AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1986

CHEMISTRY—ORDINARY LEVEL

14968

TUESDAY, 24 JUNE—AFTERNOON 2 to 5

Question 1 and **five** other questions must be answered. These five questions *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, Ca = 40
Molar volume at S.T.P. = 22·4 dm^3

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

(*a*) Write down the electronic configuration (s, p) of phosphorus (atomic number = 15).

(*b*) Define valence of an atom.

(*c*) Write the equation of state for an ideal gas.

(*d*) What does Brownian movement demonstrate?

(*e*) Given the equation $CaCO_3 \xrightarrow{heat} CaO + CO_2$ find the volume of carbon dioxide liberated at S.T.P. when 12·5 g of calcium carbonate is strongly heated.

(*f*) Give (i) one example of an ionic crystal, (ii) one example of a covalent macromolecular crystal.

(*g*) What is meant by electronegativity?

(*h*) Identify (i) an acidic oxide, (ii) an amphoteric oxide from the following:

$$Na_2O\ ,\ MgO\ ,\ Al_2O_3\ ,\ NO_2$$

(*i*) Draw the structure of benzene.

(*j*) What is the pH of a solution which contains 0·63 g HNO_3 per dm^3 (litre)?

(*k*) For what purpose is chromatography used?

(*l*) Write down the functional group in carboxylic acids.

(*m*) Name two materials that are regularly added to the top of the blast furnace.

(*n*) What is meant by galvanising and why is it carried out?

(*o*) Explain the term polymerisation. Give an example of a polymer. (11 × 6)

2. (i) Anhydrous sodium carbonate (Na_2CO_3) is used as a primary standard in volumetric analysis. Explain the underlined term and state why anhydrous sodium carbonate is used. (12)

(ii) Describe how you would make 1 dm^3 (litre) of exactly 0·1 M sodium carbonate solution. (15)

(iii) 25·0 cm^3 of the sodium carbonate solution was titrated with a solution of sulphuric acid using a suitable indicator. The following readings were obtained.

Final reading (cm^3)	20·3	40·3	30·2
Initial reading (cm^3)	0·0	20·3	10·2
Volume used (cm^3)	20·3	20·0	20·0

Given that the equation for the reaction is

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$$

find the molarity of the sulphuric acid solution. (15)

(iv) Name a suitable indicator for the titration. (6)

(v) Why is it possible to wash the sides of the conical flask with deionised water during the titration without affecting the result? (6)

(vi) Carbonates and hydrogencarbonates both release carbon dioxide when treated with dilute acid. How may this be shown? What further chemical test is needed to distinguish between carbonate and hydrogencarbonate ions in aqueous solution? (12)

3. (i) Describe, using a diagram, the preparation of ethanal by the oxidation of ethanol. (24)

(ii) What is the initial colour of the mixture when the acidified sodium dichromate(VI) is added to the ethanol? What is the final colour of the mixture after oxidation takes place? (6)

(iii) The mixture is heated until it begins to boil. What should be done at this stage and why? (6)

(iv) What material, other than ethanol and acidified sodium dichromate(VI), should be put into the reaction vessel and why? (6)

(v) Name *one* precaution that should be taken to avoid the formation of ethanoic acid. (6)

(vi) State what you would observe when (a) ethanal reacts with a solution of ammoniacal silver nitrate. (b) ethanal reacts with Fehling's reagent. Outline the experimental procedure in *either* (a) *or* (b). (18)

4. (i) Outline briefly the contribution of Mendeleef in the development of the Periodic Table. (9)

(ii) What do you understand by the terms:
atomic number, mass number, electropositive metals, halogens, d-block elements? (15)

(iii) What type of bond is involved (*a*) when an atom of an electropositive metal combines with a halogen atom, (*b*) two similar halogen atoms combine to form a halogen molecule? Give an example in each case. (12)

(iv) Why are beryllium, magnesium and calcium all in the same group of the Periodic Table, i.e. Group II? (6)

(v) What is meant by the electrochemical series of the elements? (6)

(vi) Show that Group I elements are more reactive than Group II elements by referring to the action of sodium and magnesium with water. Give equations for the reactions involved. (18)

5. What do you understand by heat of combustion? (6)

Define kilogram calorific value. Suggest a use for such values. (12)

Ethanol (C_2H_5OH) combines with oxygen according to the equation

$$C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$$

Calculate the heat of combustion of ethanol given the following information:

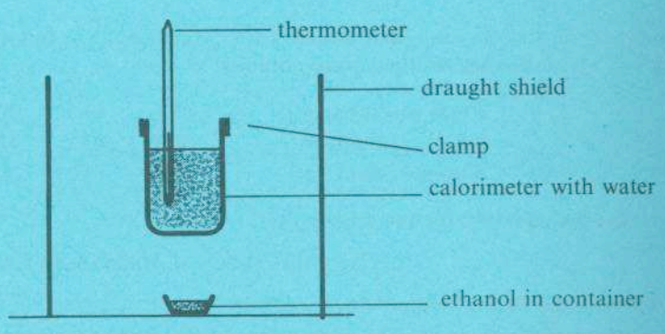
$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \qquad \Delta H = -394 \text{ kJ mol}^{-1}$$

$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)} \qquad \Delta H = -286 \text{ kJ mol}^{-1}$$

$$2C_{(s)} + 3H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow C_2H_5OH_{(l)} \qquad \Delta H = -276 \text{ kJ mol}^{-1}$$

(24)

The apparatus shown in the diagram can be used in an experiment to measure roughly the heat of combustion of ethanol.



