AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1977

CHEMISTRY—ORDINARY LEVEL

THURSDAY, 16 JUNE—AFTERNOON, 2 to 4.45

Six questions to be answered

All questions carry the same marks.

Relative atomic masses (atomic weights): H = 1, C = 12, O = 16, Na = 23, S = 32, Cl = 35·5.
Molar Volume at S.T.P. = 22·4 litres.
Avogadro constant (number) = 6×10^{23}.

1. Answer *eleven* of the following items (*a*), (*b*), (*c*), etc. All the items carry the same marks. *Keep your answers short.*
   (*a*) Give a chemical test for the nitrate ion.
   (*b*) What chemicals may be used to prepare a sample of hydrogen peroxide?
   (*c*) State Pauli's exclusion principle.
   (*d*) Write the following elements in the order in which they occur in the electrochemical series: zinc, sodium, calcium, magnesium.
   (*e*) What is the percentage of sulphur in sulphur dioxide?
   (*f*) How does the atomic radius vary across a period in the periodic table?
   (*g*) What type of bonding is generally present in compounds which are soluble in non-polar solvents?
   (*h*) Classify each of the following molecules as linear, planar or tetrahedral: H_2O , CH_4 , BeH_2
   (*i*) What is an exothermic reaction?
   (*j*) Define heat of combustion.
   (*k*) Name a suitable indicator for a titration involving a weak acid and a strong base.
   (*l*) Write down the functional group in ketones.
   (*m*) What is meant by a polymer? Give an example.
   (*n*) State one of Faraday's laws of electrolysis.
   (*o*) Write the structural formula for benzoic acid.

2. Give the name and formula of:
   (*a*) one hydride, in each case, which reacts with water to give (i) an alkaline solution, (ii) an acidic solution;
   (*b*) one oxide, in each case, which reacts with water to give (i) an alkaline solution, (ii) an acidic solution;
   (*c*) one chloride, in each case, where (i) chlorine is combined with a metal, (ii) chlorine is combined with a non-metal.
   Describe the appearance and the type of bonding present in the case of each of the six compounds you have named above.

3. (*a*) What are (i) neutrons, (ii) isotopes? Show the atomic structure of the isotopes of carbon *or* of chlorine.
   (*b*) What is meant by (i) energy levels, (ii) atomic orbitals? In what respect does a 2s orbital differ from a 1s orbital?
   (*c*) Write down the electronic configuration (s, p) of lithium, neon and sodium. Suggest a reason why (i) sodium is more reactive than lithium, (ii) neon is unreactive.

4. Choose *four* of the following statements and in each case (i) comment briefly on the statement, (ii) outline an experiment to illustrate the validity of the statement.
   (*a*) Elements in the same group in the periodic table generally react in a similar way.
   (*b*) Water which has been shaken with sodium chloride contains chloride ions, whereas water which has been shaken with carbon tetrachloride does not contain chloride ions.
   (*c*) Ethane and ethene (ethylene) are both hydrocarbons but they differ significantly in respect of some of their chemical reactions.
   (*d*) The pH of pure water changes when hydrogen chloride gas is dissolved in it.
   (*e*) An aqueous solution of sulphuric acid is a strong electrolyte whereas an aqueous solution of acetic acid is a weak electrolyte.

5. In a reaction 10·6 grams of sodium carbonate reacted completely with dilute hydrochloric acid forming sodium chloride, carbon dioxide and water.
   (*a*) Write a balanced equation for the reaction.
   (*b*) How many moles of each of the three products were formed?
   (*c*) How many grams of each of the three products were formed?
   (*d*) Calculate the volume at S.T.P. of carbon dioxide obtained.
   (*e*) Calculate the number of molecules of carbon dioxide obtained.
   (*f*) Give the names *or* formulae of the products obtained when carbon dioxide reacts with (i) water, (ii) sodium hydroxide, (iii) lime-water.

