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SECTION A

1. The pictures show some uses of metals.

a coating to prevent rusting



aircraft bodies



electrical wiring



railway tracks



Complete the table.

Use	Name of metal with this use	Property on which the use depends
a coating to prevent rusting		
aircraft bodies		
electrical wiring		
railway tracks		

(Total 8 marks)

Q1



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2. Use the Periodic Table on page 2 to help you answer this question.

(a) Identify the most reactive metallic element in the Periodic Table.

.....
(1)

(b) Give the formula of the compound formed between sodium and the most reactive element in Group 7.

.....
(1)

(c) All of the metals in Group 1 react with water. There are similarities between the reactions. Put a cross (☒) in **three** boxes to show which statements apply to the reactions of **all** Group 1 metals with water.

- a flame is seen
- a solution of the metal hydroxide is formed
- a solution of the metal oxide is formed
- carbon dioxide is formed
- hydrogen is formed
- the metal sinks
- the solution formed is acidic
- the solution formed is alkaline

(3)

(d) The elements in Group 0 were originally thought to be totally unreactive. However, in 1962 the first compound of xenon was made but it was not until 2000 that the first compound of argon was made.

What does this order of discovery suggest about the trend in reactivity of the elements in Group 0?

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

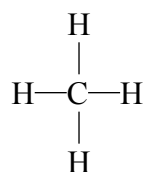
Q2

(Total 6 marks)



3. Methane, CH₄, is an organic compound. It is the first member of an homologous series of **saturated hydrocarbons**.

The displayed formula of methane is



- (a) What is meant by the term **hydrocarbon**?

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

(2)

- (b) What is meant by the term **saturated**?

.....
.....

(1)

- (c) Name the homologous series of which methane is the first member.

.....

(1)

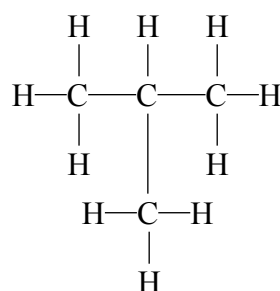
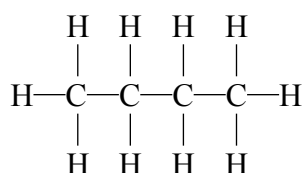
- (d) Draw the displayed formula of the second member of this homologous series.

(2)



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(e) The displayed formulae of two other organic compounds are



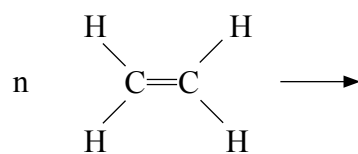
(i) What is the molecular formula of these two compounds?

..... (1)

(ii) What name is given to compounds that have the same molecular formula but different displayed formulae?

..... (1)

(f) Some other organic compounds are used to make polymers.
Poly(ethene) is an addition polymer made from many identical monomer molecules.
Complete the following equation to show the formation of poly(ethene).



(2)

(g) Nylon is another example of a polymer.

(i) What type of polymer is nylon?

..... (1)

(ii) Put a cross (☒) in the **two** boxes to show the types of monomers used in the manufacture of nylon.

- alcohol
- alkene
- diamine
- dicarboxylic acid

(2)

(Total 13 marks)

Q3

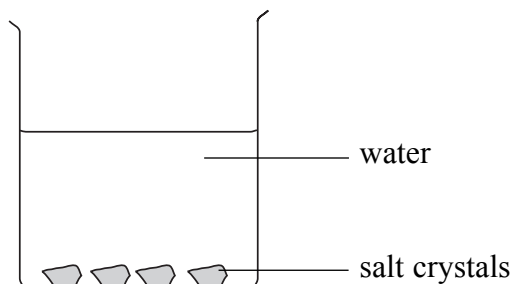
7

Turn over



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4. A few crystals of a green salt are placed in a beaker of cold water. The crystals start to dissolve.



- (a) Describe how the appearance of the contents of the beaker change over a period of time.

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

(2)

- (b) Name the process that occurs after the crystals dissolve.

.....

(1)

- (c) How will the results of the experiment differ if hot water is used in place of cold water? Explain your answer.

Difference

.....

Explanation

.....

(2)

- (d) A sample of the solution is removed from the beaker. Describe a test, and its result, that would show the sample contains ammonium ions.

Test

.....

Result

.....

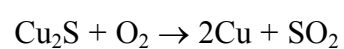
(3)

Q4

(Total 8 marks)



5. One way of obtaining the metal copper is by heating copper(I) sulphide in air. The equation for the reaction is



- (a) Explain why this reaction could be described as the oxidation of sulphur.

.....

 (1)

- (b) The sulphur dioxide produced reacts with water to form a single product. This product is an acid.

- (i) Write a chemical equation for the reaction of sulphur dioxide with water.

.....
 (1)

- (ii) Identify the ion in the product which causes it to be acidic.

