



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2003

CHEMISTRY - ORDINARY LEVEL

TUESDAY, 17 JUNE - AFTERNOON 2.00 to 5.00

400 MARKS

Answer **eight** questions in all

These **must** include at least **two** questions from **Section A**

All questions carry equal marks (50)

Information

Relative atomic masses: H = 1, C = 12, O = 16, Na = 23, Mg = 24, Ca = 40

Molar volume at s.t.p. = 22.4 l

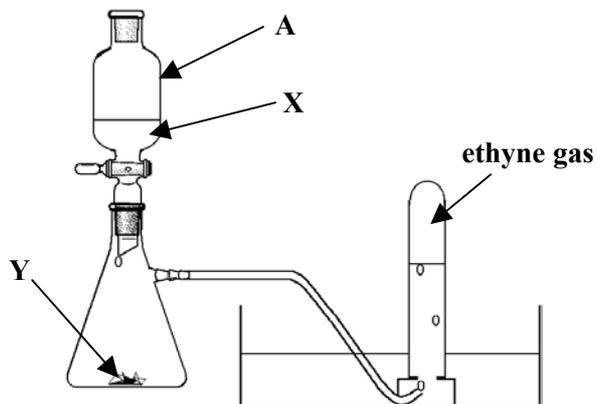
Avogadro constant = $6 \times 10^{23} \text{ mol}^{-1}$

Section A

Answer at least two questions from this section [see page 1 for full instructions]

1. The diagram shows an apparatus that can be used for the preparation of ethyne gas, C_2H_2 . A liquid **X** is dropped onto the solid **Y** and the gas collected in test tubes as shown. The first few test tubes of gas collected are not usually used.

- (a) Name the piece of equipment, **A**, from which the liquid **X** is added. (5)
- (b) Identify the liquid **X** and the solid **Y**. (12)
- (c) Describe the appearance of the solid **Y**. (3)
- (d) Why are the first few test tubes of gas collected not usually used? (6)
- (e) What is observed when a sample of ethyne gas is burned in air? (6)
- (f) To what family of compounds (homologous series) does ethyne belong? (6)
- (g) Ethyne is a *hydrocarbon*. What is meant by the term *hydrocarbon*? (6)
- (h) The common name for ethyne is acetylene. Give **one** use of this gas. (6)
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2. To prepare 500 cm³ of a standard solution of sodium carbonate, Na₂CO₃, 2.65 g of solid anhydrous sodium carbonate, was weighed on a clock glass using an electronic balance. All of the solid was then carefully transferred from the clock glass into a beaker and a small amount of deionised water was added. When the solid was dissolved the solution was transferred to a 500 cm³ volumetric flask and deionised water added until the bottom of the meniscus was level with the mark. The volumetric flask was then stoppered and inverted several times. Some of the pieces of equipment used are drawn on the right.

(a) What is meant by a *standard solution*? (5)

(b) Name the pieces of equipment **A**, **B**, **C** and **D**. (12)

(c) Why was it important to transfer all of the solid from the clock glass to the beaker? What could you do to insure all the solid was transferred? (9)

(d) Why was deionised water used to make up the solution? (6)

(e) Why was the volumetric flask stoppered and inverted several times at the end? (6)

(f) The solution contained 2.65 g of anhydrous sodium carbonate, Na₂CO₃, in 500 cm³ of solution. Calculate the concentration of the solution in moles per litre. (12)



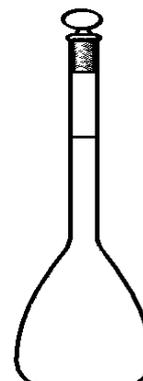
A



B



C



D

3. Flame tests can be used to identify metallic elements present in salts.

(a) Copy and complete the table below into your answer book matching the following flame colours with the correct metallic elements. (14)

orange-yellow lilac green crimson-red

METAL	Lithium (Li)	Sodium (Na)	Potassium (K)	Copper (Cu)
FLAME COLOUR				

(b) Describe how you would carry out a flame test on a sample of sodium sulfate. (18)

(c) Outside a science laboratory where would you expect to find lights containing sodium vapour? (6)

(d) Describe a test to confirm the presence of sulfate ions in aqueous solution. (12)

Section B

[See page 1 for instructions regarding the number of questions to be answered]

4. Answer **eight** of the following items (a), (b), (c), etc. (50)

(a) How many (i) protons and (ii) neutrons has ${}_{17}^{37}\text{Cl}$?

