A level Chemistry B

H433/03 Practical skills in chemistry

Question Set 4

1 (a) (i) **This question refers to the *Practical Insert* that is provided as a Resource material to this paper**

Name the piece of apparatus which is most suitable for removing the 25.0 cm^3 of the Cu^{2+} ion solution. **[1]**

(ii) Use the student's results in the *Practical Insert* to work out an average titre that thestudent should use in calculating the amount of Cu^{2+} in the 'coin solution'.

average titre = ……cm^3 **[1]**

(iii) Use your answer from **(a)(ii)** to calculate the percentage by mass of copper in the coin.Give your answer to an **appropriate** number of significant figures.

percentage by mass of copper in coin =……% **[4]**

(iv) The student considers the uncertainties of measurement in the experiment.

The percentage measurement uncertainty marked on the apparatus used to transfer the25 cm^3 of the 'copper' solution is ±0.24%.
The volumetric flask is marked ±0.08%.

Calculate the measurement uncertainties of the other pieces of apparatus used. Which piece of apparatus contributes most to the measurement uncertainty in this experiment? **[2]**

(v) Name another method that the student could use to find the concentration of Cu^{2+} ions inthe 'coin solution'. **[1]**

1 (b)* The student's method requires a standard solution of sodium thiosulfate for the titration.

Describe the techniques and procedures used to prepare a standard solution of a specificconcentration from a solid. **[6]**

Total Marks for Question Set 4 = 15

Resource Materials

Question Set No: 1

Practical Insert

Fake coins

There has been concern about the number of fake coins in circulation.
Below a student describes an investigation to compare the amount of copper in various coins.

- **To find the amount of copper in the coins I decided to use a titration with sodium thiosulfate**
- **I need to dissolve a coin in nitric acid and then add excess iodide ion solution; the liberated iodine can then be titrated with the thiosulfate solution**
- **In a genuine one pence coin the percentage by mass of copper should be 96%.**

The relevant reactions are:

$$Cu(s) + 2NO_3^-(aq) + 4H^+(aq) \rightarrow Cu^{2+}(aq) + 2NO_2\ (g) + 2H_2O(l)$$
$$2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq$$

(Note: the copper ions are produced in solution when the copper coin dissolves in the concentrated nitric acid)

$$2S_2O_3^{2-}(aq) + I_2(aq) \rightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$$

Dissolving the coin

Weigh a penny coin on an electric balance, reading to two decimal places. Add the coin to excess concentrated nitric acid and warm in a fume cupboard.

After all the coin has dissolved allow the solution to cool and transfer carefully to a 250 cm^3 volumetric flask. Make the resulting solution up to the mark using distilled water.
Ensure the solution is thoroughly mixed by inverting the stoppered flask several times.

Determining the copper content of the coin

1. Take 25.0 cm^3 portions of the copper ion solution and transfer to a conical flask.
2. Neutralise excess acid by adding sodium carbonate solution in small volumes until any fizzing stops.
3. Add excess potassium iodide solution (about 25 cm^3 of approximately 1.0 $mol\,dm^{-3}$ solution).
4. Add a few drops of freshly prepared starch solution. The presence of the starch will cause the mixture in the flask to go black.
5. Titrate the liberated iodine with a standard solution of 0.200 $mol\,dm^{-3}$ sodium thiosulfate solution until all the iodine has reacted and the mixture in the flask goes white.
6. Repeat the titration until three concordant results are obtained.
7. Calculate the concentration of copper ions in the original copper ion solution and work out the percentage of copper in the coin.
8. Compare the percentage with data book values to decide whether the coin was a fake.

[Reference: Modified from Graham Hill, John Holman (2001): *Chemistry in Context, Laboratory Manual, Fifth Edition* Cheltenham, Nelson Thornes.]

Results

Mass of coin dissolved = 3.56 g

	Titration 1	Titration 2	Titration 3	Titration 4
Final burette reading / cm^3	22.85	45.45	22.55	45.20
Starting burettereading / cm^3	0.00	22.85	0.00	22.55

Comments on my experiments

The experiment seemed to go well.

My percentage value was lower than the suggested value of 96% copper. This could mean, either thecoin was a fake, or possibly the errors in my experiment were more significant than I thought.

My procedure seemed to be sound, although I did notice that the standard solution of thiosulfate I hadmade up had gone a bit cloudy.

I calculated the errors due the measurements I took, to see if they were significant.