

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided.

There is useful data on the front cover, and a Periodic Table is printed on the back of this booklet.

1. For each of the following reactions involving transition metal compounds:

- describe what you would see
- identify the product that contains the transition metal ion
- write an equation for the reaction if required.

(a) Aqueous sodium hydroxide is added to aqueous iron(III) chloride.

Observation

Name of product

Equation

(3)

(b) A few drops of aqueous ammonia are added to aqueous copper(II) sulphate followed by an excess of ammonia.

Observation after adding a few drops of ammonia

Name of product

Observation after adding excess ammonia

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Formula of complex ion product

(4)

(c) Copper(II) carbonate is heated strongly.

Observation

Name of product

Equation

(3)

(Total 10 marks)

Q1

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2. (a) For each of the following covalent molecules, draw a dot and cross diagram to show the outer shell electron arrangement and a diagram to show the shape.

(i) ammonia, NH_3

electron arrangement

shape

(ii) carbon dioxide, CO_2

electron arrangement

shape

(6)

(b) (i) State which particle in the nucleus of an atom is responsible for the position of an element in the Periodic Table.

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(ii) State which particle in the nucleus of an atom is responsible for the isotopes having different mass numbers.

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(iii) State how the position of an element in the Periodic Table is related to its electron configuration, and give an example.

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(4)

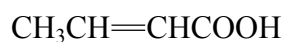
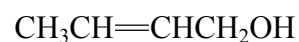
(Total 10 marks)

Q2

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3. This question refers to the three organic compounds labelled **A**, **B** and **C** below.

Compound A**Compound B****Compound C**

(a) Which one of the compounds has a relative molecular mass of 86?

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(1)

(b) Compounds **B** and **C** could react together to form an ester. Give the two conditions used for this reaction.

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(2)

(c) Aqueous sodium carbonate was added to each compound.

(i) State which of the compounds **A**, **B** and **C** would react with sodium carbonate to give carbon dioxide.

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(1)

(ii) Describe a test for carbon dioxide.

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(2)

(d) Each compound was shaken with bromine water.

(i) State which of the compounds **A**, **B** and **C** would decolourise the bromine water.

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(1)

(ii) Identify the structural feature that is responsible for the decolourisation of bromine water.

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(1)

(iii) State the type of reaction occurring when bromine water is decolourised.

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(1)

(iv) Write an equation for the reaction between bromine and one of the compounds.

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(1)

(Total 10 marks)

Q3



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4. (a) You are provided with bromine water, aqueous sodium chloride and aqueous sodium iodide, together with a supply of test tubes. Using these solutions only, describe **two** experiments to show the relative reactivity of chlorine, bromine and iodine.

For each experiment, describe what you would do and what observation you would make. State how the results of the experiments confirm the relative reactivity and write an equation for any reaction that occurs.

Experiment 1

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Experiment 2

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(8)

- (b) State how the addition of aqueous silver nitrate to aqueous sodium chloride and to aqueous sodium iodide would enable you to distinguish between the two compounds.

Observation with NaCl(aq):

Observation with NaI(aq):

(2)

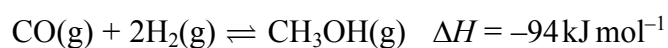
Q4

(Total 10 marks)

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5. The reaction which produces methanol from carbon monoxide and hydrogen is represented by the equation



The reaction is carried out at high pressure and the gases are passed through a mixture of zinc oxide and chromium oxide maintained at 400 °C. These conditions are chosen to give a good yield of methanol at a satisfactory rate.

- (a) (i) Explain why increasing the pressure gives a better yield.

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 (1)

- (ii) Give one disadvantage of using high pressure in an industrial plant.

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 (1)

- (b) (i) The value of ΔH is negative. What does this tell you about the reaction?

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 (1)

- (ii) State, with a reason, whether a high temperature or low temperature will give a better yield of methanol at equilibrium.

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 (1)

- (iii) With reference to your answer in (b)(ii), suggest why a temperature of 400 °C is used in practice.

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 (1)



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(c) Suggest why the gases are passed through a mixture of zinc oxide and chromium oxide.

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(2)

(d) Calculate the maximum mass of methanol that can be obtained from 14 kg of carbon monoxide.

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(3)

(Total 10 marks)

Q5

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TOTAL FOR SECTION A: 50 MARKS



SECTION B

Answer TWO questions in this section. If you change your mind, put a line through the box (⊗) and then indicate your new question with a cross (⊗).

Where appropriate, give equations and diagrams to clarify your answers.

If you answer question 6 put a cross in this box

6. (a) Describe how you would prepare crystals of each salt using the method indicated. Write an equation for each reaction.

(i) Sodium nitrate, NaNO_3 , by reacting an acid with an alkali.

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(6)



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(ii) Anhydrous iron(III) chloride, FeCl_3 , by direct reaction of the elements.

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(6)

(iii) Copper(II) sulphate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, by reacting an acid with a metal oxide.