(b) State *Le Chatelier's principle*.

(c) What is the shape of the methane, CH_4 , molecule?

(d) List the following three types of radiation in order of decreasing penetrating power

alpha- (α -)

beta- (β -)

gamma- (γ -)

(e) Write a balanced chemical equation for the combustion of methane, CH_4 , in oxygen.

(f) What is the percentage by mass of carbon in calcium carbonate, CaCO_3 ?

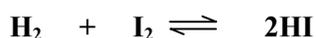
(g) Define the term *relative atomic mass*.

(h) Calculate the pH of a 0.01 M solution of hydrochloric acid, HCl .

(i) The famous Irish scientist shown on the right, was born in 1627. He was a son of the Earl of Cork. His name is associated with a gas law. Name him.



(j) Write the equilibrium constant expression, K_c , for the equilibrium



(k) Answer part **A** or **B**

A How does *nitrogen fixation* occur in nature?

or

B What is meant by the *corrosion of metals*?

5. (a) Mendeleev was one of the first scientists to produce a periodic table of the elements.

(i) How were the elements arranged in Mendeleev's periodic table? (8)

(ii) State **two** differences between the way in which Mendeleev arranged the elements in his periodic table and the way in which the elements are arranged in the modern periodic table. (12)

(b) Match the following scientists with the statements (i) to (v) below. (30)

Thomson

Curie

Rutherford

Bohr

Dalton

(i) The scientist who said that atoms were indivisible

(ii) The scientist who discovered the nucleus of the atom

(iii) The scientist who discovered the radioactive elements polonium and radium

(iv) The scientist who discovered that electrons were sub-atomic particles

(v) The scientist who proposed a model for the atom which stated that electrons travel around the nucleus in fixed energy levels or shells.

6. The fractional distillation of crude oil in an oil refinery produced the following fractions:

gas naphtha kerosene gas oil residue

(a) Select from the list the fraction which is the main fraction used to make petrol. (5)

The hydrocarbons present in the fraction that is used to make petrol usually have a low *octane rating*.

(i) What is meant by the term *octane rating*? (6)

(ii) Name the heavy metal that was commonly used in compounds that were added to petrol to increase its octane rating? Why was its use discontinued? (12)

(iii) Name a chemical process that is now used to increase the octane rating of petrol. (6)

(b) Select from the list above the fraction

(i) which is used as an aircraft fuel

(ii) which is used as “tar” or “bitumen” in surfacing roads. (12)

(c) Select from the list the fraction which is used as a heavy fuel oil for furnaces and which was spilled in large quantities from the oil tanker the “Prestige” causing major environmental damage on the coast of Spain in November 2002. State **one** of the types of environmental damage done by this spillage. (9)

7. (a) Define *electronegativity*. (8)

Describe using dot and cross diagrams the bonding in

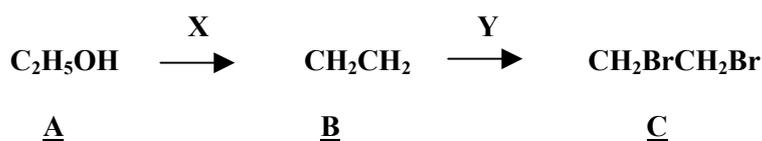
(i) sodium chloride, **NaCl**, (ii) hydrogen chloride, **HCl**. (18)

Which of these two substances would you expect to have the higher melting point? Give a reason for your answer. (6)

