AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1985

CHEMISTRY–ORDINARY LEVEL

TUESDAY, 25 JUNE–AFTERNOON 2.00 to 5.00

Question 1 and **five** other questions must be answered.
These 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, Na = 23, Cl = 35·5, 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*) What is meant by isotopes?

(*b*) In the general gas equation $PV = nRT$, what does R represent?

(*c*) What volume of alcohol and what volume of water would be required to make a 10% v/v solution of alcohol in water?

(*d*) Sketch the shape of a p-orbital.

(*e*) Write the equilibrium constant expression, K_c, for the reaction,

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

(*f*) What is the pH of a 0·1 M NaOH solution?

(*g*) Name and sketch the shape i.e. linear, trigonal (planar), tetrahedral, of *one* of the following molecules:

$$BF_3, \quad BeH_2, \quad CH_4$$

(*h*) What do you understand by catalytic cracking?

(*i*) What is the functional group in ketones?

(*j*) What do you understand by eutrophication of water?

(*k*) What catalyst is used in the oxidation of sulphur dioxide to sulphur trioxide?

(*l*) Write the structural formula for methylbenzene.

(*m*) Define an acid in terms of the Brönsted-Lowry theory.

(*n*) What volume of carbon dioxide, measured at S.T.P., is liberated when 50 g of calcium carbonate reacts with hydrochloric acid?

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

(*o*) State Le Chatelier's Principle.

(11 × 6)

2. (*a*) What colour change would you observe when (i) a copper salt e.g. copper sulphate, (ii) a sodium salt e.g. sodium sulphite is heated in a Bunsen flame? (6)
Describe how you would carry out the tests experimentally. (15)
Barium chloride solution is used to test for the presence of sulphate ions and the presence of sulphite ions in aqueous solution. What would you observe if a barium chloride solution is added to (i) a solution of copper sulphate, (ii) a solution of sodium sulphite? What further test is necessary to distinguish between sulphate and sulphite ions? (12)

(*b*) Outline the experimental procedures and state the colour changes you would observe when ethanal reacts with a solution of each of the following:

(i) potassium manganate (VII) (potassium permanganate),

(ii) Fehling's reagent. (2 × 12)

What difference in behaviour would you expect if propanone instead of ethanal were added to (i) above? (9)

3. **A** is a solution of sodium hydroxide of unknown concentration. **B** is a solution containing 3·65 g dm^{-3} of hydrochloric acid.

(i) What is a primary standard? (6)

(ii) As neither the sodium hydroxide nor the hydrochloric acid solutions are primary standards name and give the formula of a primary standard which a student could use to standardise the hydrochloric acid solution. (9)

(iii) Give a reason why it is preferable to put solution **B** in the burette. (6)

(iv) If a 25cm^3 pipette was not available for transferring the sodium hydroxide solution which of the following should the student have used: a 25 cm^3 graduated cylinder, a 25 cm^3 beaker, a 50 cm^3 burette? State your reason. (12)

(v) Name a suitable indicator and state its colour before and after the endpoint of the titration. (9)

(vi) Given that the volume of hydrochloric acid solution required in the titration was 24·5 cm^3, calculate the mass of sodium hydroxide in 1 dm^3 of solution **A**. (18)

(vii) If the solution of sodium hydroxide were left exposed to the air the concentration of sodium hydroxide would decrease. State the reason for this decrease. (6)

4. (i) What is meant by (*a*) energy level, (*b*) ionisation energy? (12)

(ii) What are the electronic configurations (s,p) of (*a*) fluorine, (*b*) chlorine? (12)

(iii) What name is given to the group of elements to which fluorine and chlorine belong? (6)

(iv) What oxidation number is given to this group of elements when they combine with sodium. (6)

(v) Chlorine will react with iron (II) chloride according to the reaction:

$$2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$$

Show, by changes in oxidation numbers, that this is an oxidation-reduction reaction. (12)

(vi) State the type of bonding present in the product formed (*a*) when chlorine reacts with sodium, (*b*) when chlorine reacts with phosphorus. Using electronegativity values (Mathematics Tables p. 46) justify your answer in the case of *either* (*a*) *or* (*b*). (18)

5. (*a*) In the case of any *three* of the following oxides

$$Na_2O, \quad NO_2, \quad NO, \quad Al_2O_3, \quad ZnO,$$

classify the type of oxide. Describe the reaction of the oxide, (if any), with water mentioning the products formed where appropriate. (3 × 12)

(*b*) Describe ionic and molecular crystals under the following headings: (i) the units occupying the lattice points, (ii) the bonding forces between the units, (iii) solubility, (iv) melting points. (4 × 6)

What units occupy the lattice points in a covalent macromolecular crystal e.g. diamond? (6)

6. (*a*) Copper can be purified by the electrolysis of an aqueous copper sulphate solution using copper electrodes. Describe, with the aid of a labelled diagram, the apparatus you would use to obtain pure copper. (12)

Show the reactions that take place at the anode and at the cathode and indicate where reduction occurs. (12)

Outline *two* ways in which corrosion of metals might be prevented. (12)

(*b*) What do you understand by (i) electropositive metals, (ii) d-block metals? Give one example of each type of metal. (12)

In the case of either one of the examples state briefly how the metal is extracted from its ore. Give an equation for the reaction involved. (18)