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(6)



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(b) The mineral kieserite has the formula $\text{MgSO}_4 \cdot \text{H}_2\text{O}$.

(i) Calculate the percentage by mass of magnesium in kieserite.

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(3)

(ii) Describe one test to show that kieserite contains sulphate ions.

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(4)

Q6

(Total 25 marks)



(b) Rubidium, Rb, is the fourth member of Group 1. Name the products and write an equation for any reaction that occurs when the following compounds are heated:

(i) rubidium carbonate;

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(1)

(ii) rubidium nitrate.

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(3)

(c) Aqueous sodium chloride (brine) containing litmus indicator is electrolysed in apparatus that prevents the products formed at the electrodes from mixing. The indicator turns blue near the cathode and colourless near the anode.

(i) Write an equation for the reaction occurring at the anode and explain why the litmus turns colourless.

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(2)

(ii) Write an equation for the reaction occurring at the cathode and explain why the litmus turns blue. What other observation would you see at the cathode?

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(4)



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(iii) Name an important compound that is produced industrially by the electrolysis of brine and give one large-scale use for it.

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(2)

(d) Describe a simple experiment to show whether a white powder is a sodium compound or a potassium compound.

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(3)

Q7

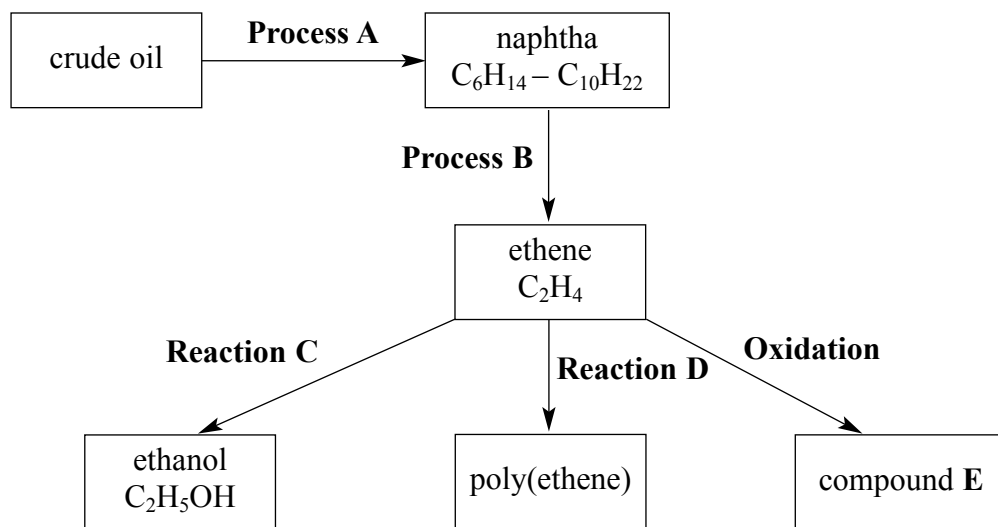
(Total 25 marks)

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If you answer question 8 put a cross in this box

8. Crude oil is a source of many compounds that are of great importance in the chemical industry. Study the scheme below and answer the questions that follow.



- (a) Give the name of **Process A**. Describe how the process of separating crude oil into fractions, including naphtha, is carried out.

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(4)



- (b) Give the name of **Process B**, in which the naphtha fraction is converted into many different compounds, including ethene. Describe how this is done and explain what happens to the original molecules present in the naphtha. State the importance of this process in the petrochemical industry.

Write an equation using C_6H_{14} to show the formation of ethene and one other compound.

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(7)

- (c) Describe how ethene is converted into ethanol in **Reaction C**. Write an equation for the reaction, using displayed formulae.

Give one advantage and one disadvantage that this method of producing ethanol has over the fermentation method.

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(7)



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(d) Name the type of polymerisation taking place in **Reaction D**. Draw the repeating unit of the polymer.

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(2)

(e) **Compound E** has the following percentage composition by mass:

C = 38.7% H = 9.7% O = 51.6%

(i) Use these figures to calculate the empirical formula of **E**.

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(3)

(ii) Given that 0.05 mol of **E** has a mass of 3.1 g, calculate the relative molecular mass of **E** and hence determine its molecular formula.

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(2)

(Total 25 marks)

Q8

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If you answer question 9 put a cross in this box

9. Use your knowledge of structure and bonding to explain each of the following observations.

(a) Diamond is one of the hardest substances known whereas graphite is soft and is used in pencils.

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(5)

(b) Sodium metal is a good conductor of electricity when solid and when molten. Sodium chloride does not conduct electricity when solid but does when molten.

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(5)



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(c) At room temperature, MgO is a solid with a high melting point whereas H₂O is a liquid that vaporises easily.

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(7)

(d) Argon and nitrogen are both unreactive at room temperature. Nitrogen will combine with other elements at high temperature.

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(4)



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(e) There is more than one compound with the molecular formula $C_2H_4Cl_2$.

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(4)

Q9

(Total 25 marks)

TOTAL FOR SECTION B: 50 MARKS

END



