Beatty Secondary School
Science Department (Chemistry Unit)
Chemistry 6092

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Name: ___________________________________ (   )   Date: ________________

Class: 4E___

Practical 2: VA2 – O level 6092 Chemistry Paper 3 Nov 2018 Q2 & Q3

1 Tablets taken for the prevention and treatment of iron deficiency contain an iron(II) compound. You are going to determine the mass of iron present in a tablet by performing a titration using aqueous potassium manganate(VII).

No indicator is needed for this titration as the products of the reaction are almost colourless and one drop of aqueous potassium manganate(VII) in excess produces a pale pink colour.

Read all the instructions below carefully before starting the experiment in Question 2.

Instructions

Q is 0.0105 mol/dm^3 potassium manganate(VII).

R is an aqueous solution of iron(II) ions. The solution was made by dissolving nine tablets containing the iron(II) compound completely in sulfuric acid and making the final volume up to 250 cm^3 by adding water.

(a) (i) Put **Q** into the burette.
The colour of **Q** makes it difficult to see the bottom of the meniscus so you should take all your readings using the top of the meniscus.

Pipette 25.0 cm^3 of **R** into a flask.

Add **Q** from the burette. At first the purple colour disappears quickly but as more **Q** is added the colour disappears less quickly. At the end-point, one drop of **Q** produces a pale pink colour that does not disappear on swirling.

Record your titration results in the space provided, repeating the titration as many times as you consider necessary to achieve consistent results.

Results

titration number	1	2	3
final burette reading / cm^3	20.50	20.00	20.00
initial burette reading / cm^3	0.00	0.00	0.00
volume of solution Q added / cm^3	20.50	20.00	20.00
best titration results		✓	✓

Range 19.80 to 20.20cm^3

[5]

(ii) From your titration results, obtain an average volume of **Q** to be used in your calculations. Show clearly how you obtained this volume.

Average volume of Q used = $\frac{20.00 + 20.00}{2}$

= **<u>20.00 cm^3</u> (2 dp)**

average volume of **Q** **<u>20.00 cm^3</u>** [1]

(b) (i) **Q** is 0.0105 mol/dm^3 aqueous potassium manganate(VII).
Calculate the number of moles of potassium manganate(VII) present in the average volume of **Q**.

No of mol of $KMnO_4$ **=** $0.0105 \times \frac{20.00}{1000}$

= <u>0.000210 mol (3 sf)</u>

number of moles of potassium manganate(VII) **<u>0.000210 mol</u>** [1]

(ii) In the reaction five moles of iron(II) ions react with one mole of potassium manganate(VII). Using your answer from **(i)**, calculate the number of moles of iron(II) ions present in 25.0 cm^3 of **R**.

Comparing mole ratio:

$KMnO_4$: Fe^{2+}

1 : 5

0.000210 : 0.00105

No of mol of Fe^{2+} = 0.00105 mol (3 sf)

number of moles of iron(II) ions **<u>0.00105 mol</u>** [1]

(iii) Using your answer from **(ii)**, calculate the number of moles of iron(II) ions in 250 cm^3 of **R**.

No of mol of Fe^{2+} in 250 cm^3 **= 0.00105 × 10**

= 0.0105 mol (3 sf)

number of moles of iron(II) ions in 250 cm^3 of **R** **<u>0.0105 mol</u>** [1]

(iv) Using your answers from **(iii)**, calculate the mass of iron in one tablet.
[A_r: Fe, 56]

Mass of Fe present in 9 tablets = 0.0105 × 56

= 0.588 g

Mass of Fe present in 1 tablets = 0.588 ÷ 9

= 0.0653 g (3 sf)

mass of iron in one tablet **<u>0.0653 g</u>** [4]

(c) One of the tablets containing the iron(II) compound is dissolved in nitric acid and a few drops of barium nitrate. A white precipitate is observed.

Based on this observation, determine the formula of the iron(II) compound in the tablet.

$FeSO_4$ [1]

(d) A sample of a different brand of tablets containing an iron(II) compound is analysed. It is found that these tablets contain some solid impurities which are insoluble in water.

Describe how the impurities could be removed to leave a clear solution that contains all of the iron(II) ions present in the tablets.

1. **Crush the sample into powder form.**
2. **Add excess water to dissolve the iron(II) compound completely.**
3. **Filter the mixture to remove the insoluble solid impurities as the residue and the clear solution contain iron(II) ions as the filtrate.**
4. **Wash the residue with deionised water to ensure all the iron(II) ions are collected in the filtrate.**

[Total: 16]

2 Sea shells are used to make cement because of their high carbonate content.

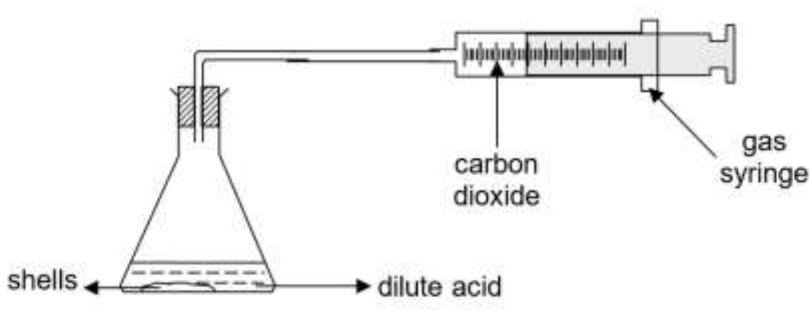
Cockle shells, which are a type of sea shell, are said to contain nearly 60% carbonate, CO_3^{2-}, by mass.

Given 1 g cockle shells, outline a method by which the percentage by mass of carbonate in the shells can be determined.

You can assume all the apparatus and reagents normally found in a school laboratory are available.

In your method you should note any assumptions that you make, include the measurements you would take and explain how you would use your results to determine the percentage by mass of carbonate in the cockle shells.

[A_r: C, 12; O, 16]



Procedure

1. **Measure 1.0 g of cockle shells using an electronic balance and place it into a conical flask.**

2. **Measure 20 cm^3 of excess dilute hydrochloric acid / nitric acid using a measuring cylinder.**

3. **Connect the gas syringe to the delivery tube as shown in the diagram.**

4. **Pour the excess acid into the conical flask and replace the stopper immediately. The carbon dioxide gas given off will be collected in the gas syringe.**

5. **Record the volume of the carbon dioxide gas collected when the reaction is completed, that is, when no more effervescence is seen in the flask.**

6. **Calculate the number of moles of carbon dioxide using the formula**

$$\text{No. of mol of } CO_2 = \frac{\text{volume of } CO_2\ (dm^3)}{24}$$

7. **By comparing the molar ratio of using chemical equation, find the number of moles of carbonate ions.**

Mole Ratio:

$CO_2 : CO_3^{2-}$

$1 : 1$

$x : x$

8. **Find the mass of carbonate ions using the formula**

$$\text{mass} = x\ \text{(mol)} \times \text{molar mass of } CO_3^{2-}\ \text{(g/mol) [60.0]}$$

9. **Find the percentage of carbonate ions in shells using the formula:**

$$\text{\% of carbonate ions} = \frac{\text{mass of carbonate ions}}{1\text{ g}} \times 100\%$$

Assumptions made:

- **Only the carbonate ions present in the cockle shells will react with the dilute acid, other impurities do not react with the dilute acid.**
- **Mole ratio of $CO_2 : CO_3^{2-}$ is 1 : 1**

[Total: 5]