.....
 (1)

- (iii) Name a substance that could be added to confirm the presence of this ion. What would be seen if this ion were present?

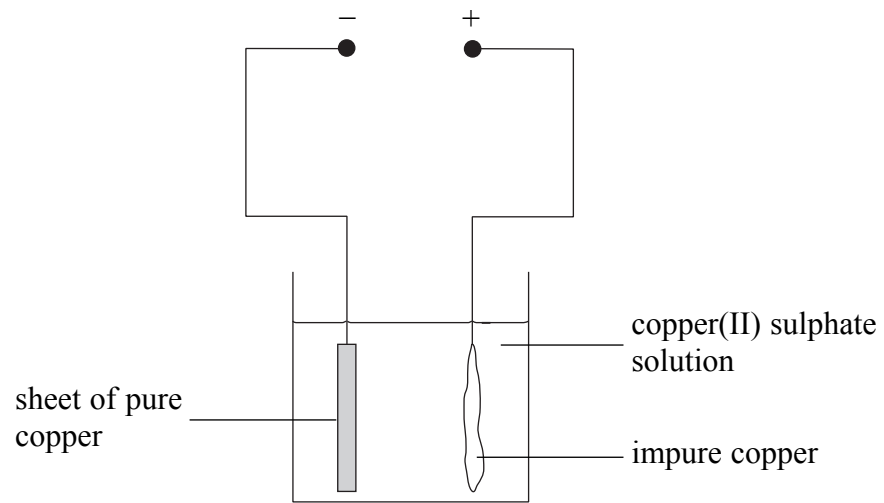
Substance added

What would be seen

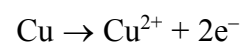
.....
 (2)



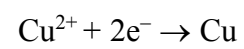
(c) Impure copper can be purified using the circuit shown:



The equation for the reaction at the positive electrode is



The equation for the reaction at the negative electrode is



What happens to the mass of the sheet of pure copper as the reactions occur? Explain your answer.

.....

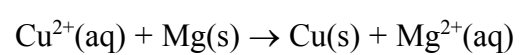
.....

.....

(2)



(d) Copper forms when magnesium reacts with copper(II) nitrate solution. The ionic equation for the reaction is



(i) What does this reaction indicate about the reactivity of copper?

.....
(1)

(ii) Describe the colour change of the solution if an excess of magnesium is added.

Colour at start

Colour at finish

(2)

(Total 10 marks)

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Q5

TOTAL FOR SECTION A: 45 MARKS



SECTION B

6. Alkenes are unsaturated hydrocarbons.

(a) State the general formula of all alkenes.

.....
(1)

(b) Draw the displayed formula of ethene.

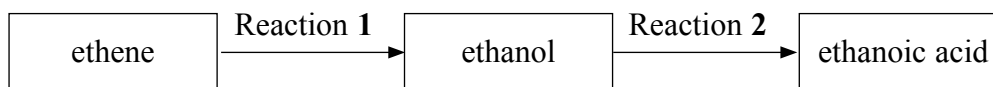
(1)

(c) Alkenes can be shown to be unsaturated using bromine water. Describe the colour change that occurs when an alkene reacts with bromine water.

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



(d) Ethene is the starting material in the following sequence of reactions.



(i) State the other reagent, the catalyst, and one other condition used in Reaction 1.

Reagent

Catalyst

Condition

(3)

(ii) The reagents used in Reaction 2 are potassium dichromate(VI) and dilute sulphuric acid. State the type of reaction that occurs.

.....

(1)

(iii) Ethanoic acid, CH_3COOH , and ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, react together to form ethyl ethanoate.

Give the structural formula of ethyl ethanoate and name the homologous series to which it belongs.

Structural formula

Name of homologous series

(2)

Q6

(Total 10 marks)



<p>(d) Ammonia and sulphuric acid react together to make a compound used in fertilisers.</p> <p>(i) Name the compound formed when ammonia and sulphuric acid react together, and write a chemical equation for the reaction that occurs.</p> <p>Name</p> <p>Equation</p> <p>..... (3)</p> <p>(ii) State the type of reaction occurring.</p> <p>..... (1)</p> <p style="text-align: right;">(Total 16 marks)</p>	Leave blank
	Q7



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8. (a) The combustion of hydrogen gives out a lot of heat. What term is used to describe reactions that give out heat?

..... (1)

(b) The atoms in a molecule of hydrogen are joined by a strong covalent bond.

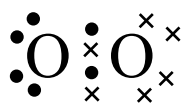
What is a covalent bond?

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

(c) Explain why hydrogen is a gas at room temperature.

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

(d) A molecule of oxygen can be represented by a dot and cross diagram:



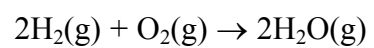
Draw a dot and cross diagram, showing only the outer electrons, to represent a molecule of water.

