



AN ROINN OIDEACHAIS
 LEAVING CERTIFICATE EXAMINATION, 1995
 CHEMISTRY — ORDINARY LEVEL

MONDAY, 19 JUNE — AFTERNOON 2.00 to 5.00

Question 1 and five other questions must be answered.

These five *must* include question 2 or question 3 but may include *both* question 2 and question 3.

All questions carry the same number of marks.

Relative atomic masses: H = 1, C = 12, N = 14, O = 16, Na = 23, P = 31, S = 32, Cl = 35.5, Ca = 40.

Molar volume at S.T.P. = 22.4 dm³. Avogadro constant = 6 x 10²³ mol⁻¹.

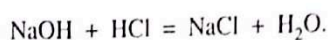
1. Answer *eleven* of the following items (a), (b), (c), etc. All items carry the same number of marks. *Keep your answers short.*

- (a) What element has the electronic configuration $1s^2 2s^2 2p^6 3s^1$?
- (b) What are *isotopes*?
- (c) What is meant by *electronegativity*?
- (d) How would you confirm the presence of nitrate ions in aqueous solution?
- (e) Name the types of crystals in which the structural units are (i) neutral atoms (ii) molecules.
- (f) What is the pH of a 0.1 M solution of sodium hydroxide?
- (g) What is the systematic (IUPAC) name for $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$?
- (h) Define (i) oxidation, (ii) reduction, in terms of electron transfer.
- (i) A solution contains 10.0 g of sodium hydroxide dissolved in 500 cm³ of solution. Express the concentration of the solution as a percentage (w/v).
- (j) What is *cracking*?
- (k) Write down the following equation giving oxidation numbers for zinc and copper.

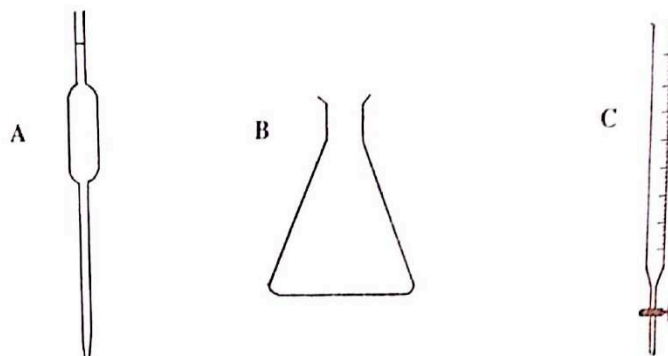
$$\text{Zn} + \text{CuSO}_4 \longrightarrow \text{Cu} + \text{ZnSO}_4$$
- (l) In the Bronsted-Lowry theory, what term is used for an acid and base which differ by one proton?
- (m) Sketch the shape of (i) a methane molecule, (ii) a water molecule.
- (n) Draw the structural formula for methylbenzene.
- (o) State *Hess's Law*.

(11 x 6)

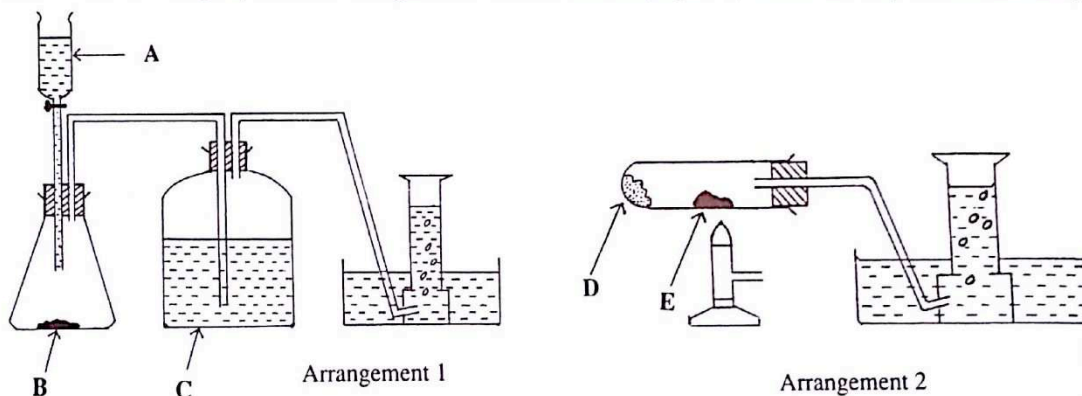
2. In a titration experiment to determine the concentration of sodium hydroxide in a solution, 24.0 cm^3 of a hydrochloric acid solution containing $7.30 \text{ g l}^{-1} (\text{dm}^{-3})$ were needed to neutralise 25.0 cm^3 of sodium hydroxide solution in the reaction.



