



**SECTION A:**            **Answer ALL questions in this section, using the spaces provided.**  
**This section carries 60 marks.**

1. (a) Lithium chloride, LiCl, is an ionic compound. Draw a dot/cross diagram, showing **all** electron shells, to show the electron configuration and charge of the lithium ion and the chloride ion.

(3 marks)

- (b) Lithium chloride is an electrolyte both when fused and as a concentrated solution.

- (i) Chlorine gas is liberated at the anode in both electrolysis experiments.  
Give the colour of chlorine and a simple test to identify the gas.

colour: \_\_\_\_\_ test: \_\_\_\_\_ (2 marks)

- (ii) Give the ionic **half** equations for the electrode reactions that take place when **fused** (molten) lithium chloride is electrolysed.

at cathode: \_\_\_\_\_ at anode: \_\_\_\_\_ (3 marks)

- (iii) When the concentrated **solution** is electrolysed, hydrogen gas is liberated **at the cathode**. This is different from the result of fused lithium chloride. Briefly explain why the electrolysis of the solution gives a different result at the cathode.

\_\_\_\_\_  
\_\_\_\_\_

(2 marks)

2. Hydrogen can combine directly with both metals and non-metals. The compounds formed are called hydrides.

- (a) Sodium is one metal that combines with hydrogen.

- (i) Give the formula for the compound. \_\_\_\_\_

- (ii) Sodium hydride is ionic.

Predict if the charge on the hydrogen ion is positive or negative. \_\_\_\_\_

- (iii) Give one property that you would expect this compound to show.

\_\_\_\_\_

(3 marks)

- (b) Another hydride is formed when nitrogen reacts with hydrogen.

- (i) Give the formula of this compound. \_\_\_\_\_ (1 mark)

- (ii) This compound is covalent. Draw a dot/cross diagram, showing only the **outer** electron shells, to show the bonding in this compound.

(2 marks)

- (c) Some hydrides dissolve in water to give an acidic or alkaline solution, while other hydrides are neutral or insoluble in water. State whether water would turn acidic, alkaline or remain neutral, when the following hydrides are added to it.

- (i) the hydride of nitrogen \_\_\_\_\_  
(ii) methane \_\_\_\_\_  
(iii) hydrogen chloride \_\_\_\_\_

(3 marks)

3. (a) There are four general methods of preparing salts. These are:

method 1: Adding excess of solid (metal, base or carbonate) to a dilute acid.  
method 2: By titration  
method 3: By precipitation  
method 4: By synthesis

State which of these methods would be used to prepare each of the following salts.

- (i) potassium chloride method \_\_\_\_\_  
(ii) iron (III) chloride method \_\_\_\_\_  
(iii) copper (II) sulfate method \_\_\_\_\_  
(iv) lead (II) sulfate method \_\_\_\_\_

(4 marks)

- (b) Methods 1 and 2, listed above, involve the use of an acid.

- (i) **Name one** acid needed to prepare the salts that you selected in part (a) by these methods.

\_\_\_\_\_

- (ii) What would you expect the pH value of this acid to be? \_\_\_\_\_ (2 marks)

- (c) Some reactions involving acids can be represented by a general ionic equation (omitting spectator ions). Write the general ionic equation that represents:

- (i) the neutralisation of any acid by any alkali.

\_\_\_\_\_

- (ii) the reaction between any carbonate and any acid.

\_\_\_\_\_

(4 marks)

4. (a) Hydrogen peroxide decomposes in the presence of a catalyst.

- (i) Write an equation for the decomposition of hydrogen peroxide.

\_\_\_\_\_

(2 marks)

- (ii) Name a suitable catalyst for this reaction and explain the meaning of this term.

\_\_\_\_\_

\_\_\_\_\_

(3 marks)

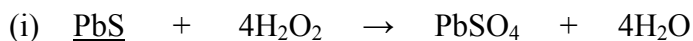
- (iii) What is a practical application of this reaction **in the laboratory**?

\_\_\_\_\_

(1 mark)

(b) Hydrogen peroxide is an **oxidising agent**.

Support this statement by completing the sentences that describe the oxidation of the underlined substances below.



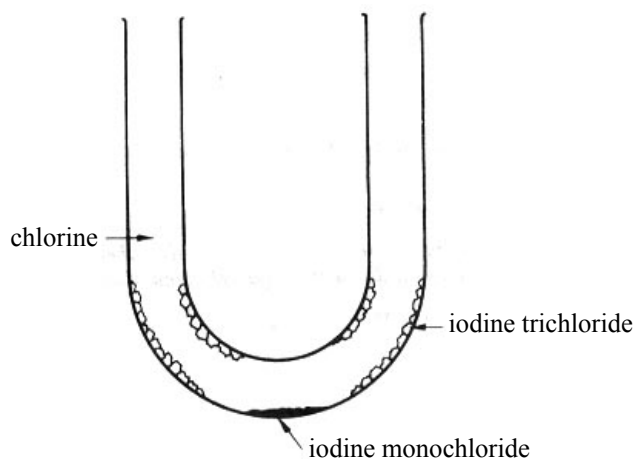
PbS is oxidised to \_\_\_\_\_ because \_\_\_\_\_



