SAMPLE questions for the 3rd midterm exam

Note: these are just examples. Any question similar to homework could be asked in an exam.

1. (a) (3) Calculate Ksp for cobalt iodate \((\text{Co(IO}_3)_2)\) given that its solubility is 0.011 M at 18 °C.

b) (3) The Ksp of \(\text{SrCO}_3\) is 9.3X10^{-10}. Find its solubility in g/L (Molar masses: Sr: 87.62, C: 12.01 O:16.00)

2. (5) Will a precipitate form when 50 mL of 0.20 M \(\text{Pb(NO}_3)_2\) is mixed with 80 mL of 0.020 M HCl? (Ksp of \(\text{PbCl}_2\) is 1.7X10^{-5}).

3. (5) A solution contains 1.500 g \(\text{Ba}^{2+}\) per 100 mL. Calculate the pH at which 95% of the barium will precipitate as \(\text{Ba(OH)}_2\) (whose Ksp is 5X10^{-3})

4. (10) A solution containing 0.0010 M \(\text{Pb}^{2+}\) and 0.0010 M \(\text{Sn}^{2+}\) is saturated with H2S. Kspa of \(\text{PbS}\) is 3X10^{-7} and of \(\text{SnS}\) 1X10^{-5}.

a) Calculate the \([\text{H}^+]\) needed to achieve maximum separation of \(\text{Sn}^{2+}\) and \(\text{Pb}^{2+}\)
b) Calculate the \( \text{Pb}^{2+} \) and \( \text{Sn}^{2+} \) concentrations remaining in solution at the point of maximum separation.

5. (10) At 500 °C \( K_p = 2.7 \times 10^{-2} \) for the reaction

\[
2\text{NOCl} (g) \rightleftharpoons 2\text{NO}_2 (g) + \text{Cl}_2 (g)
\]

a) Calculate \( \Delta G^\circ \) at 500 °C
b) Calculate \( \Delta G \) at 500 °C when each gas is at a partial pressure of 0.50 atm
c) Which direction is spontaneous under the conditions of Part b?

6. (3) Predict whether the entropy of the system increases or decreases in the following reaction:

\[
2\text{KClO}_3 (s) \rightarrow 2\text{KCl} (s) + 3\text{O}_2 (g)
\]

7. (3) Calculate the entropy change when a 3.00-g sample of methanol vapor condenses to liquid at its normal boiling point of 65.0 °C. The heat of vaporization of methanol is 37.6 kJ/mol.
8. (10) Use the following data to determine whether silver oxide (Ag₂O) is thermodynamically stable with respect to its elements at a) 25 °C and b) 180 °C. Assume that the partial pressure of oxygen is 1.00 atm.

<table>
<thead>
<tr>
<th></th>
<th>ΔH°_f (kJ/mol)</th>
<th>ΔG°_f (kJ/mol)</th>
<th>S° (J/mol K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag (s)</td>
<td>0</td>
<td>0</td>
<td>42.55</td>
</tr>
<tr>
<td>Ag₂O (s)</td>
<td>-31.05</td>
<td>-11.20</td>
<td>121.3</td>
</tr>
<tr>
<td>O₂ (g)</td>
<td>0</td>
<td>0</td>
<td>205.138</td>
</tr>
</tbody>
</table>

9. (8) Calculate the potential E of a cell consisting of a) a zinc electrode in a 1.2 M Zn(NO₃)₂ solution and b) a copper electrode dipped into a 1.5 M CuSO₄ solution. (Table 20.1 is given)

10. (10) Find the Ksp of Hg₂Cl₂ (s) given that:

\[
\text{Hg}_2^{2+} (aq) + 2e^- \rightarrow 2\text{Hg} (l) \quad \text{E}^o = 0.796 \text{ V}
\]

\[
\text{Hg}_2\text{Cl}_2 (s) + 2e^- \rightarrow 2\text{Hg}(l) + 2\text{Cl}^- (aq) \quad \text{E}^o = 0.268 \text{ V}
\]

11. (5) How many grams of lead will be deposited from a solution of Pb²⁺ ions by a 0.15-A current flowing for 1.00 h?