





**SECTION A**

1. (a) The table gives the names of some compounds. Place ticks (✓) in the table to show the type of bonding in each compound and whether it is soluble or insoluble in water. Each row should have two ticks. Some ticks have already been done for you.

Name of compound	Ionic bonding	Covalent bonding	Insoluble in water	Soluble in water
ammonia				
methane			✓	
poly(ethene)		✓		
sodium chloride				
sodium hydroxide	✓			✓

(4)

- (b) All the substances listed are very useful.

- (i) Give **one** use of poly(ethene).

.....  
(1)

- (ii) Name **two** products that are made using sodium hydroxide.

Product 1 .....

Product 2 .....

(2)

(Total 7 marks)

Q1



N 2 3 0 5 2 A 0 3 2 4

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2. This question is about chlorine.

(a) Give the name of a substance that reacts with hydrochloric acid to produce chlorine gas.

.....  
(1)

(b) Describe the test for chlorine.

Test .....

Result .....

(2)

(c) Chlorine gas reacts with iron to form a solid.

(i) Give the name of this solid.

.....  
(1)

(ii) When this solid is dissolved in water a yellow solution is formed. State what you see when sodium hydroxide solution is added to this yellow solution.

.....  
(1)

(d) When chlorine gas is bubbled through colourless potassium iodide solution a brown solution is formed.

(i) Name the substance that makes the solution brown.

.....  
(1)

(ii) What does this reaction show about the reactivity of chlorine compared with that of iodine?

.....  
(1)

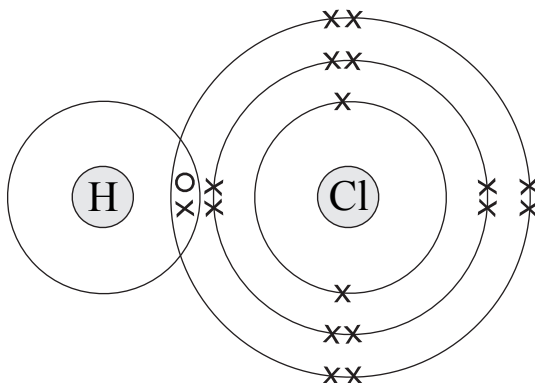
(Total 7 marks)

Q2



3. This question is about two covalently bonded compounds.

(a) The dot and cross diagram shows the covalent bonding in a hydrogen chloride molecule.



What is a covalent bond?

.....  
(1)

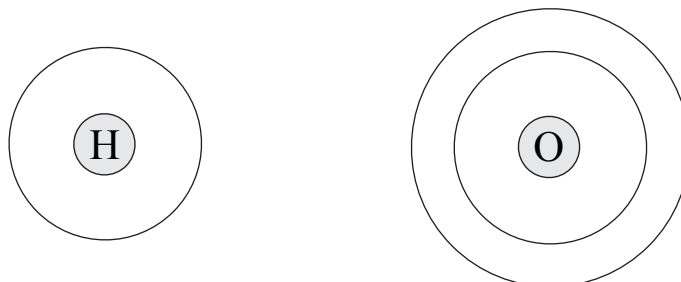
(b) Use words from the box to complete the sentences about hydrogen chloride. Each word may be used once, more than once or not at all.

<b>giant</b>	<b>high</b>	<b>ions</b>	<b>low</b>
<b>molecules</b>	<b>simple</b>	<b>strong</b>	<b>weak</b>

Hydrogen chloride has a ..... molecular structure. There are ..... forces between the ..... Because of this, hydrogen chloride has a ..... boiling point.

(4)

(c) (i) Use the Periodic Table to help you complete the diagrams to show the electronic configuration of hydrogen and of oxygen.



(2)



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(ii) Draw a dot and cross diagram to show the covalent bonding in a water molecule.

(2)

(iii) State the shape of a water molecule.

.....

(1)

Q3

(Total 10 marks)

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4. The table gives the electronic configuration of three different atoms.

Atom	Electronic configuration
fluorine	2.7
magnesium	2.8.2
sodium	2.8.1

(a) Describe the electron transfers that take place when magnesium reacts with fluorine to make the ionic compound magnesium fluoride,  $MgF_2$ . You may use diagrams to help your answer.

.....

.....

.....

.....

.....

**(3)**

(b) In this reaction both oxidation and reduction have occurred. State which element has been oxidised, giving a reason.

.....

.....