Describe how you would carry out the experiment. (18)

State any *one* other procedure in this experiment that could be carried out in order to give a more accurate result. (6)

6. Hydrogen peroxide solution decomposes rapidly at room temperature in the presence of a catalyst according to the equation

$$2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$$

1·0 g of a catalyst was added to 100 cm^3 of a solution of hydrogen peroxide. A gas was released and collected and its volume noted every 10 seconds as shown in the table.

Time (seconds)	0	10	20	30	40	50	60	70	80	90
Vol. of oxygen (cm^3)	0	24	42	58	70	78	82	83	83	83

(i) What common catalyst would you use in this reaction? (6)

(ii) Draw a diagram of a suitable apparatus for this experiment. (18)

(iii) Using graph paper, plot the volumes of oxygen liberated (vertical axis) against time (horizontal axis). (12)

(iv) From the graph determine (*a*) the volume of oxygen liberated after 25 seconds, (*b*) the time at which the reaction could be said to to be complete. (12)

(v) How could it be shown that the catalyst used in the reaction remained unchanged after the reaction was completed? (12)

(vi) Name any *two* factors (other than a catalyst) that may affect the rate of a chemical reaction. (6)

7. (*a*) Alkanes, alkenes and alkynes are all aliphatic hydrocarbons The alkanes are saturated hydrocarbons whereas the alkenes and alkynes are unsaturated hydrocarbons. Explain the underlined terms. (18)

Write down the structural formula for the first member of (i) the alkanes, (ii) the alkenes, (iii) the alkynes. (18)

Describe a chemical test to show the presence of alkenes or alkynes. (9)

(*b*) In a refinery crude oil can be distilled to give a number of fractions. Name any *two* of these fractions.(12)

What is meant by catalytic cracking? Give *one* reason why the cracking is carried out. (9)

8. (i) Give *one* difference between an electron and a proton. (6)

(ii) Define oxidation in terms of electron transfer. (6)

(iii) Rewrite the equation $2KI + Cl_2 \rightarrow 2KCl + I_2$ as an ionic equation and show how the reaction illustrates an oxidation-reduction reaction. (12)

(iv) Define oxidation in terms of change in oxidation number. What oxidation number is usually assigned to (*a*) an atom of a free element, (*b*) oxygen in its compounds? (12)

(v) Show, by changes in oxidation numbers, which species is being oxidised and which is being reduced in the following equation,

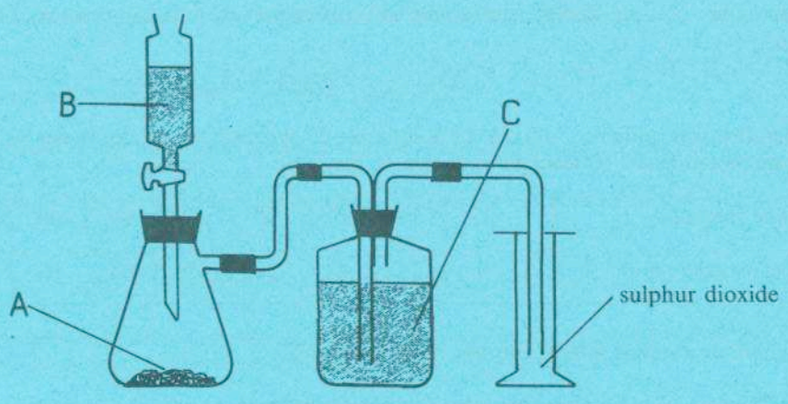
$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$ (12)

(vi) Define (*a*) an acid, (*b*) a base, in terms of the Bronsted-Lowry theory. (6)

(vii) Indicate the acid-base pairs in the following equation

$$H_2O + NH_3 \rightleftharpoons NH_4^+ + OH^-$$ (12)

9. (*a*)



Dry sulphur dioxide is prepared in the laboratory by using the apparatus shown above.

(i) Name the solid A and the liquids B and C. (12)

(ii) What is the function of the liquid C? (6)

(iii) The gas is collected by the upward displacement of air. What does this mean? (6)

(iv) Write a balanced equation for the above preparation of sulphur dioxide. (12)

(*b*) State Le Chatelier's Principle. (6)

Sulphur dioxide reacts with oxygen of the air in the presence of a catalyst according to the equation

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad \Delta H = -98 \text{ kJ mol}^{-1}$$

Explain what you would expect to happen to the yield of sulphur trioxide when the mixture is (i) heated, (ii) compressed to half its volume. (24)

10. Answer any *two* of the following:

(*a*) The preparation of nitric acid in this country is carried out by the oxidation of ammonia according to the equation,

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 6H_2O_{(g)} + 4NO_{(g)}$$

Outline the process, giving the appropriate equations involved. (24)

Ammonia and nitric acid are important chemicals in the manufacture of nitrogenous (nitrogen-containing) fertilisers. Name *two* commonly used nitrogenous fertilisers and give the chemical formula of *one* of them. (9)

(*b*) State how the electron pair repulsion theory may be used to assign shapes to molecules. (15)

In the case of *two* of the following molecules, indicate its shape, i.e. linear, trigonal (planar), or tetrahedral

$$BF_3, \quad BeCl_2, \quad CH_4$$

Justify your answer in each case. (18)

(*c*) An organic compound was composed of 62·1% carbon, 10·3% hydrogen and 27·6% oxygen by mass. The compound which was prepared by the oxidation of propan-2-ol was found to have a relative molecular mass of 58. Find the molecular formula of the compound. (24)

Name the compound and write its structural formula. (9)

(*d*) Explain the terms (i) effluent, (ii) sewage, (iii) eutrophication. (9)

1 dm^3 (litre) of water was found to contain 0·126 g of total suspended solids. Express this result in parts per million (p.p.m.). (9)

State *one* effect of eutrophication. (6)

What principles are involved in the primary treatment of sewage? (9)