

TIME: 1h 30min

Class: _____

State symbols are expected to be included in all chemical equations.

133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86
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relative atomic mass
symbol
atomic number

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SECTION A – Answer ALL questions. This section carries 60 marks.

- 1 In the laboratory, zinc oxide can be prepared by the thermal decomposition of either zinc carbonate or zinc nitrate.

a. Explain the term **thermal decomposition**.

[1]

- b. (i) Write down balanced equations, **including state symbols**, to show how zinc oxide is prepared from :

- zinc carbonate: _____
- zinc nitrate: _____

- (ii) The prepared compound in b. (i) undergoes a noticeable colour change as it cools down to room temperature. Fill in the two boxes below with the colour of the compound at the temperatures indicated.

At 100°C

At 20°C

[6]

- c. Zinc sulfate can be prepared in the laboratory from zinc oxide.

- (i) Which one of these types of reactions is used in this preparation?

precipitation	<input type="checkbox"/>	displacement	<input type="checkbox"/>
neutralization	<input type="checkbox"/>	synthesis	<input type="checkbox"/>

- (ii) Give one important practical step that ensures that the zinc sulfate solution obtained is pure.

- (iii) Which method is suitable to obtain hydrated zinc sulfate from zinc sulfate solution?

[3]

2 Most gases can be collected by one of the following methods:

- A** - downward delivery
B - upward delivery
C - over water

Fill in the table below:

Name of gas collected.	One suitable method of collection. Choose A or B or C .	Reason why this gas is collected using this method.
hydrogen		
chlorine		
ammonia		
sulfur dioxide		
hydrogen chloride		

[10]

3 a. Fill in the table below as follows:

Column 1: In this column, write down the names of **two** starting materials that are required for the manufacture of **each** of the named chemicals.

Column 2: In this column, give the name of the catalyst that is used for **each** of the processes involved in the industrial preparation of the named chemicals.

Column 3: In this column, write down one important use for **each** of the named chemicals.

Name of Industrial process	Name of starting materials. Column 1.	Name of catalyst. Column 2.	One important use. Column 3.
Haber process. (Ammonia)	(i) (ii)		
Contact process. (Sulfuric acid)	(i) (ii)		
Ostwald process. (Nitric acid)	(i) (ii)		

[9]

b. Aqueous ammonia reacts with dilute sulfuric acid to produce aqueous ammonium sulfate and water. Write down a balanced equation for this reaction. **No need to include state symbols.**

[1]

4 **X** is an unknown crystalline solid. To identify the ions present in a sample of **X**, a student performed the tests below.

- A sample of **X** was heated with aqueous sodium hydroxide. A gas **Y** which turned damp pH paper blue was evolved.
- An aqueous solution of **X** was treated with silver nitrate solution acidified with dilute nitric acid. A pale yellow precipitate **Z** was formed.

a. (i) Give the name of the gas **Y**. _____

(ii) Name one drying agent suitable to dry a sample of **Y**. _____

(iii) Give a reason why gas **Y** turned damp pH paper blue. _____

[3]

b. (i) Give the name of the precipitate **Z**. _____

(ii) Write down an ionic equation to show the formation of **Z** by the reaction between **X** in aqueous solution and acidified silver nitrate. **Include state symbols.**

[3]

c. (i) Identify the substance **X**. _____

(ii) Write down the ionic formula of **X**. _____

[2]

d. It was found experimentally that the pH of an aqueous sample of **X** was 5.2. Is such a solution acidic, neutral or alkaline? _____

[1]

e. Crystals of substance **X** must necessarily be stored in a dry airtight container. Which property of **X** makes this necessary? _____

[1]

- 5 To answer this question, you have to use the Periodic Table printed on the front page of this question paper together with the information in the table below:

Metal	Reaction with Water	Melting Point in °C	Density in g cm ⁻³
Lithium	slow	181	0.54
Sodium	fast	98	0.97
Potassium	very fast	63	0.86
Rubidium		39	1.53

a. Fill in the empty space in the table. [1]

b. (i) Lithium, sodium and potassium float on water but rubidium and caesium do not. Give **one** reason for this. _____

(ii) Give a chemical equation for the reaction of **one** of the metals in the table with water.

Include state symbols. _____

(iii) Suggest a pH value for the resulting solution in b. (ii). _____

[4]

c. (i) Caesium melts if it is held in the hand. Is this true or false?

True

☐

False

☐

(ii) Give a reason for your answer to c. (i).

[2]

d. (i) Choose **one** metal from the table and write a symbol equation for the formation of its ion.

No need to include state symbols. _____

(ii) The formation of a metallic ion is an oxidation. Give a reason for this.

[2]

e. Choose **one** metal from the table and state the **colour** that its compounds impart to the Bunsen flame. Metal: _____ Colour: _____

[1]

6 This question concerns a dilute aqueous solution of sodium sulfate.

a. Write down the formulae of the **four** ions present in the solution.

