1. When 2.00 mol of SO₂Cl₂ is placed in a 2.00 L flask at 303 K, 56% of the SO₂Cl₂ decomposes to SO₂ and Cl₂:

$$\text{SO}_2\text{Cl}_2(g) \rightleftharpoons \text{SO}_2(g) + \text{Cl}_2(g)$$

What is the equilibrium constant in terms of molar concentrations, $K_c$, for this reaction at 303K?

2. The following $K_c$ values were attained at 823 K:

$$\text{CoO(s) + H}_2(g) \rightleftharpoons \text{Co(s) + H}_2\text{O(g)} \quad K_c = 67$$

$$\text{CoO(s) + CO(g) \rightleftharpoons Co(s) + CO}_2(g) \quad K_c = 490$$

Calculate the equilibrium constant for:

$$\text{H}_2(g) + \text{CO}_2(g) \rightleftharpoons \text{CO(g) + H}_2\text{O(g)}$$

3. Calculate the Gibbs free energy of reaction, $\Delta G_{rxn}$, that occurs in a closed vessel with constant volume, temperature and total pressure for the reaction:

$$2\text{H}_2\text{S}(g) \rightleftharpoons 2\text{H}_2(g) + \text{S}_2(g)$$

when the partial pressures of the substances are as follows: $P_{H2S} = 0.445 \text{ bar}$; $P_{H2} = 0.112 \text{ bar}$; $P_{S2} = 0.055 \text{ bar}$. The value of $K = 2.4 \times 10^{-4}$ at 1073K.

4. A 0.084 M solution of phenylacetic acid, $C_6H_5CH_2COOH$, has a pH of 2.68. What is the acid dissociation constant for this acid?

5. Which of the following will act as the strongest base in water?

$$\text{Cl}^- \quad \text{NO}_3^- \quad \text{HSO}_4^- \quad \text{ClO}^-$$

6. Hypoiodous acid, $\text{HIO}$, has a $pK_a = 10.64$ at 25°C. A solution is 0.250 M of hypoiodous acid. What is the $[\text{OH}^-]$ in the solution?

7. What is the pH of 0.045 M solution of Sr(OH)$_2$?

8. $K_{sp} = 1.4 \times 10^{-7}$ for copper(II) iodate, $Cu(IO_3)_2$ in water at 25°C. Estimate the molar solubility of the compound at 25°C.

9. A buffer contains equal amounts of a weak base and its conjugate acid. It has a $pH = 10.84$. Out of the following, what is a reasonable value for the $pH$ after the addition of a small amount of base?

3.16 7.00 10.74 10.94 13.84

10. What is the $pH$ of a 0.265 M solution of ammonium nitrate, $NH_4NO_3$? The $K_b$ value of $NH_3 = 1.76 \times 10^{-5}$.

11. Consider the titration of 30.0 mL of 0.115 M KOH with 0.250 M HClO$_4$. What is the $pH$ after 10.0 mL of HClO$_4$ has been added?

12. Approximately how many moles of NaOH must be added to 1.00 liter of 0.150 M acetic acid to make the $pH$ of the solution 5.240? Assume no change in volume. The $K_a$ of acetic acid = $1.8 \times 10^{-5}$.

13. Calculate $\Delta G_{rxn}$ in kJ for the following reaction occuring in a galvanic cell at 25°C.

$$\text{Pb}^{2+}(aq) + \text{Mg(s)} \rightarrow \text{Pb(s)} + \text{Mg}^{2+}(aq) \quad E_{cell}^o = +0.63V$$
14. Balance the following reaction in acidic solution.

\[ \text{Mn}^{2+}(aq) + \text{NaBiO}_3(s) \rightarrow \text{Bi}^3(aq) + \text{Na}^+(aq) + \text{MnO}_4^-(aq) \]

What is the coefficient in front of \(H^+(aq)\) and which side of the equation is it on in the overall, balanced reaction?

15. Gold can be plated out of a solution containing \(\text{Au}^{3+}\). What mass of gold (in grams) can be plated by a 10.0-min. flow of a 5.5 Amp current?

16. A galvanic electrochemical cell was made at 25°C using the redox couples \(\text{Mn}^{2+}/\text{Mn}\) and \(\text{Sn}^{2+}/\text{Sn}\). What is the cell potential of the electrochemical cell?

17. If the cell potential of a galvanic cell made using the redox couples \(H^+/H_2\) and \(\text{Zn}^{2+}/\text{Zn}\) is 0.55 \(V\) at 25°C when the concentration of zinc ions is 1.2 \(M\) and the partial pressure of \(H_2 = 1.0 \text{ atm}\), what is the \(pH\) of the cathode solution?

18. If you start with 0.0250 \(mol\) of \(\text{N}_2\text{O}_5(g)\) in a volume of 2.0 \(L\), how many minutes will it take for the quantity of \(\text{N}_2\text{O}_5(g)\) to drop to 0.010 \(mol\)?

19. Which of the following extrinsic semiconductors would form a \(p\)-type semiconductor?

\[ \text{Ge} : \text{S} \quad \text{Ge} : \text{P} \quad \text{Si} : \text{Al} \quad \text{Si} : \text{N} \]

**CHEM 1212K Reading Day Study Session - Fall 2017 (Solutions)**

1. 0.71
2. \(K_c = 0.14\)
3. 24 \(kJ/mol\)
4. \(5.4 \times 10^{-5}\)
5. \(\text{ClO}^-\)
6. \(4.2 \times 10^{-9}\)
7. \(pH = 12.95\)
8. 0.0033 \(mol/L\)
9. 10.94
10. \(pH = 4.911\)
11. \(pH = 12.376\)
12. 0.114 \(mol NaOH\)
13. \(-120 \text{ kJ}\)
14. 14, left side of the equation.
15. 2.2 \(g\)
16. +1.04 \(V\)
17. \(pH = 3.51\)
18. 2.2 \(min.\)
19. \(Si : Al\)