**(2)**

(c) (i) Give the symbols of the ions formed by sodium and fluorine.

.....

**(1)**

(ii) Give the formula of sodium fluoride.

.....

**(1)**

(d) A flame test is carried out on separate samples of magnesium fluoride and sodium fluoride.

The magnesium fluoride does not colour the flame.

What colour do you see when the sodium fluoride is tested?

.....

**(1)**

**(Total 8 marks)**

**Q4**



5. The table gives the colours of some indicators at different pH values.

Indicator	pH							
	1	3	5	7	9	11	13	
litmus	← red →			purple	← blue →			
phenolphthalein	← colourless →					← pink →		
methyl orange	← red →		← yellow →					

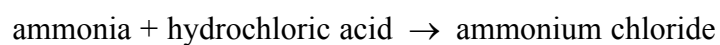
(a) (i) Use the table to find the pH of a solution in which litmus is red **and** methyl orange is yellow.

.....  
(1)

(ii) Litmus is purple in sodium chloride solution. What colour is phenolphthalein in sodium chloride solution?

.....  
(1)

(b) A student was investigating the neutralisation of aqueous ammonia using hydrochloric acid.  
She placed 25 cm<sup>3</sup> of aqueous ammonia in a conical flask and added a few drops of litmus.  
She then slowly added hydrochloric acid to the mixture in the flask.  
The indicator turned purple after she had added 15 cm<sup>3</sup> of hydrochloric acid.  
The word equation for the reaction is



(i) Write a chemical equation for the reaction of ammonia with hydrochloric acid.

.....  
(2)



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blank

- (ii) Describe a chemical test to show that the solution obtained contains ammonium ions. Give the result of the test.

.....  
.....  
.....

(3)

- (iii) The student used the same original solutions of aqueous ammonia and hydrochloric acid to make a pure sample of ammonium chloride crystals. Describe how she could do this.

.....  
.....  
.....  
.....  
.....

(3)

- (c) (i) Lead(II) chloride is insoluble. Name two solutions that react together to make lead(II) chloride.

First solution .....

Second solution .....

(2)

- (ii) Write a **word** equation for this reaction.

.....  
.....

(1)

(Total 13 marks)

Q5

**TOTAL FOR SECTION A: 45 MARKS**



**SECTION B**

6. In an experiment a student left some solid sodium chloride in a beaker of water for several days. The diagrams show the beaker at the start and end of the experiment.



(a) Write the formulae, with state symbols, of the two substances in the beaker at the start of the experiment.

.....  
(2)

(b) At the end of the experiment the student took a sample of the solution from near the top of the water. He tested it for the presence of chloride ions. The test was positive.

(i) Name the **two** substances the student added to test for the presence of chloride ions.

.....  
.....  
(2)

(ii) Describe the observation made in the test.

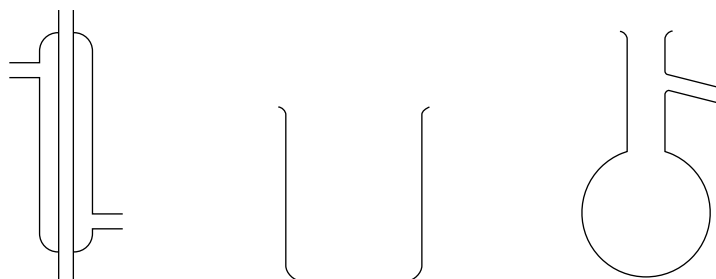
.....  
(1)

(iii) Name the process by which the chloride ions moved through the water to near the top of the water.

.....  
(1)



(c) Sea water contains dissolved sodium chloride. The following pieces of laboratory apparatus can be used to make drinking water from sea water.



(i) Draw a labelled diagram to show how these pieces of apparatus can be assembled to do this.

(3)

(ii) Name the technique used in this process.

.....

(1)

Q6

(Total 10 marks)

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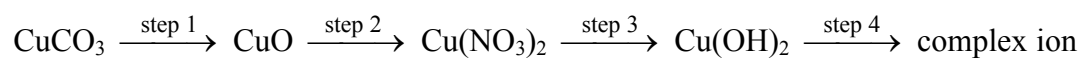
7. This question is about the transition metal copper and some of its compounds.

(a) Describe the structure of copper metal and explain why it is a good conductor of electricity.

.....  
 .....  
 .....  
 .....

**(3)**

(b) The sequence shows reactions involving copper compounds.



