Question #59450, Chemistry / General Chemistry

Question:

1. The concentration of ammonia in commercially available cloudy solution used for cleaning was conducted in a laboratory.
   25.00mL of the cloudy ammonia solution was pipetted into a 250.00mL conical flask.
   50.00mL of 0.100N HCl was immediately added to the conical flask which reacted with the ammonia in solution.
   NH3 (aq) + HCl (aq) NH4Cl (aq) The excess HCl was then titrated with 0.050M Na2CO3.
   21.50mL of Na2CO3 was required for the titration.
   2HCl (aq) + Na2CO3 (aq) 2NaCl (aq) + CO2 (g) + H2O (aq)
   Calculate the concentration of the ammonia in the cloudy solution, in Molarity.
2. There are 9 points discussed in Analytical Method Validation. Consider a titration between an acid and a base with the use of an indicator, state which 3 (amongst the 9) are most important and your reasons.

Answer:

1. Let's calculate the excess of chloric acid:
   $$n(HCl) = 2 \cdot n(Na_2CO_3) = 2c(Na_2CO_3) \cdot V(Na_2CO_3)$$
   $$n(HCl) = 2 \cdot 0.05M \cdot 21.5mL = 2.15\ mmol$$
   Then we can calculate the number of the moles of HCl that reacted with ammonia:
   $$n(HCl)' = n(HCl)_{tot} - n(HCl) = c(HCl) \cdot V(HCl) - n(HCl)$$
   $$n(HCl)' = 0.1N \cdot 50.00mL - 2.15mmol = 2.85\ mmol$$
   As far as we see from the equation, the number of the moles of chloric acid is equal to the number of the moles of ammonia reacted:
   $$n(HCl)' = n(NH_3) = 2.85\ mmol$$
   Then, the concentration of ammonia in solution is:
   $$c(NH_3) = \frac{n(NH_3)}{V(NH_3)} = \frac{2.85\ mmol}{25\ mL} = 0.1140\frac{mol}{L} = 0.1140\ M$$
2. The objective of the analytical procedure should be clearly understood since this will govern the validation characteristics which need to be evaluated. Typical validation characteristics which should be considered are: 1)Accuracy 2)Precision 3) Repeatability 4)Intermediate 5)Precision 6)Specificity 7)Detection Limit 8)Quantitation Limit 9)Linearity 10)Range. The most important validation characteristics for the titration with indicator method are: linearity, accuracy and precision. The accuracy of an analytical procedure expresses the closeness of agreement between the value which is accepted either as a conventional true value or an accepted reference value and the value found. The precision of an analytical procedure expresses the closeness of agreement (degree of scatter) between a series of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions. The linearity of an analytical procedure is its ability (within a given range) to obtain test results which are directly proportional to the concentration (amount) of analyte in the sample.