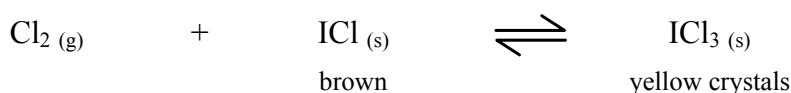
$\text{Fe}^{2+}$  is oxidised to \_\_\_\_\_ because \_\_\_\_\_

(4 marks)

5. If chlorine is passed over iodine in a U-tube, the first product is brown iodine monochloride, formula ICl. If excess chlorine is passed, this brown compound is converted into iodine trichloride, formula ICl<sub>3</sub>, which appears as yellow crystals on the walls of the U-tube as shown in the diagram below.



(a) The second of these reactions is an equilibrium.



(i) What do you understand by the term 'chemical equilibrium'?

\_\_\_\_\_  
\_\_\_\_\_  
(2 marks)

(ii) Predict what you would see if the U-tube is tipped slowly so that the chlorine escapes.

\_\_\_\_\_  
(1 mark)

(iii) Use Le Chatelier's principle to explain your prediction in (a) (ii).

\_\_\_\_\_  
\_\_\_\_\_  
(2 marks)

(b) Why should these reactions be carried out in a fume cupboard?

\_\_\_\_\_  
(1 mark)

(c) Chlorine and iodine both belong to Group 7 of the Periodic Table.

(i) What is the 'family name' of this group of elements?

\_\_\_\_\_ (1 mark)

(ii) Which of the Group 7 elements is the most reactive?

\_\_\_\_\_ (1 mark)

(iii) State **two** similarities between Group 7 elements.

\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

6. A hydrocarbon was found to contain 81.8% by mass of carbon.  
Its relative molecular mass is 44.

(a) (i) Calculate the **empirical formula** of the compound. (3 marks)

(ii) What is the **molecular formula** of the compound? (1 mark)

\_\_\_\_\_

(iii) Give the **name** and **structure** of this compound. (2 marks)

(b) The hydrocarbon of molecular formula  $C_5H_{12}$  belongs to the same **homologous series**.  
This hydrocarbon exhibits isomerism.

(i) What are **isomers**?

\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

(ii) Draw the structures for **two** possible isomers of  $C_5H_{12}$ . (2 marks)

(c) Name a **raw material** from which hydrocarbons can be obtained.

\_\_\_\_\_ (1 mark)

**Section B:** Answer any **TWO** questions from this section on the separate sheets provided.  
Each question carries 20 marks.

7. A conical flask containing some marble chips ( $\text{CaCO}_3$ ) is placed on a top pan balance, and excess dilute hydrochloric acid is added. The mass of the flask and contents are then recorded every two minutes. The mass decreases due to the carbon dioxide liberated. The results are shown in the table below.

Time in minutes	0	2	4	6	8	10	12
Mass in grammes	125.59	125.37	125.23	125.15	125.10	125.09	125.09

- On a sheet of graph paper, plot these results, with time along the horizontal axis. Draw a smooth curve through these experimental points. (6 marks)
- State **two** important precautions that must be taken in order to obtain accurate results. (2 marks)
- If you were asked to investigate the effect of surface area on this reaction, state:
  - how you would vary the surface area, (1 mark)
  - three** things that you would keep constant in order to make a fair comparison with the marble chips. (3 marks)
- what was the **mass** of carbon dioxide evolved in this experiment?
  - what is the **volume** of this gas at s.t.p.? (3 marks)
- Calcium carbonate also exists in the form of limestone. Explain why water from limestone areas is temporary hard including an equation for the reaction. (5 marks)

8. You are supplied with unlabelled samples of each of the following pairs of substances. State **ONE CHEMICAL** test that you could carry out in order to distinguish between the substances in each pair.

You should give the result / observations for **both** substances.

(If there is no change, state so clearly.)

N.B. **Give equations** for your answers to **parts (a) and (d)** only.

- A saturated hydrocarbon (e.g. ethane) and an unsaturated hydrocarbon (e.g. ethene). (6 marks)
  - Sulfur dioxide and nitrogen gases. (4 marks)
  - Solid samples of potassium carbonate and sodium carbonate. (3 marks)
  - Aqueous solutions of potassium chloride and potassium iodide. (7 marks)
9. Chemistry has had an impact on society due to the chemical industrial processes that have made it possible to **extract** or isolate **elements** from naturally occurring materials. Other chemical processes have made it possible to **synthesize** or manufacture useful **compounds**. By referring to a process of your own choice, describe:
- the **industrial ISOLATION / EXTRACTION** of **one ELEMENT**,
  - the **industrial SYNTHESIS / MANUFACTURE** of **one COMPOUND**.
- In each answer, you should include the following points.
- the main raw material(s) or starting material(s),
  - the chemical principle of the process, including chemical equations where applicable,
  - two** important uses of the main product. (20 marks)