta G represents max amt. of NRG released, free NRG**

3rd Law of Thermodynamics – the entropy of any pure crystalline substance at absolute zero is equal to zero As a reaction proceeds, delta G goes down, when Delta G is zero, no more work can be done (dead battery idea)

Delta G predicts if a particular process is spontaneous, BUT IT HAS NOTHING TO DO WITH THE RATE

The minimum of free energy curve is equilibrium, read last section