6. Acetylene is an aliphatic hydrocarbon and benzene is an aromatic hydrocarbon. What is the significance of the underlined words?
   (*a*) Write the structural formula for (i) acetylene, (ii) benzene.
   (*b*) Write an equation to show (i) how acetylene may be prepared in the laboratory, (ii) the reaction of acetylene with bromine.
   (*c*) State how benzene may be converted into (i) bromobenzene, (ii) nitrobenzene.

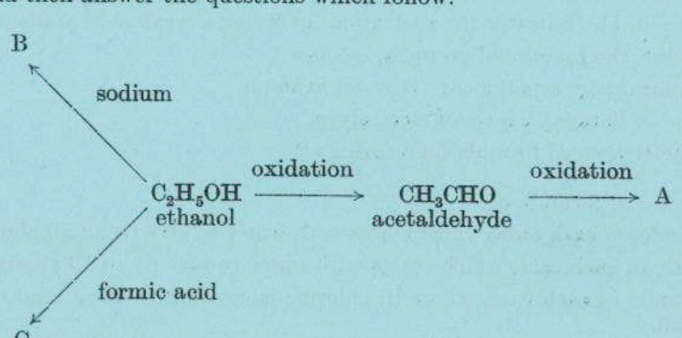
7. In a titration 20 cm^3 of a 0·1M (0·2N) sodium carbonate solution were required to neutralise 25 cm^3 of a sulphuric acid solution.
   (*a*) Calculate the concentration of the sulphuric acid solution in terms of (i) molarity (normality), (ii) grams per litre.
   (*b*) Describe how you would carry out this titration in the laboratory.
   (*c*) Outline how you would test for the presence of (i) carbonate ions in the given sodium carbonate solution, (ii) sulphate ions in the sodium sulphate solution formed in the titration.

8. Define oxidation and reduction in terms of electron transfer.
   With regard to each of the following reactions:

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$
$$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$$

   state which species has been oxidised.
   What do these reactions tell you about the relative positions of (i) iron and copper, (ii) chlorine and bromine, in the electrochemical series? (Assume the reactions take place under the conditions which apply to the series).
   Show, in terms of electron transfer, how the electrolysis of molten sodium chloride, using inert electrodes, is an oxidation/reduction reaction.

9. Study the reaction scheme and then answer the questions which follow.



   (*a*) Write the structural formula for ethanol and for acetaldehyde.
   (*b*) Name the compound A and write its structural formula.
   (*c*) Name the organic compounds B and C
   (*d*) Write (i) the molecular formula for B, (ii) the molecular formula for C.
   (*e*) Using a labelled sketch, show how the compound A is obtained in the laboratory.

10. Answer any *two* of the following.
   (*a*) Find the heat of formation of methane from the following data:

$$2H_2 + O_2 = 2H_2O \qquad \Delta H = -573 \text{ kJ}$$
$$C + O_2 = CO_2 \qquad \Delta H = -393 \text{ kJ}$$
$$CH_4 + 2O_2 = CO_2 + 2H_2O \qquad \Delta H = -879 \text{ kJ}$$

   (*b*) Define (i) an acid, (ii) a base, in terms of the Bronsted-Lowry theory. Indicate the acid, base, conjugate acid and conjugate base in the following reaction:

$$H_2O + HCl \rightleftharpoons H_3O^+ + Cl^-$$

   Comment briefly on the merits of the Bronsted-Lowry theory compared with earlier theories on acids and bases.
   (*c*) Define pH. What is the pH of (i) a 0·01M (0·01N) solution of hydrochloric acid, (ii) a solution of sodium hydroxide containing 4 grams per litre?
   Explain briefly how an indicator works.
   (*d*) What is meant by the electronegativity of an element? Indicate how, in general, the values of electronegativity vary (i) within a group, (ii) within a period, of the periodic table.
   Mention any one use which may be made of a knowledge of the values of electronegativity.