Chemistry 1B, Fall 2015 Quiz #7A KEY

You must show your work for full credit.

Exp 6 and 8 Questions

1. A 25.0 mL aliquot of a saturated $CaSO_4$ solution (no solid present) requires 32.1 mL of 0.0200 M EDTA to reach an end point.
a) What is the Ca^{2+} concentration (in M) of the solution? (**2 pts**)
$n(Ca^{2+}) = n(EDTA) = (0.0321\ L)(0.0200\ mol\ L^{-1}) = 6.42 \times 10^{-4}\ mol = [Ca^{2+}](0.025\ L)$
$[Ca^{2+}] = 2.57 \times 10^{-2}$ M

b) Ignoring activities, what is the K_{sp} for $CaSO_4$ based on the titration data? (**1 pt**)
$K_{sp} = [Ca^{2+}][SO_4^{2-}]$ and $[Ca^{2+}] = [SO_4^{2-}] = 2.57 \times 10^{-2}$
$K_{sp} = (2.57 \times 10^{-2})^2 =$ ***6.59×10^{-4}***

2. HCl is added to a mixture containing Ca^{2+}, Na^+, Ag^+, and K^+.
a) Which ion will precipitate out? (**1 pt**)
Ag^+

b) What can be added to the precipitant to make it redissolve (once it is removed from the HCl and washed)? (**1 pt**).
NH_3 (or NH_4OH)

Thermodynamics problems

3. Which of the following reactions leads to a decrease in entropy for the system? (**1 pt**)
a) $I_2(s) \leftrightarrow I_2(g)$ b) $I_2(s) \leftrightarrow I_2(aq)$ c) $I_2(s) + H_2(g) \leftrightarrow 2HI(g)$
d) $2I(g) \leftrightarrow I_2(g)$

4. Under what temperature regimes will the reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ($\Delta H° = -91.8$ kJ/mol) be spontaneous? (**1 pt**) *$\Delta S < 0$ so $\Delta G = \Delta H - T\Delta S$ < at low T*
a) never b) high temperature **c) low temperature** d) always.

5. When any spontaneous reaction occurs, $\Delta S_{universe}$ is **positive** (give sign) (**1 pt**)

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(one more on back)

6. Given that ΔG_f°(HI) = 1.7 kJ/mol (subscript f means formation), calculate K (the equilibrium constant) for $I_2(s) + H_2(g) \leftrightarrow 2HI(g)$ at 298 K. R = 8.314 J mol^{-1} K^{-1} (**2 pt**)

$\Delta G_{rxn}^\circ = 2\Delta G_f^\circ(HI) - \Delta G_f^\circ(H_2(g)) - \Delta G_f^\circ(I_2(s)) = 2(1.7kJ/mol)$ (others are elements in standard states so ΔG_f° are 0).
$\Delta G_{rxn}^\circ = 3.4$ kJ/mol = $-RT\ln K$ or $K = \exp(-\Delta G_{rxn}^\circ/RT) = e^{-3400J/(8.314\ J\ mol\text{-}1\ K\text{-}1)(298\ K)} = e^{-1.37} =$ ***0.25***