1. When 2.00 mol of $SO_2Cl_2$ is placed in a 2.00 L flask at 303 K, 56% of the $SO_2Cl_2$ decomposes to $SO_2$ and $Cl_2$:

$$SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$$

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:

$$CoO(s) + H_2(g) \rightleftharpoons Co(s) + H_2O(g) \quad K_c = 67$$

$$CoO(s) + CO(g) \rightleftharpoons Co(s) + CO_2(g) \quad K_c = 490$$

Calculate the equilibrium constant for: $H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$ at 823K.

3. Calculate the Gibbs free energy of reaction, $\Delta G^\circ_{r,x,n}$, that occurs in a closed vessel with constant volume, temperature and total pressure for the reaction:

$$2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$$

when the partial pressures of the substances are as follows: $P_{H2S} = 0.445$ bar; $P_{H2} = 0.112$ bar; $P_{S2} = 0.055$ 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?

$$Cl^- \quad NO_3^- \quad HSO_4^- \quad ClO^-$$

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

$$3.16 \quad 7.00 \quad 10.74 \quad 10.94 \quad 13.84$$

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 $\Delta G^\circ_{r,x,n}$ in $kJ$ for the following reaction occurring in a galvanic cell at 25°C.

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

\[ Mn^{2+} (aq) + NaBiO_3(s) \rightarrow Bi^{3+} (aq) + Na^+ (aq) + MnO_4^- (aq) \]

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 \( Au^{3+} \). 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 \( Mn^{2+}/Mn \) and \( Sn^{2+}/Sn \). 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 \( Zn^{2+}/Zn \) is 0.55 V at 25°C when the concentration of zinc ions is 1.2 M and the partial pressure of \( H_2 = 1.0 \ atm \), what is the \( pH \) of the cathode solution?

18. If you start with 0.0250 mol of \( N_2O_5(g) \) in a volume of 2.0 L, how many minutes will it take for the quantity of \( N_2O_5(g) \) to drop to 0.010 mol?

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

\[ Ge : S \quad Ge : P \quad Si : Al \quad Si : N \]

### CHEM 1212K Reading Day Study Session - SRING 2018 (Solutions)

1. 0.71
2. \( K_c = 0.14 \)
3. 24 kJ/mol
4. \( 5.4 \times 10^{-5} \)
5. \( ClO^- \)
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. \( -120 \) 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. \( Si : Al \)