The pieces of apparatus **A**, **B** and **C** were used in the experiment.

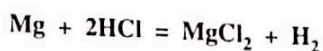


- (a) Name the pieces of apparatus labelled **A**, **B** and **C**. Draw a sketch to show how **B** and **C** are arranged when carrying out a titration. (9)
- (b) Why is it not possible to prepare a standard solution of sodium hydroxide directly? (6)
- (c) The following procedures were carried out *during* the titration
- the sides of **B** were washed down with deionised water.
 - B** was frequently swirled or shaken.
- Give **one** reason for carrying out each of these procedures. (6)
- (d) Calculate the concentration in $\text{mol l}^{-1} (\text{dm}^{-3})$ of (i) the hydrochloric acid solution (ii) the sodium hydroxide solution. (15)
- (e) Describe, briefly, how a pure dry sample of sodium chloride could be obtained having carried out the titration. (9)
- (f) Describe how you would carry out one test in each case to confirm that the salt sample in (e) contained the elements sodium and chlorine. State clearly the result expected for each test. (18)
3. Which of the following experimental arrangements could be used to prepare (i) ethene, (ii) ethyne in the laboratory?



- (a) Name the liquid **A**, the solid **B**, the solution **C**, the liquid at **D** and the solid **E**. (15)
- (b) What is the function of **E**? (6)
- (c) What is the purpose of the solution **C**? (6)
- (d) Ethene and ethyne are both unsaturated gaseous hydrocarbons. Explain the underlined words. (12)
- (e) Describe a chemical test to demonstrate that both gases are unsaturated. (6)
- (f) Both gases have the same products when burned in air. Name these products and give a chemical test for *one* of them. (9)
- (g) Write down the structural formula for (i) ethene, (ii) ethyne. (6)
- (h) Give one major industrial use for either ethene *or* ethyne. (6)

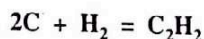
4. A student investigated the rate at which magnesium ribbon reacts with hydrochloric acid according to the equation:



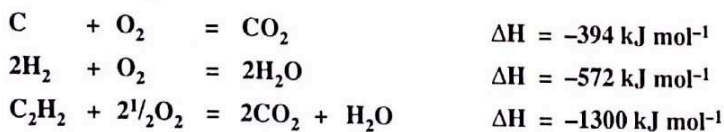
The following results were obtained in the experiment:

Time/Minutes	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Vol. of H ₂ /cm ³	0	30	48	61	75	80.5	88	92.5	96	96	96

- (a) Draw a sketch of an apparatus which could have been used to carry out this experiment. (15)
- (b) Plot a graph of the results in the above table. (12)
- (c) Why does the volume of hydrogen produced not increase any further after four minutes have elapsed? (6)
- (d) Is the rate of reaction faster after 3.5 minutes or after 3 minutes? Justify your answer from the shape of the graph. (9)
- (e) What would be the effect on the rate of the reaction of using:
- a higher temperature
 - less concentrated hydrochloric acid
 - powdered magnesium. (18)
- (f) Catalysts may be used to speed up many reactions. Name a catalyst and give an example of a reaction in which it is used. (6)
5. (a) Define (i) heat of reaction, (ii) exothermic reaction. (12)
- (b) Calculate the heat change for the reaction:



