

Thermodynamics

When heating a system, S increases where

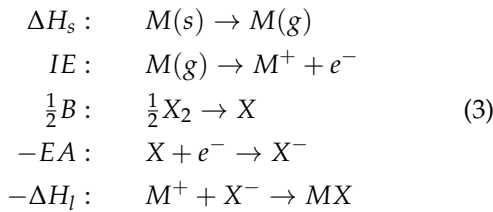
$$\Delta S_u = \Delta S + \Delta S_s > 0 \quad (1)$$

and $\Delta \sum v > 0 \iff \Delta S > 0$. As well, $S \propto T \propto r \propto V \propto n \propto P^{-1}$ where n is the moles the side to which equilibrium moves to has.

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

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

where the sub-reactions are given by



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

$$\Delta X^\ominus = \Delta \sum v X^\ominus \quad (4)$$

If $G < 0$ the reaction is spontaneous.

Equilibrium

The equilibrium constant is given by

$$K_c \sim K_p = K_c RT^{\Delta v_g} \quad (5)$$

where K_p is for gaseous reactions. Reactions are homogeneous iff it is the same phase. More reactants are formed in a reaction where

$$[A] \uparrow \iff [B] \downarrow \iff Q > K \quad (6)$$

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

$$K_{sp} = [B]^b \iff x = (K_{sp}/\Pi b^b)^{1/\Sigma b} \quad (7)$$

Materials Science

The density of a unit cell is given by

$$\rho = \frac{m}{a^3 N_a} \quad a = \{2r, 4r/\sqrt{3}, 2\sqrt{2}r\} \quad (8)$$

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

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

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

$$\bar{M}_n = \frac{\Sigma MN}{\Sigma N} \quad \bar{M}_w = \frac{\Sigma M^2 N}{\Sigma MN} \quad (9)$$

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.

Miscellaneous

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

For stoichiometric problems, use

$$n_1/v_1 = n_2/v_2 \quad (10)$$

where $n = m/M = CV$. For an equilibrium reaction, the constant is K_c and only includes gaseous or aqueous compounds.

The partial pressure of a gas is

$$P_i = X_i P \quad X_i = n_i / \sum n \quad P = \sum P_i \quad (11)$$

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

$$P_A = (1 - \delta)x \quad P_B = (v_b \delta / v)ax \quad (12)$$

where the mole fraction is $x_i = n_i/n$. The force in liquids is proportional to BP, viscosity, number of OH^- ions, H , and inversely proportional to P and T .

In calorimetry, the heats are related via

$$-m_1 C_1 \Delta T_{f1} = m_2 C_2 \Delta T_{f2} \text{ J/g} \quad (13)$$

