Titration Calculations & Questions

1. Use the information to determine the concentration of the hydrochloric acid.
   - A 25 cm^3 sample of hydrochloric acid is sucked into a pipette and transferred into a 250 cm^3 volumetric flask. The solution is made up to the mark.
   - 25 cm^3 of the diluted acid is transferred into a conical flask using a pipette.
   - A burette is used to neutralise the acid with 0.100 mol dm^{-3} sodium hydroxide.

   Hydrochloric acid reacts with sodium hydroxide according to the equation:

   $$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

   a. The average titre of the sodium hydroxide solution was 30.00 cm^3. Calculate the number of moles in the average titre.

   _____ mol (1)

   b. Determine the number of moles in the diluted sample of hydrochloric acid, and hence the concentration of the diluted acid.

   _____ mol dm^{-3} (2)

   c. Calculate the concentration of the undiluted hydrochloric acid in mol dm^{-3}.

   _____ mol dm^{-3} (1)

   d. Calculate the concentration of the hydrochloric acid in g dm^{-3}.

   _____ g dm^{-3} (2)

2. Use the information to determine the concentration of the nitric acid.
   - A 10 cm^3 sample of nitric acid is sucked into a pipette and transferred into a 100 cm^3 volumetric flask. The solution is made up to the mark.
   - 25 cm^3 of the diluted acid is transferred into a conical flask using a pipette.
   - A burette is used to neutralise the acid with 0.150 mol dm^{-3} sodium hydroxide.

   Nitric acid reacts with sodium hydroxide according to the equation:

   $$HNO_{3\,(aq)} + NaOH_{(aq)} \rightarrow NaNO_{3\,(aq)} + H_2O_{(l)}$$

   a. The average titre of the sodium hydroxide solution was 23.33 cm^3. Calculate the number of moles in the average titre.

   _____ mol (1)

   b. Determine the number of moles in the diluted sample of nitric acid, and hence the concentration of the diluted acid.

   _____ mol dm^{-3} (2)

   c. Calculate the concentration of the undiluted nitric acid in mol dm^{-3}.

   _____ mol dm^{-3} (1)

   d. Calculate the concentration of the nitric acid in g dm^{-3}.

   _____ g dm^{-3} (2)

3. Use the information to determine the concentration of the sulfuric acid.
   - A 25 cm^3 sample of sulfuric acid is sucked into a pipette and transferred into a 500 cm^3 volumetric flask. The solution is made up to the mark.
   - 25 cm^3 of the diluted acid is transferred into a conical flask using a pipette.
   - A burette is used to neutralise the acid with 0.100 mol dm^{-3} sodium hydroxide.

   Sulfuric acid reacts with sodium hydroxide according to the equation:

   $$H_2SO_{4\,(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$$

   a. The average titre of the sodium hydroxide solution was 25.00 cm^3. Calculate the number of moles in the average titre.

   _____ mol (1)

   b. Determine the number of moles in the diluted sample of sulfuric acid, and hence the concentration of the diluted acid.

   _____ mol dm^{-3} (2)

   c. Calculate the concentration of the undiluted sulfuric acid in mol dm^{-3}.

   _____ mol dm^{-3} (1)

   d. Calculate the concentration of the sulfuric acid in g dm^{-3}.

   _____ g dm^{-3} (2)

4. Use the information to determine the concentration of the hydrochloric acid.
   - A 10 cm^3 sample of hydrochloric acid is sucked into a pipette and transferred into a 500 cm^3 volumetric flask. The solution is made up to the mark.
   - 25 cm^3 of the diluted acid is transferred into a conical flask using a pipette.
   - A burette is used to neutralise the acid with 0.050 mol dm^{-3} potassium hydroxide.

   Hydrochloric acid reacts with potassium hydroxide according to the equation:

   $$HCl_{(aq)} + KOH_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)}$$

   a. The average titre of the potassium hydroxide solution was 20.00 cm^3. Calculate the number of moles in the average titre.

   _____ mol (1)

   b. Determine the number of moles in the diluted sample of hydrochloric acid, and hence the concentration of the diluted acid.

   _____ mol dm^{-3} (2)

   c. Calculate the concentration of the undiluted hydrochloric acid in mol dm^{-3}.

   _____ mol dm^{-3} (1)

   d. Calculate the concentration of the hydrochloric acid in g dm^{-3}.

   _____ g dm^{-3} (2)

Questions

1. *Explain* what the effect on the titre would be if:
   a. The pipette used to transfer the acid solution was filled to slightly above the mark. (2)

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      _____

      _____

   b. The pipette used to transfer the acid solution was filled to slightly below the mark. (2)

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      _____

   c. The volumetric flask was filled to slightly above the mark. (2)

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      _____

      _____

   d. The volumetric flask was filled to slightly below the mark. (2)

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      _____

2. Calculate the percentage uncertainty of:
   a. A 100 cm^3 volumetric flask with an uncertainty of 0.1 cm^3. (1)

      _____

      _____

   b. A 250 cm^3 volumetric flask with an uncertainty of 0.2 cm^3. (1)

      _____

      _____

   c. A 500 cm^3 volumetric flask with an uncertainty of 0.5 cm^3. (1)

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      _____

3. A student suggests washing out the pipette with water before filling it with acid solution. Explain why this is not a good idea. (2)

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Total marks: 37