7. Define the rate of a chemical reaction. (9)

A piece of magnesium ribbon was allowed to react with dilute hydrochloric acid. A gas was given off and the volume was noted every half minute. The following results were obtained:

Time (minutes)	0	0·5	1·0	1·5	2·0	2·5	3·0
Vol. of gas (cm^3)	0	60	80	88	90	90	90

(i) Write an equation for the reaction and name the gas produced. (12)

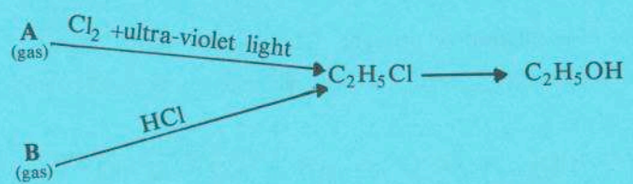
(ii) Plot a graph on graph paper of volume against time. (12)

(iii) From the graph determine (*a*) how long did it take for 70 cm^3 of gas to evolve, (*b*) when was the reaction just complete? (12)

(iv) If the reaction of the magnesium were repeated using a more concentrated solution of hydrochloric acid would it take a longer or shorter time for the reaction to go to completion? Justify your answer. (9)

(v) Draw a labelled diagram of the apparatus you could use to measure the volume of gas evolved in a given time. (12)

8. Chloroethane (C_2H_5Cl) may be prepared from two different gaseous compounds **A** and **B** as follows.



(i) Name compounds **A** and **B** and write down the structural formula of each compound named. (18)

(ii) Chloroethane may be converted to ethanol with sodium chloride as a byproduct. What reagent is used and what is this type of reaction called? (12)

(iii) Under what conditions can ethanol be converted into compound **B**? (12)

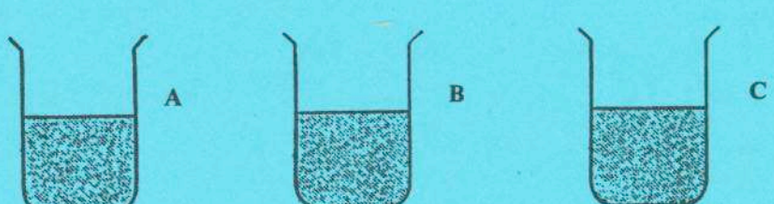
(iv) Ethanol can be prepared industrially from compound **B**. What reaction conditions are involved? (9)

(v) Give the systematic (IUPAC) name for $CH_3-\underset{\displaystyle Cl}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}}-CH_3$ (9)

(vi) Give the name of a chemical reagent used to test for unsaturation in the compound **B**. (6)

9. (*a*) Explain the role of each of the following: flocculation, filtration, chlorination and fluoridation with regard to the treatment of river water for domestic use. (4 × 9)

(*b*)



A, **B**, **C** represent beakers which contain 500 cm^3 of water samples from different parts of the country. 500 cm^3 of water sample **A** required 1 cm^3 of a soap solution to produce a lather while 500 cm^3 of water sample **B** required 20 cm^3 of the same soap solution to produce a lather. After boiling the same volume of water sample **B** required only 1 cm^3 of the soap solution to produce a lather. 500 cm^3 of water sample **C** required 15 cm^3 of the soap solution to produce a lather both before and after boiling.

(i) Which sample contained soft water? (6)

(ii) In which water sample was there temporary hardness? (6)

(iii) In which water sample was there permanent hardness? (6)

(iv) Suggest what happened to sample **B** when it was boiled. (6)

(v) State *one* disadvantage of hard water. (6)

10. Answer any *two* of the following.

(*a*) With the help of the kinetic/particulate theory of matter, explain, as fully as you can, each of the following observations:

(i) When some crystals of potassium manganate (VII) (potassium permanganate) are carefully covered with water and the mixture allowed to stand for some days, the purple colour will spread through the liquid. (12)

(ii) The volume of one mole of a liquid is much smaller than that of one mole of a gas at the same temperature. (12)

(iii) When particles of smoke are viewed through a microscope, they are seen to move continuously and irregularly. (9)

(*b*) Nitrogenous (nitrogen-containing) fertilisers are usually nitrates or ammonium salts. Name and give the chemical formula of one fertiliser of each type. (12)

What is the percentage of nitrogen in urea, $CO(NH_2)_2$? Name one of the two chemicals from which urea is obtained. (12)

Compound fertilisers are usually sold as NPK mixtures. What does NPK 7:6:17 mean if seen on a fertiliser bag? (9)

(*c*) Calculate the heat of formation of propane, C_3H_8, given that

$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)} \qquad \Delta H = -2211 \text{ kJ mol}^{-1}$$
$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)} \qquad \Delta H = -286 \text{ kJ mol}^{-1}$$
$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \qquad \Delta H = -393 \text{ kJ mol}^{-1}$$ (24)

Of what importance is the kilogram calorific value of a fuel? (9)

(*d*) A compound, of relative molecular mass 60, was found to be composed of 40% carbon, 6·7% hydrogen and 53·3% oxygen. Find the molecular formula and name the compound. (24)

A solution of this compound was added to a sodium hydrogencarbonate ($NaHCO_3$) solution and carbon dioxide was liberated. Write an equation for the reaction involved. (9)