



**SECTION A**

**Answer ALL the questions in this section.**

**There is useful data on the front cover and a Periodic Table is printed on the back cover of this question paper.**

1. (a) For the laboratory preparation of dry ammonia, state the reactants, drying agent and method of collection. Write an equation for the reaction.

Reactants .....

Drying agent .....

Method of collection .....

Equation .....

**(4)**

- (b) (i) Balance the equation for the reaction that occurs when ammonia is passed over hot copper(II) oxide.



- (ii) Give the colour change for copper(II) oxide seen during the reaction.

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- (iii) State with a reason which reactant has been oxidised.

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**(3)**

- (c) Calculate the percentage by mass of nitrogen in ammonium sulphate, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.

**(3)**

**Q1**

**(Total 10 marks)**



2. (a) When aqueous silver nitrate,  $\text{AgNO}_3$ , is electrolysed using inert electrodes, silver is deposited at the cathode and a colourless gas is evolved at the anode.

(i) Write the equation for the reaction at the cathode.

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(1)

(ii) Calculate the mass of silver produced by the passage of a charge of 0.10 faradays.

(2)

(iii) Name the colourless gas evolved at the anode and give a test to confirm its identity.

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(2)

(iv) Complete the equation for the reaction at the anode.

$4\text{OH}^- \rightarrow$  .....  
(1)

(b) The electrolytic purification of silver is similar to the method used to purify copper. Explain how pure silver is obtained from a block of impure silver. Write an equation for the reaction that will occur at the anode.

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Equation: .....  
(4)

(Total 10 marks)

Q2

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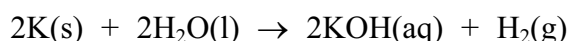


3. (a) Give **three** observations that can be made if a small piece of potassium is dropped into water.

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**(3)**

(b) The equation for the reaction between potassium and water is:



(i) If 0.195 g of potassium is added to 200 cm<sup>3</sup> of water, calculate the number of moles of potassium hydroxide formed and hence the concentration of the solution in mol dm<sup>-3</sup>.

**(3)**

(ii) If 0.195 g of sodium is used instead of potassium, the concentration of the sodium hydroxide solution formed is higher. Give a reason for this.

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**(1)**

(c) State what is observed when aqueous sodium hydroxide is added separately to solutions of iron(II) sulphate, iron(III) sulphate and copper(II) sulphate.

Iron(II) sulphate .....

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Iron(III) sulphate .....

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Copper(II) sulphate .....

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**(3)**

**Q3**

**(Total 10 marks)**



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4. (a) Alkanes can be separated by fractional distillation. The boiling points of some alkanes are given in the table.

Alkane	Boiling point / °C
methane	-162
ethane	-89
propane	-42

- (i) State which alkane would be obtained at the top of the fractionating column and give a reason.

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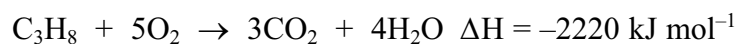
(1)

- (ii) State **two** physical changes that occur during fractional distillation.

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(2)

- (iii) Bottled propane is used as a fuel for heating. The equation for its complete combustion is:



Calculate the heat evolved when 176.0 g of propane is completely burnt in air.

(2)



(b) A student is asked to use chromatography to investigate whether a coloured material extracted from a 'LUPYJUS' drink is a single substance or a mixture of three coloured dyes. Describe how he could achieve this using a tall beaker, a strip of filter paper and common laboratory chemicals. Draw a diagram to show the result of the experiment if three dyes are present.

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(5)

Q4

(Total 10 marks)

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5. (a) State what is meant by structural isomerism.

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**(2)**

(b) Draw the structural formulae for the two alcohols with the molecular formula  $C_3H_8O$ .

**(2)**





(c) Three isomers **A**, **B** and **C** have the molecular formula  $C_3H_6O_2$ . When **A** is added to aqueous sodium carbonate, carbon dioxide is evolved. **B** and **C** are esters.

(i) Give a test to identify carbon dioxide.

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(1)

(ii) What does the liberation of carbon dioxide indicate about the class of compound to which **A** belongs? Write the structural formula for **A** showing the bonding in the functional group.

Class of compound .....

Structural formula

(2)

(iii) Write the structural formulae for the two esters **B** and **C** showing the bonding in the functional group. Name **one** of the esters.

(3)

Q5

(Total 10 marks)

**TOTAL FOR SECTION A: 50 MARKS**



### SECTION B

Answer TWO questions in this section.

Where appropriate, equations and diagrams should be given to clarify your answer.

If you answer Question 6, put a cross in this box  .

6. (a) The ore haematite contains a high proportion of iron(III) oxide,  $\text{Fe}_2\text{O}_3$ . A blast furnace is used to extract iron from the ore.

(i) Name the other raw materials that are used in the blast furnace process.

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(3)

(ii) Write **three** equations for the reactions that lead to the formation of iron.

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(3)

(iii) Describe how the silica impurity present in iron ore is removed. Write equations for the reactions that occur.

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(4)



(b) Iron rusts when it comes in contact with air and water.

- (i) A long tube sealed at one end contains  $100 \text{ cm}^3$  of air. It is inverted in a beaker of water so that the tube is vertical with its open end below the level of water in the beaker. Suspended inside the tube is a small bag of moist iron filings. Explain what you would see when the apparatus is left for a few days.