(b) Define *oxidation* in terms of electron transfer. (6)

In the reaction of sodium with chlorine to produce sodium chloride which element is reduced? Explain your answer. (12)

8. Examine the reaction scheme and answer the questions which follow:



(a) Which of the compounds A, B or C can be polymerised to make the plastic used in plastic bags and milk crates? (5)

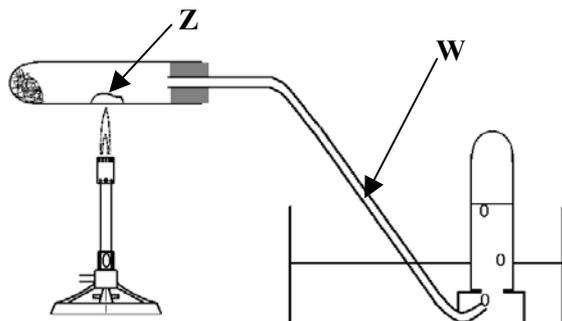
(b) Classify the conversions **X** and **Y** as *addition*, *elimination* or *substitution* reactions. (12)

(c) Name the compounds A, B and C. (18)

(d) The apparatus used for the conversion of A to B in a school laboratory is drawn on the right.

(i) Identify the solid **Z** and state its colour. (9)

(ii) Why is it important to remove the delivery tube, **W**, from the trough of water when the heating is stopped? (6)



9. (a) The following words are omitted from the passage below:

Arrhenius neutralisation hydrogen ions salt

Write in your answer book the omitted words corresponding to each of the numbers 1 to 4. (25)

According to 1 an acid is a substance that produces 2 when it is dissolved in water.

When an acid reacts with a base a 3 reaction occurs producing a 4 and water.

(b) The following words are omitted from the passage below:

chlorination flocculation filtration fluoridation

Write in your answer book the omitted words corresponding to each of the numbers 5 to 8. (25)

Aluminium salts are added to water in a waterworks to encourage suspended material to settle in a process called 5 . Harmful bacteria are killed in drinking water by 6 . In accordance with legislation 7 is carried out to help prevent tooth decay. The process of passing water through sand beds is called 8 .

10. Answer any **two** of the parts (a), (b) and (c) (2 × 25)

(a) Paper chromatography, thin-layer chromatography or column chromatography are all separation techniques.

(i) Describe with the aid of a diagram an experiment to separate a mixture of indicators using any **one** of these techniques. (18)

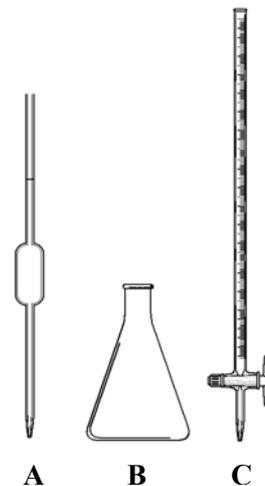
(ii) What use is made of thin-layer chromatography in forensic science? (7)

(b) The equipment drawn on the right was used in a titration between hydrochloric acid, **HCl**, and sodium hydroxide, **NaOH**.

(i) Identify the pieces of equipment **A**, **B** and **C**. (10)

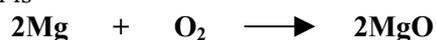
(ii) Which piece of equipment is used for measuring the 25 cm³ portions of sodium hydroxide? Describe the correct procedure for washing and filling this piece of equipment. (12)

(iii) Name a suitable indicator for this titration. (3)



(c) Magnesium burns in oxygen to produce magnesium oxide, **MgO**.

The equation for the reaction is



In an experiment 2.4 grams of magnesium were burned in oxygen.

