For the record, this quiz has two sides. It is expected that the student spend 20 minutes on this quiz (with a maximum of 30 minutes permitted). SHOW ALL WORK. NO “MAGIC” PERMITTED. WATCH SET-UPS, SIG FIGS.

1. Later on in the term, you will be required to prepare a solution of HCl with a concentration of 6.0M. Figure that you will need 50.0 mL of this 6.0M HCl solution. To prepare the solution you will have available to you concentrated HCl. The information on the label of this bottle of concentrated HCl tells you that the HCl is 37.0% pure and that it has a specific gravity (you can assume this to be the same as density) of 1.187.

   a) First of all, what is the Molarity of the concentrated HCl (MW = 36.55)?

\[
\left( \frac{37.0 \text{ g HCl}}{100 \text{ g soln.}} \right) \left( \frac{1.187 \text{ g soln.}}{1 \text{ mL soln.}} \right) \left( \frac{\sqrt{1000 \text{ mL}}}{1 \text{ L}} \right) \left( \frac{1 \text{ HCl}}{36.55 \text{ g HCl}} \right) = 12.0 \text{ M}
\]

   b) Secondly, how much of this concentrated HCl will you need to make the needed 50.0 mL of 6.0M HCl?

(Note: you need to solve part a) to be able to solve part b). If you can’t do part a), you can ASSUME a concentration of 13.1M for use in part b); you’ll pay a penalty for using this value, but at least you can work this part of the problem)

\[
\left( \frac{50.0 \text{ mL}}{\text{ mL} \text{ HCl}} \right) \left( \frac{6.0 \text{ HCl}}{\text{ mL}} \right) = \left( X \text{ mL} \right) \left( \frac{12.0 \text{ HCl}}{\text{ mL}} \right)
\]

\[X = 25.0 \text{ mL}\]

   c) Explain HOW you will go about preparing the desired 6.0M solution.

Use the appropriate graduated cylinder to measure 25.0 mL HCl, then dilute this to a final volume of 50.0 mL.

2. Given a solution of Acetic acid, CH₃COOH (MW = 60.00) -- but henceforth we’ll write it as HOAc -- whose label on the bottle describes it as having a concentration of 5.00% (w/v), what is its Molarity?

\[
\left( \frac{5.00 \text{ g HOAc}}{100 \text{ mL soln.}} \right) \left( \frac{1000 \text{ mL}}{1 \text{ L}} \right) \left( \frac{1 \text{ HOAc}}{60.00 \text{ g HOAc}} \right) = 0.833 \text{ M}
\]
3. We've introduced the term "Ultimate Unit(s)" when describing solutions.
   a) What is the relationship between a compound's Bulk Formula and that same compound's Ultimate Unit(s)?
      \[
      \text{Bulk formula} = \text{macro. description of a compound.} \\
      \text{Ultimate units} = \text{micro. description of a compound.}
      \]
   b) Under what conditions are these two the same?
      If a cpd. is molecular
   c) Under what conditions are these two different?
      If a cpd. is ionic
   d) Why is the concept of an Ultimate Unit important enough to both introducing it?
      Since chemical reactions take place at a micro. scale, we need to be able to describe species at a micro scale.

4. A %KHP determination is carried out by taking a 1.5432 g sample of impure KHP and titrating it with a NaOH (MW = 40.00) titrant. It takes 44.11 mL of the titrant to reach the experimental end point. In the standardization phase of this determination, 45.55 mL of this same titrant is needed to titrate 0.7654 g of primary standard KHP (MW = 204.3).
   a) Determine the %KHP in the impure sample.
      \[
      \begin{align*}
      \text{First, standardize NaOH:} & \quad (765.4 \text{ mg KHP}) \left( \frac{1 \text{ mmol KHP}}{204.3 \text{ mg}} \right) \left( \frac{1 \text{ mmol NaOH}}{1 \text{ mmol KHP}} \right) \left( \frac{1}{45.55 \text{ mL}} \right) = 0.08225 \text{ M} \\
      \text{then calc. \%KHP:} & \quad \left( \frac{44.11 \text{ mL OH}^-}{0.08225 \text{ mmol OH}^-} \right) \left( \frac{1 \text{ KHP}}{1 \text{ OH}^-} \right) \left( \frac{204.3 \text{ mg KHP}}{1 \text{ mmol KHP}} \right) \left( \frac{1}{1543.2 \text{ mg sample}} \right) \\
      & = 0.4803 \text{ mg KHP/mg sample} \times 100 = 48.03 \% \text{ KHP}
      \end{align*}
      \]
   b) Assuming that the only K in the sample comes from KHP, what is the %K (AW = 39.10) in the sample?
      \[
      \left( \frac{44.11 \text{ mL OH}^-}{0.08225 \text{ mmol OH}^-} \right) \left( \frac{1 \text{ KHP}}{1 \text{ OH}^-} \right) \left( \frac{39.10 \text{ mg K}}{1 \text{ mmol K}} \right) \left( \frac{1}{1543.2 \text{ mg sample}} \right) \times 100 = 9.192 \% 
      \]

I pledge I have neither given nor received any unacknowledged aid: ____________________________

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