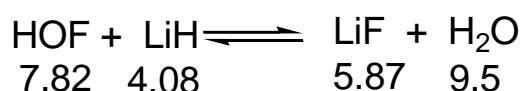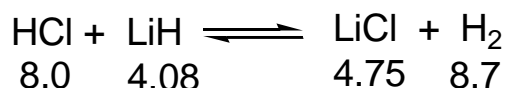# Topic-I

Q-I.1. The boiling point of the inert gases are as follows: He – 4 K , Ne – 10 K, Ar -100 K, Kr-170 K and Xe-220K. Rationalize the trend observed.
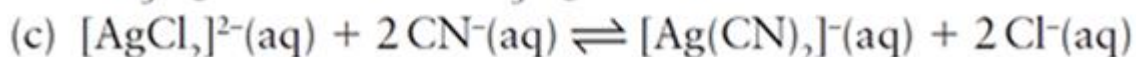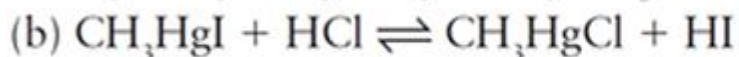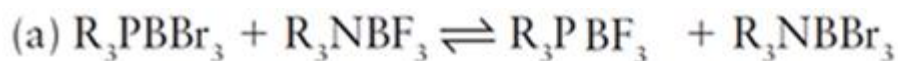
Q-I.2. Between the two reactions listed below, predict the following (i) in which direction the reaction equilibrium lies (ii) qualitatively predict which reaction is favourable using the following absolute η values.

$$HCl + LiH \rightleftharpoons LiCl + H_2$$
8.0   4.08   4.75   8.7

$$HOF + LiH \rightleftharpoons LiF + H_2O$$
7.82   4.08   5.87   9.5

Q-I.3. Predict the relative solubility trend in water for the following two sets of molecules.
(a) NaF, NaCl, NaBr, NaI (b) CuF, CuCl, CuBr and CuI. Briefly rationalize your answer.

Q-I.4. Using hard-soft concepts, which of the following reactions are predicted to have an equilibrium constant greater than 1? Unless otherwise stated, assume gas-phase or hydrocarbon solution and 25°C.

(a) $R_3PBBr_3 + R_3NBF_3 \rightleftharpoons R_3P BF_3 + R_3NBBr_3$
(b) $CH_3HgI + HCl \rightleftharpoons CH_3HgCl + HI$
(c) $[AgCl_2]^{2-}(aq) + 2 CN^-(aq) \rightleftharpoons [Ag(CN)_2]^-(aq) + 2 Cl^-(aq)$

Q-I.5. Draw at least two possible interactions that can exist between 1,3,5-trinitrobenzene and benzene.
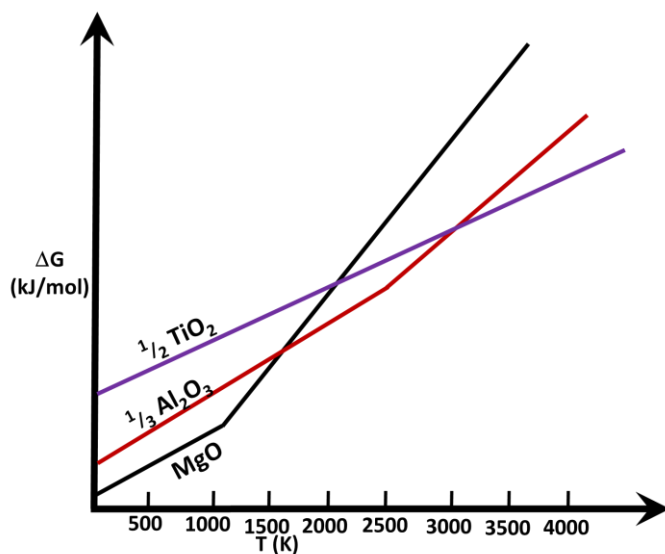
Topic-II

Q-II.1. Why are the metals Al and Ti are not produced by pyrometallurgical extraction of Al_2O_3 and TiO_2? What will be a better method to produce such metals?
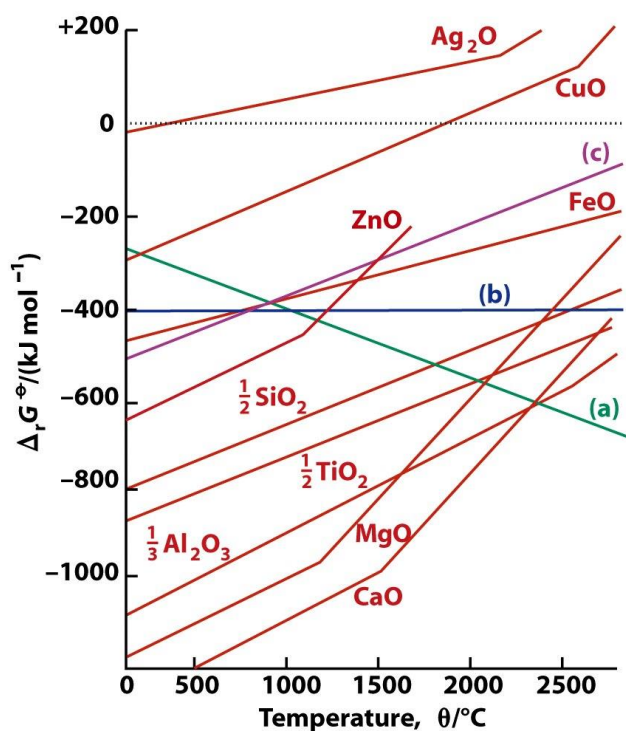
Q-II.2. The Ellingham diagram of metal oxides is given below. Depict how to obtain (a) Mg from MgO using Al and Ti metals (b) Al from Al_2O_3 using Mg and Ti metals (c) Ti from TiO_2 using Mg and Al in the graph given below.

Q-II.3. To a silver nitrate solution, an aluminium rod is initially inserted. After ~20 minutes, a magnesium rod is inserted to the same solution. After another 20 minutes, O_2 is bubbled into the solution at a slightly elevated temperature. What are the products formed at each stage? (You may use the following redox potentials Al^{3+}/Al = -1.66 V; Ag^+/Ag = +0.80 V; Mg^{2+}/Mg = -2.36 V; $O_2/2O^{2-}$ = + 1.36 V).