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.

$AgNO_3(aq) + NaCl(aq) \rightarrow \underline{AgCl(s)} + NaNO_3(aq)$

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

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/Ag** 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 $cm^3$ 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 $cm^3$ of water at 40 °C can be determined.

- Measure 100 $cm^3$ 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 $cm^3$ of water at 40 °C}
= Mass of evaporating dish + solid - Mass of evaporating dish

3 An organic acid has the molecular formula $C_6H_8O_7$.

When this organic acid crystallises from aqueous solution, it forms the monohydrated solid, $C_6H_8O_7.H_2O$, 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.

[$M_r$: $C_6H_8O_7$, 192; $H_2O$, 18]

Step 1:
**Weigh 1 g of solid $C_6H_8O_7.nH_2O$** 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 $C_6H_8O_7$ = $\frac{x}{192}$ mol

Hence, if the ratio of the number of moles of $H_2O$ : number of moles of $C_6H_8O_7$ is 1 : 1, the acid is a monohydrated acid.

4 The formula of hydrated sodium carbonate is $Na_2CO_3.xH_2O$ 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 <u>exactly</u> 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.

M1V1 = M2V2

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

V = 100 $cm^3$ (total volume of solution is 100 $cm^3$)

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