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**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) State how a dry sample of carbon dioxide can be prepared and collected in the laboratory using dilute hydrochloric acid as one of the reagents.

Other reagent: .....

Drying agent: .....

Method of collection: .....

**(3)**

- (b) Describe what is observed when carbon dioxide is passed into a saturated solution of calcium hydroxide until no further change occurs. Write equations for the reactions that occur.

First observation:

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Equation: .....

Second observation:

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.....

Equation: .....

**(4)**

- (c) When carbon dioxide is passed over red-hot carbon, a colourless gas is produced. This gas burns with a blue flame. Identify the gas and write equations for the two reactions that occur.

Identity of gas: .....

Equation 1: .....

Equation 2: .....

**(3)**

**Q1**

**(Total 10 marks)**



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2. This question is about the elements magnesium and sulphur.

(a) (i) Write equations to show the formation of:

a magnesium ion from magnesium;

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a sulphide ion from sulphur.

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(2)

(ii) State which of the above is oxidation and explain your answer.

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(1)

(b) Which element, magnesium or sulphur, would form an acidic oxide? Write equations to show the formation of the acidic oxide and its reaction with water.

Element: .....

Formation of the acidic oxide:

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Reaction of the oxide with water:

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(3)

(c) Draw a labelled diagram to show the arrangement of particles in the lattice of magnesium and state how it is possible for magnesium to conduct electricity.

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(4)

(Total 10 marks)

Q2

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3

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3. Describe how you would carry out the following separations using only the chemicals given. State how you would collect the named substance. Write equations for any reactions that occur.

(a) Nitrogen from a mixture of nitrogen and oxygen using copper.

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(4)

(b) Oxygen from a mixture of oxygen and sulphur dioxide using sodium hydroxide.

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(c) Iodine from a mixture of iodine and sand.

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(3)

(Total 10 marks)

Q3

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4. (a) Calculate the empirical formula of the oxide of phosphorus that has the following composition by mass.

$$P = 56.4\% \quad O = 43.6\%$$

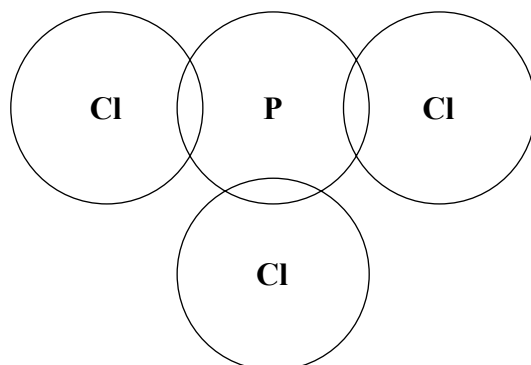
(3)

- (b) Phosphorus(III) chloride,  $\text{PCl}_3$ , is a covalent compound.

- (i) Give a reason why the bond between phosphorus and chlorine is covalent.

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(1)

- (ii) Complete the diagram below to show the outer shell arrangement of electrons in phosphorus(III) chloride.



(2)



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(c) Sodium chloride is an ionic compound.

(i) Give a reason why the bond between sodium and chlorine is ionic.

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(1)

(ii) Explain why sodium chloride has a higher melting point than phosphorus(III) chloride.

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(3)

(Total 10 marks)

Q4

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7

Turn over



5. The table below gives the solubilities of sodium chloride, potassium chlorate and potassium nitrate at temperatures between 0°C and 90°C.

Temperature/°C	10	30	50	70	90
Solubility of sodium chloride/g per 100 g water	35	36	37	38	39
Solubility of potassium chlorate/g per 100 g water	4	10	17	31	46
Solubility of potassium nitrate/g per 100 g water	21	45	84	137	203

Use the table to answer the following. Do **not** draw graphs.

(a) Which compound has the greatest rise in solubility with increase in temperature?

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(1)

(b) Suggest the temperature at which sodium chloride and potassium chlorate would have the same solubility.

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(1)

(c) What mass of potassium chlorate will crystallise from solution when a saturated solution in 100 g of water at 70°C is cooled to 30°C?

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(1)

(d) What is the minimum temperature at which 42 g of potassium nitrate will dissolve in 50 g of water?

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(1)





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- (e) A beaker contains a solution of 8.5 g of potassium chlorate in 50 g of water at 80°C. A thermometer is inserted into the solution and it is allowed to cool. State the temperature at which crystals will first appear and explain your answer.

Temperature: .....

Explanation:

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(2)

- (f) A mixture of 30 g of sodium chloride and 30 g of potassium nitrate is shaken with 100 g of water at 10°C. The temperature is then raised to the boiling point and 50 g of water is evaporated off.

