A-Level Chemistry

Inorganic Practical Questions

Question Paper

Time available: 76 minutes
Marks available: 61 marks

1. A student does two test-tube reactions on four colourless solutions (**A**, **B**, **C** and **D**).

The table below shows the student's observations.

Solution	**Test 1** Add $Na_2CO_3(s)$	**Test 2** Add acidified $AgNO_3(aq)$
A	Effervescence	No visible change
B	Effervescence	White precipitate
C	No visible change	No visible change
D	No visible change	Very pale yellow precipitate

(a) Identify the gas formed in **Test 1**.

Describe a further test to confirm the identity of this gas.

Identity of gas _____

Test

_____

_____

(2)

(b) Explain how the observations from **Test 1** and **Test 2** can be used to show that solution **B** contains hydrochloric acid.

_____

_____

_____

_____

(2)

(c) Describe a series of tests that the student can use to show that solution **C** contains ammonium sulfate.

(4)

(d) The student does an additional experiment to show that solution **D** contains a mixture of halide ions. One of the halide ions is chloride.

Method:

Step 1 Add an excess of $AgNO_3(aq)$ to 10.0 cm^3 of solution **D**.
Step 2 Filter, wash, dry and weigh the precipitate.
Step 3 Add an excess of dilute ammonia to the dry precipitate.
Step 4 Filter, wash, dry and weigh the solid that remains.

Explain how the masses recorded during this experiment can be used to show that solution **D** contains a mixture of halide ions.

(2)

(Total 10 marks)

2. Tschermigite is a hydrated, water-soluble mineral, with relative formula mass of 453.2

The formula of tschermigite can be represented as $M.xH_2O$, where M represents all the ions present.

The table below shows its composition by mass.

Element	% by mass
N	3.09
H	6.18
Al	5.96
S	14.16
O	70.61

In an analysis, it is found that the mineral contains the ions NH_4^+, Al^{3+} and SO_4^{2-}

Calculate the empirical formula of tschermigite and the value of x in $M.xH_2O$

Describe the tests, with their results, including ionic equations, that would confirm the identities of the ions present.

(Total 6 marks)

3. This question is about Group 7 chemistry.

(a) Give an equation for the reaction of solid sodium bromide with concentrated sulfuric acid to form bromine.

State **one** observation made during this reaction.

Equation

_____

Observation _____

_____

_____

(2)

(b) A solution that is thought to contain chloride ions and iodide ions is tested.

1. Dilute nitric acid is added to the solution.
2. Aqueous silver nitrate is added to the solution.
3. A pale yellow precipitate forms.
4. Excess dilute aqueous ammonia is added to the mixture.
5. Some of the precipitate dissolves and a darker yellow precipitate remains.

Give a reason for the use of each reagent.

Explain the observations.

Give ionic equations for any reactions.

(5)

(Total 7 marks)

4. This question is about some Group 7 compounds.

(a) Solid sodium chloride reacts with concentrated sulfuric acid.

Give an equation for this reaction.
State the role of the sulfuric acid in this reaction.

Equation

Role _____

(2)

(b) Fumes of sulfur dioxide are formed when sodium bromide reacts with concentrated sulfuric acid.

For **this** reaction
- give an equation
- give **one** other observation
- state the role of the sulfuric acid.

Equation

_____

Observation _____

_____

Role _____

(3)

(c) Chlorine reacts with hot aqueous sodium hydroxide as shown in the equation.

$$3\ Cl_2 + 6\ NaOH \rightarrow NaClO_3 + 5\ NaCl + 3\ H_2O$$

Give the oxidation state of chlorine in $NaClO_3$ and in NaCl

$NaClO_3$ _____

NaCl _____

(1)

(d) State, in terms of redox, what happens to chlorine in the reaction in part **(c)**.

_____

_____

(1)

(e) Solution **Y** contains **two** different negative ions.

To a sample of solution **Y** in a test tube a student adds
- silver nitrate solution
- then an excess of dilute nitric acid
- finally an excess of concentrated ammonia solution.

The observations after each addition are recorded in the table.

Reagent added to solution Y	**Observation**
silver nitrate solution	cream precipitate containing compound **D** and compound **E**
excess dilute nitric acid	cream precipitate **D** and bubbles of gas **F**
excess concentrated ammonia solution	colourless solution containing complex ion **G**

Give the formulas of **D**, **E** and **F**.
Give an **ionic** equation to show the formation of **E**.
Give an equation to show the conversion of **D** into **G**.

