Chem 216
Sample Quiz 3 Key

1.) H₂O₂ solution is 30% by mass and has a density of 1.11 g/mL.
   a.) Determine the molarity of the solution.
   Answer:
   \[
   \text{Molarity} = \frac{\frac{1.11 \text{ g soln}}{\text{mL soln}} \times \frac{30 \text{ g H}_2\text{O}_2}{100 \text{ g soln}} \times \frac{1 \text{ mol}}{34 \text{ g}} \times \frac{1000 \text{ mL}}{1 \text{ L}}}{9.79 \text{ M}}
   \]
   b.) If 25 mL of this solution is diluted with 75 mL of H₂O, what is the final concentration in moles/L of the diluted solution of hydrogen peroxide.
   Answer:
   \[
   (9.79 \text{ M})(25 \text{ mL}) = M_2(100 \text{ mL})
   \]
   \[
   M_2 = 2.45 \text{ M}
   \]

2.) A 10.0-mL sample of water is titrated with 0.0100 M EDTA at pH 10, using EBT as the indicator. Determine the concentration of CaCO₃ in the water sample if 20.5 mL of the EDTA solution was used to reach the blue endpoint.
   Answer:
   \[
   (0.0100 \text{ M})(20.5 \text{ mL}) = \text{Conc of CaCO}_3(10 \text{ mL})
   \]
   \[
   \text{Conc of CaCO}_3 = 0.0205 \text{ M}
   \]

3.) Given the following kinetics data for the reaction:
   \[
   \text{F}_2(\text{g}) + 2 \text{ClO}_2(\text{g}) \rightarrow 2 \text{FClO}_2(\text{g})
   \]
   \[
   \begin{array}{|c|c|c|}
   \hline
   [\text{F}_2], \text{ M} & [\text{ClO}_2], \text{ M} & \text{initial rate, M/s} \\
   \hline
   0.10 & 0.010 & 1.2 \times 10^{-3} \\
   0.10 & 0.040 & 4.8 \times 10^{-3} \\
   0.20 & 0.010 & 2.4 \times 10^{-3} \\
   \hline
   \end{array}
   \]
   Determine the order of the reaction, write the rate law and calculate the rate constant k.
   Answer:
   \[
   \text{rate} = k [\text{F}_2]^a [\text{ClO}_2]^b
   \]
   To get order of F₂ and ClO₂: (by inspection) or,
Therefore, first order with respect to F$_2$ and first order with respect to ClO$_2$.

Rate law: \[ \text{rate} = k \ [F_2] \ [\text{ClO}_2] \]

Rate constant, $k$;

\[ \frac{\text{rate}_1}{\text{rate}_3} = \frac{[F_2]^a}{[F_2]^a} \frac{\text{rate}_1}{\text{rate}_2} = \frac{[\text{ClO}_2]^b}{[\text{ClO}_2]^b} \]

\[ \frac{1.2 \times 10^{-3}}{2.4 \times 10^{-3}} = \frac{(0.1)^a}{(0.2)^a} \frac{1.2 \times 10^{-3}}{4.8 \times 10^{-3}} = \frac{(0.01)^b}{(0.04)^b} \]

\[ \log 0.5 = a \log (0.5) \quad \log 0.25 = b \log (0.25) \]

\[ a = 1 \quad b = 1 \]

Therefore, first order with respect to F$_2$ and first order with respect to ClO$_2$.

Rate law: \[ \text{rate} = k \ [F_2] \ [\text{ClO}_2] \]

Rate constant, $k$;

\[ \text{rate} = k \ [F_2] \ [\text{ClO}_2] \]

\[ k = \frac{1.2 \times 10^{-3}}{(0.10)(0.01)} \]

\[ k = 1.2 \ M^{-1} s^{-1} \]