Redox Titration Lab 2

Teacher Notes

Name Answers

Purpose:

- To determine the concentration of an unknown $K_2Cr_2O_{7(aq)}$ solution.
- To develop skill with a burette:
- To experience colour change as a visible marker for the endpoint of a reaction

Materials: funnel, volumetric flask, beaker, Erlenmeyer flask, burette, burette brush, pipette, 5.0 mol/L $H_2SO_{4(aq)}$, $FeSO_4.(NH_4)_2SO_4.6H_2O_{(aq)}$, $K_2Cr_2O_7{}_{(aq)}$

Prelab:

➢ The $K_2Cr_2O_{7(aq)}$ will be the titrant since it has a vivid colour. Write a balanced redox reaction. Be sure to include voltage

$Cr_2O_{7(aq)}^{2-} + 14\ H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ $\quad E^o = 1.23$ V

$Fe^{2+} \rightarrow Fe^{3+} + e^-$ $\quad E^o = -0.77$ V

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$ $\quad E^o = 0.46$ V

- ❖ Color of Excess reagent: orange ($Cr_2O_7^{2-}$)
- ❖ Color of limiting reagent: lime green or colourless (Fe^{2+})
- ❖ Color at equivalence point: green + pale yellow (Cr^{3+} and Fe^{3+})
- ❖ Color at end point: Brownish (orange + green + pale yellow)

➢ Calculate the mass of iron (II) ammonium sulfate hexahydrate that is required to make 0.10 L of 0.10 mol/L solution

$N = c \times v$
$= 0.10$ mol/L $\times$ 0.10 mol
$= 0.01$ mol

$m = n \times M$
$= 0.01$ mol $\times$ 392.21 g/mol
$= 3.92$ g

Procedure:

You will be making the dichromate solution. Remember that without the acid being in the solution, it will have a good shelf life.
If you want the students to use between 8 mL and 15 mL of titrant, then you need to make the concentration of this solution between 0.0200 and 0.0011 mol/L

- CAUTION. Do not discard any of the solutions today down the sink. Save the titrated solutions, the unused solutions and return to the front. There will be labeled containers for you to use.
  - You can react all the excess potassium dichromate with the Fe^{2+} solution. If you run short, just add some of the solid iron (II) ammonium sulfate until you get the required colour change.
  - Remember it is not friendly to dump oxidizing agents down the sink!!

Observations:

Students need to be careful of significant digits. They should be able to read the burettes to two decimal places and the scales for measuring should be to a minimum of one (hopefully two) decimal places.
Their calculations and the significant digits will be based on what they observe!

Analysis of DATA

- Calculate concentration of the $K_2Cr_2O_{7(aq)}$ solution that was provided.

I often give bonus marks for being less than 5% away from the concentration that I made up for them.

- Why is the **acid** added to the iron (II) ammonium sulfate and not to the potassium dichromate solution? Give half reactions to support your answer!

They should show that acidified dichromate ions will be a downhill reaction with water. So over time, an undesired reaction is taking place. You want them to have the reaction START when the dichromate is in the presence of the Fe^{2+} ions.