Formula of **D** _____

Formula of **E** _____

Formula of **F** _____

Ionic equation to form **E**

_____

Equation to show the conversion of **D** into **G**

_____

(6)
(Total 13 marks)

5. The percentage by mass of iron in a steel wire is determined by a student.

The student

- reacts 680 mg of the wire with an excess of sulfuric acid, so that all of the iron in the wire forms $Fe^{2+}(aq)$
- makes up the volume of the $Fe^{2+}(aq)$ solution to exactly 100 cm^3
- takes 25.0 cm^3 portions of the $Fe^{2+}(aq)$ solution
- titrates each portion with 0.0200 mol dm^{-3} potassium manganate(VII) solution.

(a) Give the equation for the reaction between iron and sulfuric acid.

_____

(1)

(b) The titration results are shown in the table.

	1	**2**	**3**
Final volume / cm^3	22.90	45.60	22.60
Initial volume / cm^3	0.00	22.90	0.00
Titre / cm^3	22.90	22.70	22.60

Calculate the mean titre.

Mean titre _____ cm^3

(1)

(c) Give the overall ionic equation for the oxidation of Fe^{2+} by manganate(VII) ions, in acidic conditions.

_____

(1)

(d) State the colour change seen at the end point of the titration.

_____

(1)

(e) Name the piece of apparatus used for these stages of the method.

Taking the 25.0 cm^3 portions _____

Adding the
potassium manganate(VII) solution _____

(1)

(f) The balance used to weigh the 680 mg of iron wire has an uncertainty of ±0.005 g

A container was weighed and its mass was subtracted from the total mass of the container and wire.

Calculate the percentage uncertainty in using the balance.

% uncertainty _____

(1)

(Total 6 marks)

6. The table below shows observations of changes from some test-tube reactions of aqueous solutions of compounds **Q**, **R** and **S** with five different aqueous reagents. The initial colours of the solutions are not given.

	$BaCl_2$ + HCl	**$AgNO_3$ + HNO_3**	**NaOH**	**Na_2CO_3**	**HCl (conc)**
Q	no change observed	pale cream precipitate	white precipitate	white precipitate	no change observed
R	no change observd	white precipitate	white precipitate, dissolves in excess of NaOH	white precipitate, bubbles of a gas	no change observed
S	white precipitate	no change observed	brown precipitate	brown precipitate, bubbles of a gas	yellow solution

(a) Identify each of compounds **Q**, **R** and **S**.
You are **not** required to explain your answers.

Identity of **Q** _____

_____

Identity of **R** _____

_____

Identity of **S** _____

_____

(6)

(b) Write ionic equations for each of the positive observations with **S**.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

7. Iron(II) ethanedioate is another insoluble solid used as a pigment in paints and glass. It occurs as a dihydrate ($FeC_2O_4.2H_2O$). One procedure used for the preparation of iron(II) ethanedioate is outlined below.

Procedure

A 6.95 g sample of hydrated iron(II) sulfate ($FeSO_4.7H_2O$) was added to 100 cm^3 of water in a beaker and stirred until all of the solid dissolved. A 150 cm^3 volume of 0.20 mol dm^{-3} sodium ethanedioate solution was added to the beaker. The mixture was stirred until precipitation was complete. After filtration, 3.31 g of the dihydrate ($FeC_2O_4.2H_2O$) were collected.

(a) Write an equation for the reaction between iron(II) sulfate and sodium ethanedioate.

_____

(1)

(b) Calculate the amount, in moles, of $FeSO_4.7H_2O$ in 6.95 g of hydrated iron(II) sulfate. Show your working.

_____

_____

_____

(2)

(c) Calculate the amount, in moles, of sodium ethanedioate in 150 cm^3 of 0.20 mol dm^{-3} sodium ethanedioate solution.

_____

_____

(1)

(d) Calculate the percentage yield of iron(II) ethanedioate dihydrate (M_r = 179.8) formed in this reaction.
Give your answer to the appropriate precision. Show your working.

_____

_____

_____

_____

(2)

(e) In this experiment, no side reactions take place, the reagents are pure and the reaction goes to completion.

Suggest **one** reason why the yield of iron(II) ethanedioate dihydrate in this experiment is less than 100%.

_____

_____

_____

(1)

(f) When dissolved in dilute sulfuric acid, the number of moles of ethanedioate ions in a pigment can be determined by titration with acidified potassium manganate(VII).

Explain why the titration of a sample of iron(II) ethanedioate would require a different amount of potassium manganate(VII) than a titration of an equimolar amount of copper(II) ethanedioate.

_____

_____

_____

_____

(2)

(Total 9 marks)