(2)



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(e) The equation for the combustion of hydrogen is



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

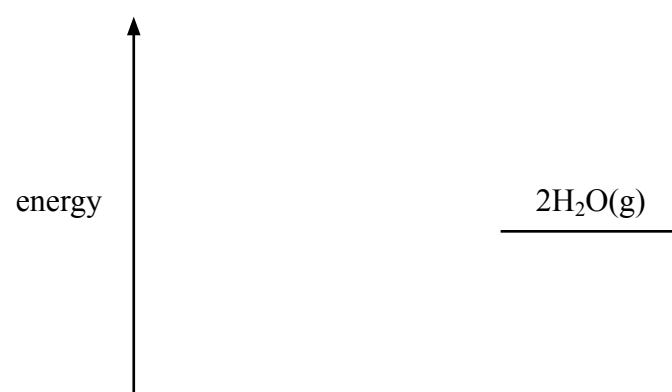
Bond	H—H	O=O	O—H
Dissociation energy (kJ/mol)	436	496	463

Use the values in the table to calculate the energy change for the combustion of hydrogen.

(3)

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

Complete the diagram by inserting the reactants.



(1)



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blank

(g) On cooling, the $\text{H}_2\text{O}(\text{g})$ produced in the combustion of hydrogen is converted into $\text{H}_2\text{O}(\text{l})$.

Describe how the speed of, and the distance between, the particles change during this conversion.

Speed of particles

.....

Distance between particles

.....

(2)

(h) When water is added to white anhydrous copper(II) sulphate, blue hydrated copper(II) sulphate is formed.

Write a chemical equation for the reaction that occurs. Include state symbols in the equation.

.....

.....

(3)

Q8

(Total 16 marks)

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9. A sample of copper contains two isotopes.

(a) What are isotopes?

.....

(2)

(b) (i) Complete the table for these isotopes of copper.

Atomic number	Mass number	Number of protons	Number of neutrons	Percentage of each isotope in sample
29	63			69
		29	36	31

(3)

(ii) Use information from the table to calculate the relative atomic mass of this sample of copper. Give your answer to one decimal place.

(2)

(c) Identify the element, and its mass number, which is used in the definition of relative atomic mass.

.....

(2)

(d) Why do the two isotopes of copper have the same chemical properties?

.....

(1)



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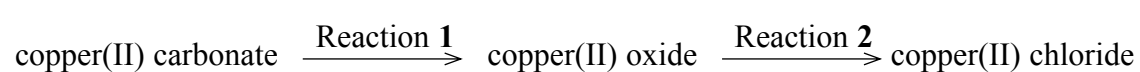
(e) Copper is a transition metal. State two properties of copper or its compounds that are typical of transition metals but not of other metals.

1

2

(2)

(f) Two reactions involving copper compounds are shown in this sequence:



(i) Reaction 1 occurs when copper(II) carbonate is heated. Carbon dioxide is the other product of this reaction.

Describe the colour change seen and write a chemical equation for the reaction. Include state symbols in the equation.

Colour change

Chemical equation

(4)

(ii) The other substance needed for Reaction 2 is dilute hydrochloric acid. Write the chemical equation for Reaction 2.

.....

.....

(3)

(g) Give the formula of another oxide of copper.

.....

(1)

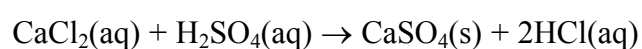
(Total 20 marks)

Q9

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10. Calcium sulphate can be prepared using a precipitation reaction between calcium chloride solution and dilute sulphuric acid.



(a) State three steps needed to produce a pure dry sample of calcium sulphate from the mixture formed in this reaction.

Step 1

Step 2

Step 3

(3)

(b) A 5.55 g sample of calcium chloride ($M_r=111$) is dissolved in water to make a solution.

(i) Calculate the amount, in moles, in the sample of calcium chloride.

.....

.....

.....

(2)

(ii) What amount, in moles, of sulphuric acid is needed to react completely with the calcium chloride solution?

.....

.....

(1)

(iii) Calculate the relative formula mass of calcium sulphate. Use data from the Periodic Table on page 2.

.....

.....

(1)

(iv) Calculate the mass, in grams, of calcium sulphate formed.

.....

.....

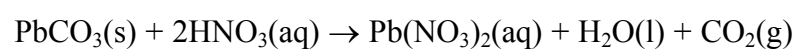
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(2)



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(c) The following equation represents a reaction used to prepare the salt lead(II) nitrate.



In this experiment the amount of nitric acid used was 0.0400 mol.

(i) The concentration of the dilute nitric acid used was $0.500 \text{ mol dm}^{-3}$. Calculate the volume, in cm^3 , of dilute nitric acid used.

(3)

(ii) In this experiment, 0.0200 mol of carbon dioxide gas was produced. Calculate the volume, in cm^3 , that this amount of carbon dioxide occupies at room temperature and pressure (rtp).
(molar volume of any gas = $24\,000 \text{ cm}^3$ at rtp)

(1)

Q10

(Total 13 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

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