_____ [2]

b. While conducting a test for sulfate ions in solution, an acidified reagent is used.

(i) Give the name of this reagent. _____

(ii) Give the name of the acid used to acidify this reagent. _____

(iii) Write down what you observe if sulfate ions are present. _____

_____ [3]

c. If this solution is electrolysed between platinum electrodes, a gas **A** which relights a glowing splint is produced at one electrode and another gas **B** which burns in air with a pop is produced at the other electrode.

(i) Give the name of:

• Gas **A**: _____

• Gas **B**: _____

(ii) Give the name of the **electrode** at which:

• Gas **A** is produced: _____

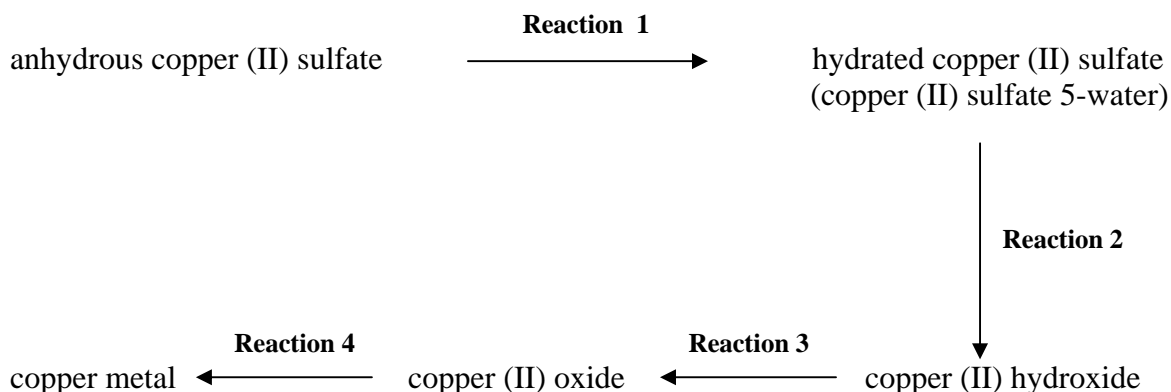
• Gas **B** is produced: _____

(iii) Give the name of the apparatus that is usually used in the laboratory to conduct this electrolysis. _____

[5]

SECTION B – Answer TWO questions only on the foolscap provided.
This section carries 40 marks.

- 7 The reaction scheme below shows a chain of chemical reactions that can be carried out in the laboratory to produce copper metal from anhydrous copper (II) sulfate.



Explain how you would carry out **Reactions 1 to 4** in the laboratory. In **each** case, your explanation must include:

- the name of the reagent required, if any.
- any condition necessary for the reaction to take place, if such condition exists.
- a chemical equation for each reaction. **No need to include state symbols.**

For **Reaction 4** only, your answer must also include a labelled diagram of the apparatus used.

[20]

- 8 Give a chemical explanation for **each** of the statements below. In each case, give the equation/s for the reaction/s described. **Diagrams are not required.**
- Although different methods are used to extract aluminium and iron, both processes involve a reduction reaction. [5]
 - Since strontium is below calcium in Group II of the Periodic Table, it reacts similarly with water and dilute hydrochloric acid. [6]
 - When zinc is added to copper (II) sulfate solution, a precipitate is formed but there is no reaction when copper is added to zinc sulfate solution. [4]
 - If chlorine gas is bubbled into a solution of potassium bromide, a redox reaction occurs and a colour change is observed. [5]

- 9 A suitable container is filled with 15 cm^3 of a standard solution of sodium carbonate. After adding an appropriate indicator, this volume of sodium carbonate is titrated against a solution of hydrochloric acid of unknown concentration.

The following information may be useful:

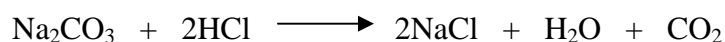
Relative atomic masses: **H = 1, Cl = 35.5**

- a. The questions below refer to the practical set-up, the experimental steps and precautions required while carrying out a titration.

- (i) Name **three** main items of apparatus needed to carry out a titration.
- (ii) Name a suitable indicator for this titration and state its colour change at the end point.
- (iii) State **two** important steps that must be taken while measuring the volume of a solution.
- (iv) State **three** precautions, other than those given in a. (iii) that must be taken in order to obtain accurate results for the titre values.

[10]

- b. The molar concentration of the sodium carbonate solution was 0.25 mol dm^{-3} . It was found that 15 cm^3 of sodium carbonate required 37.5 cm^3 of hydrochloric acid for exact neutralization.



- (i) Calculate the number of moles of sodium carbonate present in the 15 cm^3 solution.
- (ii) Calculate the number of moles of hydrochloric acid present in the 37.5 cm^3 solution.
- (iii) Calculate the molarity of the hydrochloric acid.
- (iv) Change your answer to question b. (iii) from mol dm^{-3} to g dm^{-3} .

[10]