(When answering the following questions, you do **not** need to perform calculations.)

- (i) State what happens to each substance at 10°C.

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(2)

- (ii) State what happens when the temperature is raised to 100°C.

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(1)

- (iii) State what happens as the 50 g of water evaporates off.

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(1)

(Total 10 marks)

Q5

**TOTAL FOR SECTION A: 50 MARKS**



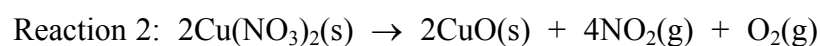
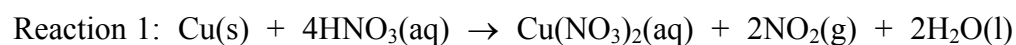
**SECTION B**

**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) A good yield of copper(II) oxide can be obtained from copper metal if copper is converted to copper(II) nitrate which is then decomposed by heating. The equations for the reactions are:



- (i) State what would be observed when each of the reactions is carried out.

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**(4)**

- (ii) Describe how a pure, dry sample of copper(II) nitrate could be obtained by Reaction 1. Give practical details but do **not** draw diagrams.

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(iii) Starting from 12.7 g of copper metal, calculate the maximum mass of copper(II) oxide that could be obtained.

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**(3)**

(b) 4.83 g of copper(II) nitrate,  $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ , was gently heated to remove the water of crystallisation and 3.75 g of anhydrous copper(II) nitrate was formed. Calculate the value of  $x$ .

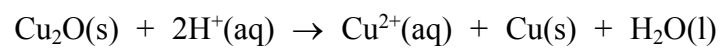
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(c) Copper(I) oxide is a red solid which reacts with aqueous sulphuric acid.



State the type of reaction and describe what would be observed when this reaction takes place. State how the copper could be separated from the other products and give one physical test that would show that a metal has been formed.

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(5)

(d) State what would be observed if a few drops of aqueous ammonia were added to the aqueous solution of the copper(II) salt. Write an ionic equation for the reaction that occurs. Give the observation made if an excess of aqueous ammonia is now added and write the formula of the final product.

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Q6

(Total 25 marks)



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

7. (a) Crude oil can be converted by a series of reactions into ethanol.



Name each stage in the process and describe how each is carried out. Write equations where appropriate.

(i) Crude oil to hydrocarbon fractions.

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(ii) A hydrocarbon fraction to ethene.

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(iii) Ethene to ethanol.

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**(6)**





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

8. (a) (i) In the first stage of the extraction of zinc metal from the ore zinc blende, ZnS, the ore is roasted in air to form zinc oxide and sulphur dioxide. The second stage is the conversion of the zinc oxide into zinc using coke.

Write an equation for each stage of the reaction.

Describe how the second stage is carried out to produce pure zinc and explain the role of the coke in this reaction.

State one environmental problem associated with this extraction.

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(7)

- (ii) The sulphur dioxide produced as a by-product in the extraction can be used as a raw material in the production of sulphuric acid using the Contact Process. Describe with equations and details of conditions how this process is carried out.

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(8)





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- (b) (i) State what would be observed when zinc reacts with aqueous sulphuric acid and give a test to identify the gas evolved. Write equations for the two reactions that occur.

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- (ii) State the conditions needed for rusting to occur and give the chemical name of rust. Explain how zinc is used to protect iron from rusting.

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(Total 25 marks)

Q8

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

9. Explain each of the following observations and write equations for any reactions that occur.

(a) When two pieces of cotton wool, one soaked in concentrated aqueous ammonia and the other soaked in concentrated hydrochloric acid, are placed at opposite ends of a long glass tube, a white ring is formed closer to one end than the other.

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(5)

(b) When two identical pieces of magnesium ribbon are placed in test tubes containing the same volumes of hydrochloric acid and ethanoic acid of equal concentration, bubbles of gas evolve faster in one test tube than in the other.

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(6)



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- (c) When aqueous barium chloride is added to solutions of sodium sulphite and sodium sulphate, both produce a white precipitate. When aqueous hydrochloric acid is then added, one of the precipitates dissolves and a gas is evolved.

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- (d) When propane reacts with chlorine in ultra-violet light, two products with the same molecular formula,  $C_3H_7Cl$ , can be formed.

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- (e) When aqueous bromine is added to aqueous sodium iodide, a black solid is formed but when aqueous bromine is added to aqueous sodium chloride, there is no reaction.

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(4)

(Total 25 marks)

Q9

**TOTAL FOR SECTION B: 50 MARKS**  
**TOTAL FOR PAPER: 100 MARKS**

**END**



