General Chemistry II
August 6, 2021

Final Exam Review #2

Old school material:

1.   A compound is known to be a potassium halide, KX (i.e. KF, KCl, KBr or KI). If 2.00 g of the salt is dissolved in exactly 100. g of water, the solution freezes at –0.998 °C. Identify the halide ion in this formula. K_{fp} water is -1.86 °C/m. Assume complete dissociation of the halide:

2.   A sample of N_2O_4 gas with a pressure of 1.00 atm is placed in a flask. When equilibrium is achieved, 20.0% of the N_2O_4 has been converted to NO_2 gas.
   a) Calculate Kp for the reaction:

   b) If the initial pressure of N_2O_4 is 0.16 atm, **what percent of the gas will disassociate at equilibrium?**

3.   What is the pH change when 17.7 mL of 0.126 M NaOH is added to 87.3 mL of a buffer solution consisting of 0.135 M NH_3 and 0.160 M NH_4Cl? Ka NH_4^+ is $5.6x10^{-10}$

4.   Calculate the equilibrium constant for the following reaction:

$AgOH(s) + CN^-(aq) \leftrightarrow AgCN(s) + OH^-(aq)$ | $K_{sp}(AgOH) = 2.0\times10^{-8}$ | $K_{sp}(AgCN) = 6.0\times10^{-17}$

New stuff:

5.   A sample of hard water contains about 4.4×10^{-3} M Ca^{2+}. A soluble fluoride-containing salt, such as NaF, is added to "fluoridate" the water (to aid in the prevention of dental cavities). What is the maximum concentration of F^- that can be present without precipitating CaF_2? $K_{sp} = 5.3 \times 10^{-11}$

6.   Titanium(IV) oxide is converted to titanium carbide with carbon at a high temperature. Calculate the $\Delta G°$ and K using the values below. Note the non standard temperature when calculating the K value!

Compound	$\Delta_f G$ at730.°C (kJ/mol)
$TiO_2(s)$	-757.23
$TiC(s)$	-162.53
$CO(g)$	-200.48

$TiO_2(s) + 3\ C(s) \rightarrow 2\ CO(g) + TiC(s)$
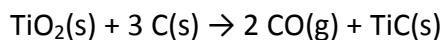
7. Some metal oxides can be decomposed to the metal and oxygen under reasonable conditions.
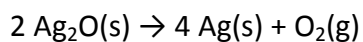
$$2\ Ag_2O(s) \rightarrow 4\ Ag(s) + O_2(g)$$

Thermodynamic data are given below:

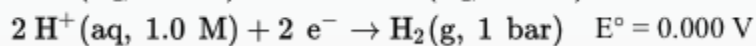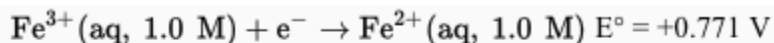|	$2\ Ag_2O(s)$	$\rightarrow$	$4\ Ag(s)$	$+$	$O_2(g)$
$\Delta_fH°(kJ/mol)$	-31.1		-		-
$S°(J/K \cdot mol)$	121.3		42.55		205.07

a) What are the values of $\Delta H°$, $\Delta S°$ and $\Delta G°$?

b) Is the reaction product favored at 25 °C? If not, at what temperature does it become product favored?

8. Balancing:

$$TeO_3^{2-} + N_2O_4 \leftrightarrow Te + NO_3^- \text{ (in acid)}$$

$$IO_3^- + Re \leftrightarrow ReO_4^- + IO^- \text{ (in base)}$$

9. For the following cell:

Pt | H_2(P = 1 bar) | H^+(aq, 1.0 M) || Fe^{3+}(aq, 1.0M), Fe^{2+}(aq, 1.0 M) | Pt

$$Fe^{3+}(aq, 1.0\ M) + e^- \rightarrow Fe^{2+}(aq, 1.0\ M)\quad E^\circ = +0.771\ V$$
$$2\,H^+(aq, 1.0\ M) + 2\,e^- \rightarrow H_2(g, 1\ bar)\quad E^\circ = 0.000\ V$$
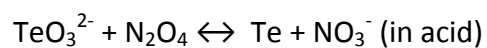
a) Calculate the cell potential (E°)

b) Will the reaction be more or less favorable at lower pH?

c) What will E_{cell} be when the pH of the hydrogen cell is 6.50 and everything else remains under standard conditions?

10. Thorium-232 decays in a series of steps to Pb-208. How many alpha and how many beta particles were emitted in this series? If the first 4 steps were alpha-beta-beta-alpha, please write the complete reactions for each step:

11. Iodine-131 ($t_{1/2}$ = 8.04 days), a β emitter, is used to treat thyroid cancer.

a) Write the equation for the decomposition of ^{131}I:

b) If you ingest a sample of NaI containing ^{131}I, how much time is required for the activity to decrease to 57.0% of its original value?

12. A sample of wood from a Thracian chariot found in an excavation in Bulgaria has a C-14 activity of 10.9 dpm/g. Estimate the age of the chariot, if $t_{1/2}$ is 5730 years and the initial activity of C-14 was 14.0 dpm/g:

Thank you for an amazing summer! To quote Jane, "see you later, Crocodile"

2021 Addendum: Jane is from ~5 years ago when this was made, but let's all thank Jane, wherever they are, for our PLI worksheets. It has been amazing learning and growing with you all. Y'all be easy.
-Brown, Lewin, Pan, Rydlizky, et. al.