(i) State the colour of:

copper(II) carbonate .....

copper(II) oxide .....

**(2)**

(ii) In step 1, copper(II) carbonate decomposes on heating.

Write a chemical equation for this reaction.

.....

**(1)**

(iii) Describe a test for the gas produced in step 1.

Test .....

Result .....

**(2)**



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blank

(iv) State the reagent used in step 2, and the type of reaction occurring.

Reagent .....

Type of reaction .....

(2)

(v) Both aqueous sodium hydroxide and aqueous ammonia can be used as reagents in step 3.

Describe **one** observation in step 3 that could be made if **either** reagent were used.

.....

(1)

(vi) Excess aqueous ammonia is used as the reagent in step 4.

What is the colour of the solution formed?

.....

(1)

(vii) Give the formula of the complex ion formed in step 4.

.....

(1)

(c) Give the name and formula of another oxide of copper that is not shown in (b).

Name .....

Formula .....

(2)

Q7

(Total 15 marks)

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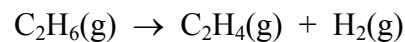
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8. The conversion of ethane to ethene is an endothermic reaction.



(a) State one use of each product formed in the reaction.

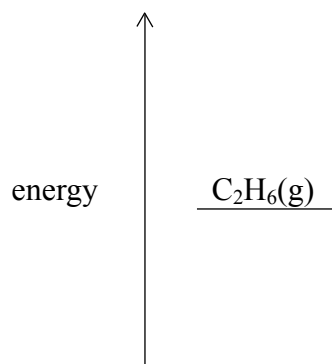
$\text{C}_2\text{H}_4(\text{g})$  .....

$\text{H}_2(\text{g})$  .....

(2)

(b) The reaction can be represented by an energy level diagram.

Complete the diagram by showing the products of the reaction.



(1)

(c) The table shows the values of some average bond dissociation energies.

Bond	C—C	C=C	C—H	H—H
Dissociation energy (kJ/mol)	348	612	412	436

(i) Ethane and hydrogen contain only single bonds. Ethene contains both single and double bonds.

Draw a displayed formula for each of the molecules ethane and ethene in the equation.

ethane

ethene

hydrogen

→

+ H—H

(2)





(ii) Use your displayed formulae and the information in the table to calculate the energy change occurring during the conversion of ethane to ethene and hydrogen.

(3)

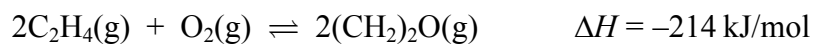
(d) At room temperature the conversion of ethane to ethene is very slow. State **two** changes in the conditions that would increase the rate of this reaction.

1 .....

2 .....

(2)

(e) The equation represents a reaction of ethene used in industry.



(i) What do the symbols  $\rightleftharpoons$  and  $\Delta H$  represent?

$\rightleftharpoons$  .....

$\Delta H$  .....

(2)

(ii) The reaction is carried out at a pressure of 2 atm and a temperature of 300 °C.

Predict what would happen to the amount of product formed at equilibrium if these conditions were changed as follows:

Pressure increased .....

.....

Temperature increased .....

.....

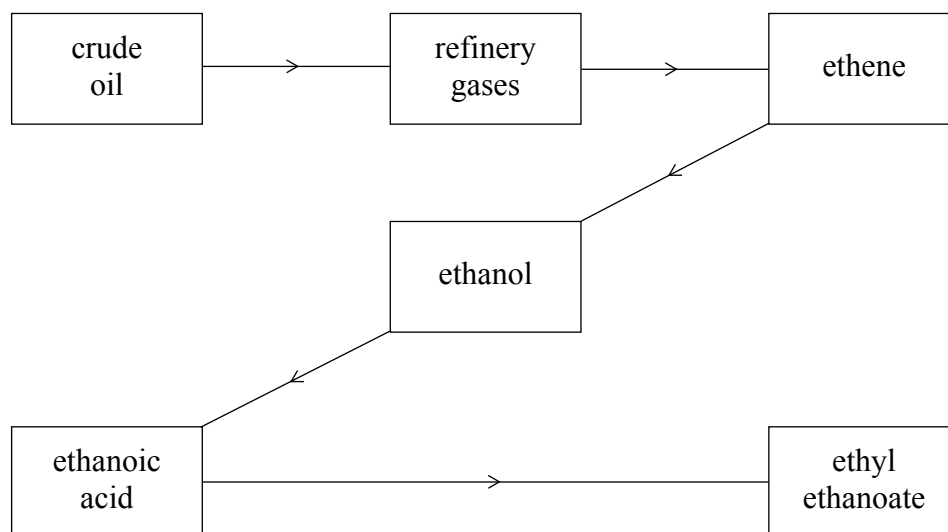
(2)

Q8

(Total 14 marks)



9. The flowchart shows how crude oil can be converted into some organic compounds.



(a) Name the process used to obtain refinery gases from crude oil.

