

## Exam Cheatsheet

A ketone is  $\text{-C(=O)-}$ ; amides, carboxylics, aldehydes, and esters are  $\text{KN-}$ ,  $\text{KOH}$ ,  $\text{KH}$ , and  $\text{KO-}$ .

For stoichiometric problems, use

$$n_1/v_1 = n_2/v_2 \quad (1)$$

where  $n = m/M = CV$ . For an equilibrium reaction, the constant is

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

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

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

Reactions are homogeneous iff all constituents are the same phase. To calculate the equilibrium concentrations, construct an ICE table such that

$$[X_i]_{eq} = [A_i] \mp ax \quad (4)$$

As well, more reactants are formed if

$$[A] \uparrow \iff [B] \downarrow \iff Q > K \quad (5)$$

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  $A(s) \rightleftharpoons bB(aq)$ , the constant

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

Gibbs free energy is defined as

$$\Delta G^\ominus = -RT \ln K = H - TS = -T\Delta S_u \quad (7)$$

When heating a system  $S$  increases such that

$$\Delta S_u = \Delta S + \Delta S_s > 0 \quad (8)$$

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

$$\Delta X^\ominus = \Delta \sum v X^\ominus \quad (9)$$

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  $MX$ ,

$$\Delta H_f = \sum H \quad H_B = \frac{1}{2}B \quad (10)$$

where

$$\begin{aligned} \Delta H_s : & \quad M(s) \rightarrow M(g) \\ IE : & \quad M(g) \rightarrow M^+ + e^- \\ \frac{1}{2}B : & \quad \frac{1}{2}X_2 \rightarrow X \\ -EA : & \quad X + e^- \rightarrow X^- \\ -\Delta H_l : & \quad M^+ + X^- \rightarrow MX \end{aligned} \quad (11)$$

The density of a unit cell is given by

$$\rho = \frac{nM}{a^3 N_a} \quad a = \{2r, 4r/\sqrt{3}, 2\sqrt{2}r\} \quad (12)$$

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

In semiconductors, temperature and impurities are proportional to conductivity, and opposite for conductors.

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

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

$$\bar{M}_n = \frac{\Sigma MN}{\Sigma N} \quad \bar{M}_w = \frac{\Sigma M^2 N}{\Sigma MN} \quad (13)$$

where  $n_{\text{chains}} = mN_a/\bar{M}$ . 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 crystals more easily and thus become liquid when heated.

The partial pressure of a gas is

$$P_i = X_i P \quad X_i = n_i / \sum n \quad P = \sum P_i \quad (14)$$

For a reactant  $A$  dissociated  $\delta\%$ , then

$$P_A = (1 - \delta)x \quad P_B = (v_b \delta / v)ax \quad (15)$$

where the mole fraction is

$$x_i = m_i M / m M_i = n_i / n \quad (16)$$

