

Planning Question from other schools

- 1 Silver nitrate is used as a topical antibacterial agent, in the form of creams, for the treatment of skin infections.

High content of silver ions are known to be toxic to humans.

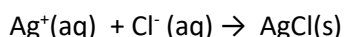
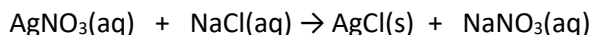
Describe a method and outline clearly the procedures needed to determine the mass of silver present in 2 g of a sample of a water soluble cream used to treat skin infection.

You can assume that all the apparatus and reagents normally found in a school laboratory are available. You should include the measurements you would take and how you would use the results to calculate the mass of silver in the sample of cream.

- 1) Dissolve 2 g of the cream completely in **distilled water**.
- 2) Add **excess aqueous sodium chloride** (or any suitable **solutions** containing chloride ions) to the mixture.
- 3) **Filter** the mixture to obtain the precipitate of silver chloride.
- 4) **Wash** the precipitate with **distilled water** and **dry** it **between pieces of filter papers**.
- 5) **Measure the mass** of precipitate using an **electronic/mass balance**.

Concept:

Precipitation reaction to precipitate out all the silver ions. Hence, excess aqueous NaCl need to be used.



Mole ratio of AgCl : Ag⁺ = 1:1

Calculations

- Calculate the **number of moles of silver chloride** by **dividing the mass of silver chloride by the molar mass of silver chloride**.
- Calculate the **mass of silver** in the cream by multiplying the **number of moles of silver chloride** (same as number of **moles of Ag⁺ ions** in the cream) by the **A_r of silver**.

2 Citric acid is very soluble in water.

The solubility of a substance is the mass of the substance (in grams) that dissolves in 100 cm³ of water at a particular temperature.

A student is investigating the solubility of citric acid in water.

Outline what the student should do to determine the solubility of citric acid in water at 40 °C.

You are provided with a sample of citric acid crystals and you can assume that all apparatus normally found in a school laboratory is available.

By using method of evaporation to dryness, the mass of substance dissolved in 100 cm³ of water at 40 °C can be determined.

- Measure 100 cm³ of water using measuring cylinder/burette and transfer to a beaker.
- Using Bunsen burner, heat the water to 40 °C / use water bath.
- Add citric acid crystals until no more dissolves, some solid remains undissolved..
- Filter mixture to remove the undissolved solid citric acid.
- Using electronic balance, weigh an evaporating dish and transfer filtrate to the evaporating dish. Evaporate filtrate to dryness
- Weigh the evaporating dish with solid (dissolved citric acid)

Results

Mass of evaporating dish=

Mass of evaporating dish + solid =

Calculation

Mass of dissolved citric acid {this mass will be mass of citric acid that dissolves in 100 cm³ of water at 40 °C}

= Mass of evaporating dish + solid - Mass of evaporating dish

3 An organic acid has the molecular formula $\text{C}_6\text{H}_8\text{O}_7$.

When this organic acid crystallises from aqueous solution, it forms the monohydrated solid, $\text{C}_6\text{H}_8\text{O}_7 \cdot \text{H}_2\text{O}$, which contains one molecule of water of crystallisation per formula.

Describe how you can show by experiment that the crystallised organic acid is a monohydrated solid.

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

You should include the measurements you would take and explain how you would use your results to confirm that it is a monohydrated solid.

[M_r : $\text{C}_6\text{H}_8\text{O}_7$, 192; H_2O , 18]

Step 1:

Weigh 1 g of solid $\text{C}_6\text{H}_8\text{O}_7 \cdot n\text{H}_2\text{O}$ and put it into an evaporating dish. **Heat the solid** using a Bunsen burner until the mass of the solid remains constant.

Step 2:

Measure and record the mass of the solid that remains.

Let the mass that remains be x g.

Mass of H_2O = $(1 - x)$ g

Number of moles of H_2O = $\frac{(1 - x)}{18}$ mol

Number of moles of $\text{C}_6\text{H}_8\text{O}_7$ = $\frac{x}{192}$ mol

Hence, if the ratio of the number of moles of H_2O : number of moles of $\text{C}_6\text{H}_8\text{O}_7$ is 1 : 1, the acid is a monohydrated acid.

4

The formula of hydrated sodium carbonate is $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ where x is a whole number.

Describe **another** method, other than titration, by which the value of x in the formula can be determined.

You can assume all the apparatus and reagents normally found in a school laboratory are available. You should include the measurements you would take and explain how you would use your results to calculate the value of x .

Correct approach – reaction and measurement [1]

Eg: heat and measure mass loss / add acid and measure vol of carbon dioxide.

Apparatus – [1]

Data processing to show how to calculate x – [2]

5

- (i) A laboratory technician bought 30% (w/v) hydrogen peroxide. This means that for 100 cm^3 of the solution, it contains 30 g of hydrogen peroxide, H_2O_2 .

A student needs to prepare 100 cm^3 of 6% (w/v) hydrogen peroxide solution for use in the investigation in (ii).

Describe a method to obtain exactly 100 cm^3 of 6% (w/v) hydrogen peroxide solution from 30% (w/v) hydrogen peroxide.

Concept: Use 20 cm^3 of 30% (w/v) H_2O_2 and dilute with 80 cm^3 with distilled water.

$$M_1V_1 = M_2V_2$$

$$\frac{300}{Mr} \times 20 = \frac{60}{Mr} \times V$$

$$V = 100 \text{ cm}^3 \text{ (total volume of solution is } 100 \text{ cm}^3\text{)}$$

Using a 50 cm^3 measuring cylinder, measure 20 cm^3 of 30% (w/v) H_2O_2 into a beaker. Using another measuring cylinder, measure 80 cm^3 of distilled water and pour it into the beaker and swirl to obtain 100 cm^3 of 6 % (w/v) H_2O_2 .

- (ii) An aqueous solution of hydrogen peroxide, such as the one prepared in (i), decomposes very slowly to form oxygen. This reaction can be speeded up by using a catalyst.

Plan an investigation to show whether copper(II) oxide or chromium(III) oxide is a better catalyst for the decomposition of hydrogen peroxide solution.

Procedure

Step 1

fixed volume of H_2O_2 e.g. 50 cm^3 in a conical flask
(accept other possible receptacles) attached to gas
syringe **or**

fixed volume of H_2O_2 e.g. 50 cm^3 in a conical flask
(accept other possible receptacles) with cotton wool
plug, and placed on electronic balance

+

fixed mass of catalyst e.g. 1 g used added to H_2O_2

Step 2

collect gas and measure volume of gas using gas
syringe **or**

measure mass decrease with cotton wool plug
placed on electronic balance

Step 3

over a fixed duration of time or
note time taken for reaction to be complete

Treatment of results[1]

- Plot volume of oxygen collected against time, and steeper gradient would show a more effective catalyst **or**
- Plot mass against time, and steeper gradient would show a more effective catalyst **or**
- Note which experiment stops bubbling first