For stoichiometric problems, use

$$n_1/v_1 = n_2/v_2 \tag{1}$$

where $n = m/M = CV$. Lewis dot structures are created by:

1. Find the sum of valence electrons
2. Connect the atoms with single bonds
3. Create multiple bonds and lone pairs for an octet

For an equilibrium reaction, the constant is

$$K_c = \prod[B]_{eq}^b / \prod[A]_{eq}^a = \prod K_i \tag{2}$$

and only includes gaseous or aqueous compounds. For gaseous reactions, then the constant is

$$K_p = K_c RT^{\Delta v_g} \iff P_x \equiv [X] \tag{3}$$

Reactions are homogeneous iff all constituents are the same phase.

To calculate the equilibrium concentrations, construct an ICE table such that

$$[X_i]_{eq} = [A_i] \mp ax \tag{4}$$

As well, more reactants are formed if

$$[A] \uparrow \iff [B] \downarrow \iff Q > K \tag{5}$$

and $P^{-1} \propto n$ where n is the moles the side to which equilibrium moves to has.

Exothermic reactions produce heat such that if temperature increases as well, more reactants are formed.

For a reaction $A(s) \leftrightharpoons bB(aq)$, the constant

$$K_s p = [B]^b \iff x = (K_{sp}/\Pi b^b)^{1/\Sigma b} \tag{6}$$

Gibbs free energy is defined as

$$\Delta G^{\ominus} = -RT \ln K = H - TS = -T\Delta S_u \tag{7}$$

When heating a system S increases such that

$$\Delta S_u = \Delta S + \Delta S_s > 0 \tag{8}$$

where $\Delta S_s = -\Delta H/T$ for a spontaneous reaction. If $\Delta \sum v > 0 \iff \Delta S > 0$.

The change in $\{S, G, \Delta H_f\}$ is

$$\Delta X^{\ominus} = \Delta \sum v X^{\ominus} \tag{9}$$

If $G < 0$ the reaction is spontaneous. Entropy is proportional to T, r, V, n, P^{-1}.

The Born Haber cycle is used to find H_f of an ionic compound MX,

$$\Delta H_f = \sum H \qquad H_B = \tfrac{1}{2}B \tag{10}$$

where

$$\Delta H_s : \quad M(s) \to M(g) \tag{11}$$
$$IE : \quad M(g) \to M^+ + e^- \tag{12}$$
$$\tfrac{1}{2}B : \quad \tfrac{1}{2}X_2 \to X \tag{13}$$
$$-EA : \quad X + e^- \to X^- \tag{14}$$
$$-\Delta H_l : \quad M^+ + X^- \to MX \tag{15}$$

The density of a unit cell is given by

$$\rho = \frac{nM}{a^3 N_a} \qquad a = \left\{2r,\ 4r/\sqrt{3},\ 2\sqrt{2}r\right\} \tag{16}$$

for sc, bcc, and fcc respectively. The packing efficiency is given by nV_{sph}/a^3.

In semiconductors, temperature is proportional to conductivity, and oppoiste for conductors.

The force in liquids is proportional to BP, viscosity, number of OH^- ions, H, and inversely proportional to P and T.

Thermoplastic polymers melt and deform upon heating. The DP is $\overline{M}/M_m$ and the average molecular weight is

$$\overline{M}_n = \frac{\Sigma MN}{\Sigma N} \qquad \overline{M}_w = \frac{\Sigma M^2 N}{\Sigma MN} \tag{17}$$

where $n_{\text{chains}} = mN_a/\overline{M}$. Polymers are linear, branched, and crosslinked.

The former two are connected by non-bonded interactions and can be easily recycled, and the latter by covalent bonds.

Linear polymers form crystal more easily and thus become liquid when heated.

The partial pressure of a gas is

$$P_i = X_i P \qquad X_i = n_i/\Sigma n \qquad P = \sum P_i \tag{18}$$

For a reactant A dissociated δ%, then

$$P_A = (1-\delta)x \qquad P_B = (v_b\delta/v)ax \tag{19}$$

where the mole fraction is

$$x_i = m_i M/mM_i = n_i/n \tag{20}$$

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