(i) How many moles of magnesium were burned? (7)

(ii) How many moles of oxygen were required to completely react with the 2.4 g of magnesium? (6)

(iii) What volume of oxygen does this amount of oxygen occupy at s.t.p.? (6)
[Molar volume at s.t.p. = 22.4 litres]

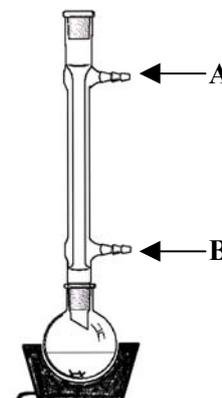
(iv) What mass of magnesium oxide was produced in this experiment? (6)

11. Answer any **two** of the parts (a), (b) and (c)

(2 × 25)

(a) The diagram on the right shows the arrangement of apparatus for a reflux.

- (i) Which of the condenser connections **A** or **B** is connected to the cold water tap? (4)
- (ii) Why are reaction mixtures sometimes refluxed? (6)
- (iii) Give an example of an experiment from your course where the reaction mixture was refluxed. (6)
- (iv) Apart from the reaction mixture what else should be added to the reaction vessel before the mixture is refluxed? Why? (9)



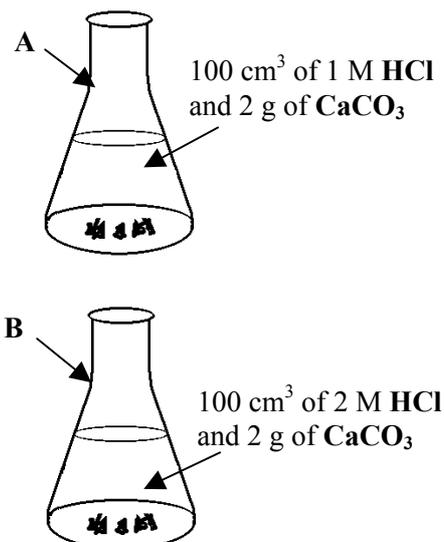
(b) Define *rate of a chemical reaction*. (7)

Hydrochloric acid, **HCl**, reacts with marble, **CaCO₃**, producing carbon dioxide gas as one of the products.

The conical flasks **A** and **B** were used in an experiment to examine the effect of concentration on the rate of a chemical reaction. Both flasks contained 2 grams of marble chips.

In each case the marble chips were approximately the same size. 100 cm³ of 1 M hydrochloric acid was added to flask **A** and 100 cm³ of 2 M hydrochloric acid was added to flask **B**.

- (i) In which flask was the reaction faster (more vigorous reaction)? Why was this reaction faster? (12)
- (ii) Describe a test for carbon dioxide gas. (6)



(c) Answer part **A** or part **B**

A

What is the chemical formula for ozone? State **one** beneficial effect of the ozone layer. (10)

CFCs are believed to be the main cause of damage to the ozone layer.

- (i) What are CFCs? What use is made of CFCs? (9)
- (ii) State **one** consequence of damage to the ozone layer. (6)

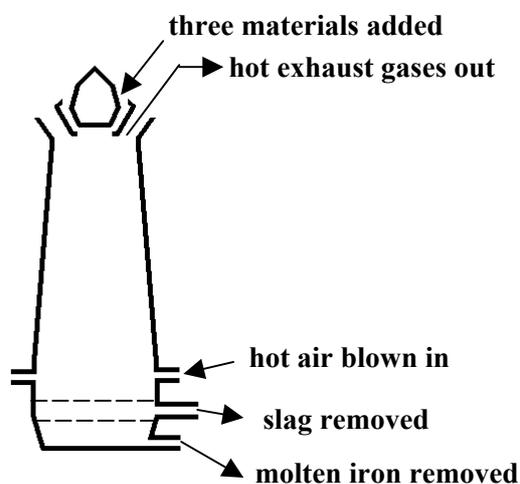
or

B

Give **two** properties of transition metals. (7)

Iron can be made using the blast furnace. The diagram on the right shows a blast furnace.

- (i) Identify the **three** materials added at the top of the blast furnace. (9)
- (ii) Write an equation for the reduction of iron oxide, **Fe₂O₃**, to iron in the blast furnace. (9)



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