Spring 2025 Midterm Study Guide

Solids have definite shape and definite volume. Liquids have definite volume and indefinite shape. Gases have indefinite shape and indefinite volume.

The boiling point is the temperature where the vapour pressure equals the atmospheric pressure. The triple point is the temperature where solids, liquids, and gases exist at the same time. The melting point is the temperature where all the particles in a solid have enough energy to become liquid.

Boyle's Law states that pressure is inversely proportional to volume. Charles' Law states that volume and temperature are directly proportional. Gay-Lussac's Law states that pressure and temperature are directly proportional. Graham's Law states that the rates of diffusion or effusion can be compared between two gases.

Solvents are the part of a solution that does the dissolving. Solutes are the part of a solution that is dissolved. Hydrates are compounds where water is part of the crystal structure. Solutions are mixtures where the particles are relatively very small and stay mixed even when not being stirred. Suspensions are mixtures where the particles are relatively very big and settle when not being stirred. Colloids are mixtures where the particles and properties are between solutions and suspensions.

Alloys are mixtures of metals where atoms of one metals replace atoms of another.

Enthalpy is the measure of heat in a system. Entropy is the measure of disorder in a system. Free energy is the amount of energy available to do work in a system, and it is used to determine spontaneity of processes.

Equilibrium is a balance between processes going forwards with its process going backwards. Spontaneous refers to processes that do not need energy to continue; or processes that happen naturally. Nonspontaneous refers to processes that need energy to continue; or processes that do not happen naturally.

Activation energy is the amount of energy required to begin a reaction. Catalysts are substances that speed a reaction without being used during the reaction. The Tyndall Effect is the scattering of light by large particles of a mixture. A saturated solution is a solution that has the maximum amount of solute possible. A supersaturated solution is a solution that has more than the maximum amount of solute possible. Molarity is a measure of concentration that compares the moles of solute per litre of solution. Molality is a measure of concentration that compares the moles of solute per kilogram of solvent. Endothermic processes are those that absorb energy from the surroundings ($\Delta H > 0$). Exothermic processes are those that release energy to the surroundings ($\Delta H < 0$).

Freezing is the process of going from the liquid state to the solid state. Fusion (melting) is the process of going from the solid state to the liquid state. Condensation is the process of going from the gas state to the liquid state. Vaporization is the process of going from the liquid state and gas state. Sublimation is the process of going from the solid state to the gas state. Deposition is the process of going from the gas state to the solid state.

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Kinetic theory is the idea that all matter is made of small constantly moving particles; kinetic energy increases the movement of these particles. Kinetic energy is the measure of the energy of movement of the particles of a sample, and it is directly related to the temperature. Temperature is the average kinetic energy of particles in a sample. Chemical potential energy is the energy stored in bonds in compounds.

Supersaturated solutions are created when we create a saturated solution at a relatively high temperature; this is allowed to cool so the solution now has more solute than should normally be possible.

Solvation is the process of dissolving solids into a liquid solvent; the individual particles are broken from the sample and surrounded by water molecules.

The three main colligative properties are the freezing point depression, boiling point elevation, and vapour point elevation.

The heat of a sample is directly proportional to the temperature of the sample; the higher the temperature, the higher the heat of the sample.

Hess' Law tells us that for calculating changes in heat of processes, only the beginning and ending of the process matter, not what happens in the middle.

Collision theory is the idea that all the small constantly moving particles are smashing together, which causes reactions to occur.

Intermediates are the relatively stable complexes that are made between steps in a multistep reaction. Activation complexes are the high-energy complexes that exist as a combination of breaking old bonds and creating new bonds.

Le Chatelier's Principle describes the state of equilibrium as a balance of forces that can be stressed. When the system is stressed, it will shift the processes of the equilibrium to release that stress. The most common stressors on an equilibrium are concentration, temperature, volume, and pressure (the last two only for gases).

Be comfortable using the molarity equation (M = mol/L).

Be comfortable using the molality equation (m = mol/kg).

Be comfortable using the colligative property equations ($T_f = k_f * m$; $T_b = k_b * m$)

Be comfortable using the enthalpy equations ($\Delta H = -m * C * \Delta T$).

Be comfortable using molar enthalpies (kJ/mol) and enthalpies of reaction steps to calculate enthalpy changes.

Be comfortable creating and using the equilibrium constants ($k_{eq} = [C]^c[D]^d/[A]^a[B]^b$).

Be comfortable creating and using the solubility product constants ($k_{sp} = [A+]^a[B-]^b$).