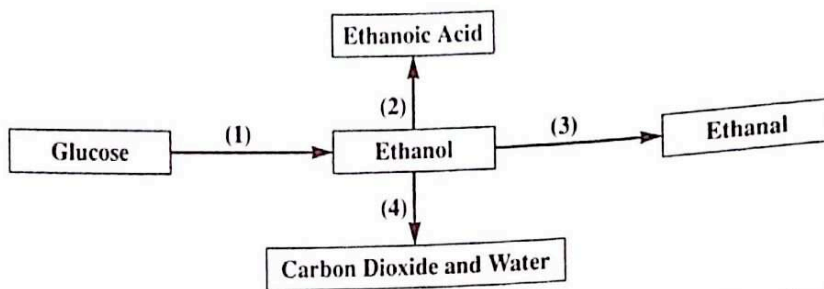
given the following data:



State whether the reaction is exothermic or endothermic? (30)

- (c) Define *heat of neutralisation*.
When 100.0 cm³ of 1 M solution hydroxide are added to 100.0 cm³ of 1 M hydrochloric acid, 5.7 kJ of heat are given out. Calculate the heat of neutralisation. (15)
- (d) Draw a labelled sketch of the apparatus you would use to measure the heat of combustion of a named liquid in the laboratory. (9)

6. Study the following reaction scheme and then answer the questions below:



- (a) Which of the above numbered steps are examples of (i) oxidation (ii) fermentation (iii) combustion, reactions? (9)
- (b) Write down the structural formula for (i) ethanol (ii) ethanal (iii) ethanoic acid. State the homologous series to which each of these molecules belongs. (18)
- (c) Describe, and explain what is observed when ethanal reacts with *either* Fehling's solution *or* ammoniacal silver nitrate. (6)
- (d) State the chemical reaction involved in the breathalyser test. What colour change takes place? (9)
- (e) Ethanol may be used to prepare both ethanal and ethanoic acid in the laboratory. Draw a sketch of the apparatus you would use in each case. Name the reagents and show how the product is collected. (24)

7. (a) The following words or phrases are omitted from the passage below:

valencies, chemical properties, coloured, atomic number, periods, catalysts, increases, electron shells, groups and transition elements.

Write down in your answer book the missing word or phrase corresponding to each of the numbers 1 to 10.

In the modern periodic table, the elements are listed in order of increasing ____ (1) _____. Vertical columns of elements are called ____ (2) _____ and all the elements in a given column have similar ____ (3) _____.

Horizontal rows of elements are called ____ (4) _____ and all the elements in a given row have the same number of ____ (5) _____. Within column one, the reactivity of the elements ____ (6) _____ from top to bottom.

The elements between scandium (atomic number 22) and zinc (atomic number 30) are called ____ (7) _____ and have the following characteristic properties (i) variable ____ (8) _____, (ii) form ____ (9) _____ compounds and (iii) may act as ____ (10) _____ in chemical reactions. (10 x 3)

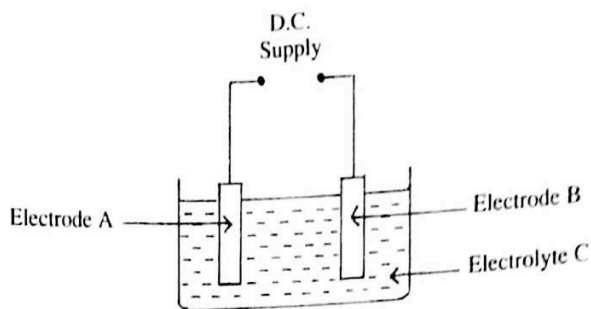
(b) Answer the following questions with reference to the six elements indicated in the section of the periodic table shown below:

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- (i) Give the symbol of the element which is a liquid at room temperature.
- (ii) Give the chemical formula of an ionic compound formed by the combination of two of these elements.
- (iii) Give the chemical formula of a basic oxide formed from two of these elements combining.
- (iv) Give the symbol of an element which will give a lilac colour to a bunsen flame.
- (v) Give the chemical formula of an acidic oxide formed by the combination of two of these elements. (5 x 6)
- (c) State *one* difference between Mendeleef's periodic table and the modern form. (6)

(18)

8. (a) Describe, briefly, how either copper *or* iron is extracted from its ore.
- (b) The diagram below shows an apparatus in which a direct current can be passed between electrode A and electrode B through an electrolyte C.