..... (1)

(b) Name **two** other fractions produced in this process.

1 .....

2 .....

(2)



(c) Ethene is converted to ethanol by reaction with steam.

State **two** conditions used in this conversion.

1 .....

2 .....

**(2)**

(d) In some countries ethanol is manufactured in a different way from the one shown in the flowchart.

(i) State the raw material used to manufacture ethanol in this way.

.....

**(1)**

(ii) Explain why some countries manufacture ethanol in this way.

.....

.....

.....

.....

**(2)**

(e) The final product in the flowchart is ethyl ethanoate.

(i) Name the reagent and conditions used in the conversion of ethanoic acid to ethyl ethanoate.

Reagent .....

Conditions .....

**(2)**

(ii) Name the homologous series to which ethyl ethanoate belongs.

.....

**(1)**

**(Total 11 marks)**

**Q9**

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10. This question is about the reactions of the metals calcium, iron and zinc.

- (a) Samples of each of the powdered metals were placed in separate beakers of water. Only calcium reacted immediately.

Describe **two** observations that could be made during the reaction of calcium with water. Write a chemical equation for the reaction.

Observation 1 .....

Observation 2 .....

Equation .....

**(3)**

- (b) A reaction occurred when powdered zinc was heated in steam.

Name the zinc compound formed. Write a chemical equation for the reaction.

Name of compound .....

Equation .....

**(2)**

- (c) Some powdered zinc was added to a solution of iron(II) sulphate.

- (i) Write an ionic equation to show the reaction that occurs.

.....

**(1)**

- (ii) State the type of reaction occurring.

.....

**(1)**

- (d) Iron rusts slowly in the presence of water.

Name one other substance that must be present for iron to rust.

.....

**(1)**



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blank

(e) Galvanising is one method used to prevent iron from rusting.

(i) Describe how a sheet of iron is galvanised.

.....  
(1)

(ii) A sheet of galvanised iron was scratched and left in the rain. The exposed iron did not rust. Explain why.

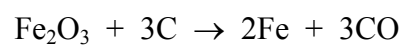
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.....  
.....  
.....  
(2)

Q10

(Total 11 marks)



11. One reaction that occurs in the blast furnace during the extraction of iron is the reaction between iron(III) oxide and carbon.



(a) Calculate the relative formula mass of iron(III) oxide, using information from the Periodic Table.

.....  
**(1)**

(b) 320 kg of iron(III) oxide were added to the blast furnace.

(i) Calculate the amount, in moles, of iron(III) oxide added.

.....  
 .....  
**(2)**

(ii) Calculate the maximum amount, in moles, of iron formed from this amount of iron(III) oxide.

.....  
 .....  
**(2)**

(iii) Calculate the maximum mass, in kilograms, of iron formed from this amount of iron(III) oxide.

.....  
 .....  
**(2)**



(c) Most of the carbon monoxide formed in the reaction in (b) is converted to carbon dioxide before it leaves the blast furnace.

(i) Explain how carbon monoxide acts as a poison.

.....  
 .....  
 (1)

(ii) During one period in the operation of the blast furnace, the amount of carbon dioxide released was 5000 moles.

Calculate the volume, in  $\text{dm}^3$ , that this amount of carbon dioxide would occupy at room temperature and pressure (rtp).

(The molar volume of a gas is  $24 \text{ dm}^3$  at rtp.)

.....  
 .....  
 (1)

(d) Write the chemical equation for the reaction in which iron(III) oxide is reduced by carbon monoxide.

.....  
 (2)

(e) (i) Limestone is added to the blast furnace to remove impurities. State the main impurity removed.

.....  
 (1)

(ii) Write **two** chemical equations to show how limestone removes this impurity.

Equation 1 .....

Equation 2 .....

(2)

Q11

(Total 14 marks)

**TOTAL FOR SECTION B: 75 MARKS**

**END**



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