Appearance of the iron filings:

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Water level inside the tube:

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Explanation:

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Equation:

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**(6)**

- (ii) Explain why iron filings rust more rapidly when exposed to the atmosphere than a single lump of iron of similar mass.

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**(2)**



(c) A mixture of iron(III) oxide and aluminium powder can be used in the thermite process to weld steel rails together when laying railway track.

(i) State how the reaction is started, what you would see happen and write an equation for the reaction.

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(3)

(ii) One mole of iron(III) oxide,  $\text{Fe}_2\text{O}_3$ , forms two moles of iron, Fe, in the reaction. Calculate the mass of iron(III) oxide required to form 224 g of iron metal.

(2)

(d) State and explain the role of iron in the Haber process for the industrial manufacture of ammonia.

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(2)

Q6

(Total 25 marks)

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If you answer Question 7, put a cross in this box  .

7. (a) A homologous series is a series of compounds with a general formula. Give **two** other features of a homologous series. Write the general formulae for the alkane and alkene series of hydrocarbons.

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(4)

- (b) Explain why alkanes and alkenes are **hydrocarbons** and why alkenes are classified as **unsaturated** hydrocarbons.

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(2)



(c) Using ethane and ethene as examples, compare the reactions of alkanes and alkenes with bromine. Your answer should include:

- the conditions under which each reaction takes place
- the type of reaction
- an equation for each reaction using structural formulae
- the name of the organic product of each reaction

Reaction of ethane

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Reaction of ethene

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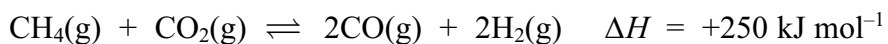
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**(8)**





(e) Methane reacts with carbon dioxide in a reversible reaction.



(i) State with a reason what effect an increase in pressure would have on the equilibrium yield of carbon monoxide and hydrogen.

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 (1)

(ii) State and explain the effect an increase in pressure would have on the rate of reaction.

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 (3)

(iii) State with a reason what effect an increase in temperature would have on the equilibrium yield of carbon monoxide and hydrogen.

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 (1)

**(Total 25 marks)**

**Q7**

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If you answer Question 8, put a cross in this box  .

8. (a) Chlorine, bromine and iodine are members of the halogen group in the Periodic Table. They exhibit similar chemical properties but their physical properties vary from element to element.

(i) Explain why the halogens have similar chemical properties. Write equations for the reaction of hydrogen with two members of the group to illustrate this similarity.

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(3)

(ii) Give the physical state at room temperature and the colour of each of the halogens chlorine, bromine and iodine.

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(3)





(ii) Give the formulae of the ions present in magnesium chloride and write the electron configuration of each ion.

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(3)

(iii) Explain why magnesium chloride is a solid with a high melting point whereas hydrogen chloride is a gas at room temperature.

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(4)

(iv) Calculate the percentage water of crystallisation in magnesium sulphate crystals,  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

(3)

Q8

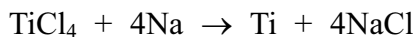
(Total 25 marks)

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If you answer Question 9, put a cross in this box  .

9. (a) Titanium is extracted from titanium(IV) chloride by heating it with sodium in an atmosphere of argon.



- (i) Suggest why an atmosphere of argon is used.

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 (1)

- (ii) Describe how water can be used to separate the products of the reaction.

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 (2)

- (iii) Identify the substance which is oxidised in this reaction.

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 (1)

- (b) Tungsten, W, is extracted by heating the oxide,  $\text{WO}_3$ , with hydrogen.

- (i) Write an equation for the reaction.

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 (1)

- (ii) Suggest one environmental advantage of using hydrogen as a reducing agent in metal extraction processes. Give one hazard associated with the use of hydrogen.

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 (2)



- (c) The extraction of metals from their sulphide ores takes place in two stages. The metal sulphide is heated in air to form the metal oxide and sulphur dioxide. The metal oxide is then heated with coke to form the metal, carbon monoxide and carbon dioxide.

Give a reason why each of these gaseous by-products is harmful to the environment. For one of these gaseous by-products suggest why an aqueous suspension of calcium hydroxide might be used to remove it; name the product formed.

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**(5)**

- (d) A metal carbonate decomposes according to the equation:



When 2.50 g of  $MCO_3$  are decomposed completely by heating,  $480 \text{ cm}^3$  of carbon dioxide are produced at room temperature and pressure. Calculate the relative formula mass of  $MCO_3$  and hence identify M.

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**(5)**





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# THE PERIODIC TABLE

Group 0

Group 1

Group 2

Group 3

Group 4

Group 5

Group 6

Group 7

Period

2	He Helium 4
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1	H Hydrogen 1
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1	3	4	5	6	7	8	9	10
2	11	12	13	14	15	16	17	18
3	19	20	21	22	23	24	25	26
4	27	28	29	30	31	32	33	34
5	35	36	37	38	39	40	41	42
6	43	44	45	46	47	48	49	50
7	51	52	53	54	55	56	57	58

## Key

Atomic number
Symbol
Name
Relative atomic mass