Parts (i) and (ii) below refer to two different experiments carried out using this apparatus.

- (i) If C is lead(II) bromide, at 370 °C, name the product formed at the positive electrode (anode) and the product formed at the negative electrode (cathode). (12)
- (ii) Describe how this apparatus might be used to refine impure copper. Your answer should (a) specify the anode and the cathode, (b) describe what happens at each electrode, and (c) include equations for the reaction at each electrode. (12)
- (c) Explain why copper is used (i) for hot water pipes, (ii) in electrical wiring. (6)
9. (a) Water from a river was found to contain large quantities of compounds of nitrogen and phosphorus. The river became choked with weeds and the amount of dissolved oxygen was greatly reduced. (6)
- (i) What is the term used to describe the enrichment and its effects? (6)
- (ii) What would be the effect of the lowering of the average amount of dissolved oxygen in the river? (6)
- (iii) Give the name and chemical formula of a fertilizer which contains nitrogen and calculate the % of nitrogen present in it. (12)
- (b) Describe the principles involved in the (i) primary, (ii) secondary and (iii) tertiary treatment of sewage. (18)
- (c) Give an explanation for each of the following statements:
- (i) Toothpaste often contains *fluoride*.
- (ii) Treated domestic water supplies are normally pathogen free (i.e. free from microorganisms which cause disease).
- (iii) Kettles in hard water areas contain a hard scale (deposit).
- (iv) Aluminium salts are used in water treatment. (4 x 6)

10. Answer any two of the following (a), (b), (c), (d).

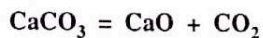
- (a) An organic compound, on analysis, is found to contain 62.1% of carbon, 10.3% of hydrogen, and 27.6% of oxygen, by mass. This compound, which may be prepared by the oxidation of an alcohol, does not reduce Fehling's solution. Its empirical is the same as its molecular formula.
- (i) Calculate the empirical formula using above information. Show your method clearly. (12)
 - (ii) Name the compound and give its structural formula. (12)
 - (iii) State the name of the homologous series to which the compound belongs. (3)
 - (iv) Name the alcohol used in its laboratory preparation. (6)

(b) Select from the following list:

carbon dioxide, ammonia, copper, methane, sulphur

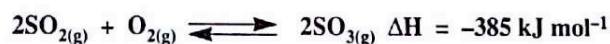
the substance which in each case is

- (i) used in the manufacture of fertilisers;
 - (ii) a member of the homologous series;
 - (iii) used in the industrial production of sulphuric acid;
 - (iv) manufactured by the Haber Process;
 - (v) used in everyday coinage;
 - (vi) found in allotropic forms;
 - (vii) used in fire extinguishers;
 - (viii) responsible for acid rain when combined with oxygen;
 - (ix) a major cause of the greenhouse effect;
 - (x) the main constituent of natural gas;
 - (xi) responsible for a characteristic bluish green colour in a bunsen flame. (11 x 3)
- (c) 10.0 g of calcium carbonate were heated, and completely decomposed, forming calcium oxide and carbon dioxide according to the equation:



- (i) Give a common name for calcium carbonate. (6)
 - (ii) How many moles of calcium carbonate were heated? (6)
 - (iii) What mass of calcium oxide was formed? (6)
 - (iv) What volume of carbon dioxide, at STP, was produced? (6)
 - (v) How many molecules of carbon dioxide were produced? (6)
 - (vi) Classify *one* of the oxides formed as acidic, basic, amphoteric or neutral. (3)
- (d) State *le Chatelier's principle*. (6)

An important step in the manufacture of sulphuric acid is the reversible reaction:



- (i) What is meant by a reversible reaction? (6)
- (ii) What symbol shows that this is a reversible reaction? (3)
- (iii) What is the relationship between the rate of the forward and backward reactions when equilibrium is reached? (6)
- (iv) How would (i) increasing the temperature, (ii) increasing the pressure, effect the yield of SO_3 ? (12)
Explain your answers in terms of *le Chatelier's principle*.