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LEAVING CERTIFICATE EXAMINATION, 1978

CHEMISTRY—ORDINARY LEVEL

MONDAY 19 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, N = 14, O = 16, Na = 23, S = 32, Cl = 35.5, K = 39
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 items carry the same marks. *Keep your answers short.*

   (a) State Hess's law.

   (b) What are isotopes?

   (c) Which one of the following formulae is correct (where E is the symbol for an appropriate element with a valence of three):

   $$E_2Cl_3\ ,\quad E_3(SO_4)_2\ ,\quad E(OH)_3\ ?$$

   (d) Write the name and formula for a linear molecule.

   (e) Name a noble (an inert) gas. What have the following ions Cl^-, K^+, S^{2-} got in common with regard to electronic structure?

   (f) What is meant by mass number?

   (g) Give an example of (i) a molecular crystal, (ii) a covalent crystal.

   (h) Write down the electronic configuration (s,p) of calcium (atomic number = 20)

   (i) Define oxidation in terms of electron transfer.

   (j) Give *one* characteristic chemical property of the alkanes e.g.ethane.

   (k) Write the structural formula for acetylene.

   (l) What is a polymer? Give an example.

   (m) Write two possible structural formulae for butane.

   (n) How many molecules are there in 3.2 grams of sulphur dioxide?

   (o) Give an example of a radioactive isotope and state *one* of its uses.

2. What are electrons? Define the electronegativity of an element.
   Distinguish between an ionic bond and a covalent bond. Illustrate by means of one example in each case (i) the formation of an ionic bond, (ii) the formation of a covalent bond.
   Outline the general properties of ionic substances and the general properties of covalent compounds. Indicate how the electronegativity values of elements may be used to predict the type of bond in a molecule.

3. *(a)* Describe a chemical test to confirm the presence of *three* of the following: (i) chloride ions in aqueous solution, (ii) carbonate ions in aqueous solution, (iii) nitrate ions in aqueous solution, (iv) sulphate ions in aqueous solution.

   (b) Give brief explanations for *three* of the following statements.

   (i) Water has a bond angle of approximately 105°.

   (ii) Metals are generally good conductors of heat and electricity whereas non-metals are not.

   (iii) In making up an acidified solution of potassium permanganate, sulphuric acid may be used but hydrochloric acid alone may not.

   (iv) Beryllium and nitrogen are exceptions to the general increase in ionisation energies shown by the other elements in the period lithium to neon. (Refer to Mathematics Tables p.45)

4. Compare (i) the physical appearance, (ii) the type of bonding involved, in each of *three* of the following: hydrogen chloride, ammonia, hydrogen sulphide, hydrogen peroxide.
   Describe a laboratory preparation of *one* of the three you have chosen and give its principal chemical properties.

5. Define *(a)* heat of combustion, *(b)* heat of neutralisation. Outline an experiment to measure either (i) *or* (ii).
Ethanol burns in air according to the equation:

$$C_2H_5OH + 3O_2 = 2CO_2 + 3H_2O \quad \Delta H = -1360kJ$$

(i) Is this reaction exothermic or endothermic?

(ii) Write down the heat of combustion of ethanol?

(iii) Calculate the heat change involved when 23 grams of ethanol are burned completely in air.

(iv) What volume of oxygen at S.T.P. would be used up in the complete combustion of 23 grams of ethanol?

6. Define (i) an acid, (ii) a base, in terms of the Bronsted-Lowry theory.
Complete the following 'equations' and in each case indicate the acids and bases:

$$HCl + H_2O \rightleftharpoons$$

$$NH_3 + H_2O \rightleftharpoons$$

In what respect does a weak acid differ from a strong acid ?
What is meant by the pH of a solution? Explain briefly how an indicator works.

7. Write the structural formula of each of the following compounds *(a)* ethene (ethylene), *(b)* acetaldehyde, *(c)* acetic acid.
Use equations to illustrate an example of each of *two* of the following:

(i) an addition reaction of ethene (ethylene),

(ii) a condensation reaction of acetaldehyde (e.g. with phenylhydrazine),

(iii) the preparation of an ester of acetic acid.

Name the products in the two examples chosen.
Show by means of a labelled diagram, how ethene (ethylene) *or* acetaldehyde may be prepared in the laboratory.

8. *(a)* You are given three metals, iron, copper and sodium. Outline *three* experiments which you would carry out on *each* one to determine the relative positions of these metals in the electrochemical series. State clearly what would be observed in each experiment, respectively, and write an equation for any reaction involved. Write down the metals in order of decreasing activity.

(b) Show, by means of a diagram, how you would pass an electric current through either acidulated water *or* a melt of sodium chloride. Describe what happens at each electrode.

9. Describe how you would make up a 0.1M(0.2N) solution of sodium carbonate and how you would use it to standardise a given sulphuric acid solution.

(i) In a titration, 25 cm^3 of 0.5M(1.0N) solution of sulphuric acid were added to an excess of 1.0M(1.0N) solution of sodium hydroxide. What actual volume of the sodium hydroxide solution was used up in neutralising the sulphuric acid solution?

(ii) If 30cm^3 of the sodium hydroxide solution was the given volume at the start of the titration in (i) find the volume of a 0.2M(0.4N) solution of sulphuric acid needed to neutralise the sodium hydroxide solution which remained after the reaction in (i).

10. Answer any *two* of the following.

(a) Write the name and formula of an oxide in the case of each of any *four* of the following elements: Mg, Al, C, N, P. Compare the oxides named in terms of bond type and classification. Show the reaction (if any) of these oxides with water.

(b) Give the structural formula of each of *three* of the following compounds:
benzene, nitrobenzene, benzoic acid, toluene.
State how *either* nitrobenzene may be obtained from benzene *or* benzoic acid may be obtained from toluene.
Give *one* chemical property of nitrobenzene and *one* chemical property of benzoic acid.

(c) Write a concise account of the merits of the periodic table in the study of chemistry.

(d) An organic compound is composed of 50% oxygen, 37.5% carbon and 12.5% hydrogen, by weight. If the relative molecular mass (molecular weight) of the compound is 32 show how its molecular formula may be determined using the given data, and name the compound.