AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1984

CHEMISTRY—ORDINARY LEVEL

FRIDAY, 22 JUNE—AFTERNOON, 2.00 to 5.00

Six questions to be answered.

All questions carry the same marks.

Relative atomic masses (atomic weights): H = 1, C = 12, O = 16, Na = 23, K = 39, Ca = 40
Molar volume at S.T.P. = 22·4 litres (dm^3)
Avogadro's constant (number) = 6×10^{23} mol^{-1}

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 the mass number of an element?

   (*b*) State what n represents in the general gas equation $PV = nRT$.

   (*c*) How many electrons are present in (i) Al^{3+} (atomic number of Al = 13), (ii) S^{2-} (atomic number of S = 16)?

   (*d*) Calculate the percentage weight of oxygen in calcium carbonate.

   (*e*) What is meant by electronegativity?

   (*f*) State the difference between a strong acid and a weak acid.

   (*g*) Complete and balance the following equation:

   $$MnO_2 + 4\underset{(conc.)}{HCl} = MnCl_2 + H_2O +$$

   (*h*) Give *one* typical property of transition metals.

   (*i*) What are isotopes?

   (*j*) State *two* factors on which the value of the ionisation energy of an element depends.

   (*k*) How many molecules are there in 4·4 g of carbon dioxide?

   (*l*) Write the structural formula for benzoic acid.

   (*m*) Give the chemical formulae for any *two* compounds which contain phosphorus.

   (*n*) What reagents are used to convert benzene to nitrobenzene?

   (*o*) What is a polymer? Give an example.

2. What is meant by (*a*) atomic orbital, (*b*) Pauli exclusion principle?

   (i) Write down the electronic configuration (*s*, *p*) of potassium (atomic number = 19).

   (ii) What is the physical state of potassium at room temperature and how is it stored?

   (iii) State what happens when potassium is added to water and mention the precautions that should be taken. Write an equation for the reaction.

   (iv) Write down the electronic configuration (*s*, *p*) for chlorine (atomic number = 17).

   (v) Show the type of bond formed when potassium and chlorine combine. Give *two* general properties associated with this type of bond.

3. Give the name and formula of (*a*) a hydride, (*b*) an oxide, of each of the following:

   nitrogen, magnesium, sulphur

   In the case of each hydride and each oxide given indicate (i) the general appearance, (ii) the reaction (if any) with water, mentioning the products formed, (iii) the type of bond involved.
   Outline a laboratory preparation of a hydride of nitrogen *or* an oxide of sulphur.

4. What is an electrolyte?
State Faraday's laws of electrolysis.
Draw a labelled diagram of the apparatus used in the electrolysis of acidulated water using platinum electrodes.
Describe the changes which take place at the electrodes.
Define oxidation in terms of electron transfer. At which electrode does oxidation occur?
State any *one* factor which determines the ions which are the first to be discharged during electrolysis.

5. (*a*) What is (i) a standard solution, (ii) a molar solution?
What volume of 0·1 M sulphuric acid would exactly neutralise 25 cm^3 of a sodium carbonate (Na_2CO_3) solution containing 21·2 grams of the anhydrous sodium carbonate per litre (dm^3)?
Outline how you would carry out the experiment.

(*b*) Describe a chemical test (one in each case) to show

(i) the presence of sulphate ions in the sulphuric acid,

(ii) the presence of carbonate ions in the sodium carbonate solution.

6. What is (i) an exothermic reaction, (ii) an endothermic reaction?
Define the heat of neutralisation of an acid. Describe briefly how you would measure the heat of neutralisation of an acid.
Calculate the heat change for the reaction:

$$2C_{(s)} + 3H_{2(g)} + \tfrac{1}{2}O_{2(g)} = C_2H_5OH_{(l)}$$

from the following data:

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

$H_{2(g)} + \frac{1}{2}O_{2(g)} = H_2O_{(l)}$ $\quad \Delta H = -286$ kJ mol^{-1}

$C_2H_5OH_{(l)} + 3O_{2(g)} = 2CO_{2(g)} + 3H_2O_{(l)}$ $\quad \Delta H = -1370$ kJ mol^{-1}

7. Write the structural formula for (i) acetylene (ethyne), (ii) ethanol, (iii) acetaldehyde (ethanal).
Use equations to illustrate any *two* of the following:

(*a*) the addition of bromine to acetylene (ethyne),

(*b*) the formation of ether (ethoxyethane) from ethanol,

(*c*) the reaction of acetaldehyde (ethanal) with phenylhydrazine ($C_6H_5NHNH_2$).

Using a labelled diagram, outline how ethanol may be converted to acetaldehyde (ethanal) in the laboratory.

8. An aliphatic unsaturated compound was found to be composed of 85·7% carbon and 14·3% hydrogen, by weight. The compound is a member of a homologous series and has a relative molecular mass (molecular weight) of 42.

(i) What is meant by the underlined terms?

(ii) Find the molecular formula of the compound and write down its structural formula.

(iii) How would you test that the compound is unsaturated?

(iv) Name *one* other unsaturated compound of the same series.

9. (*a*) What is (i) an acid, (ii) a base, (iii) a conjugate base, in terms of the Brønsted-Lowry theory? In each of the reactions below indicate the acids, the bases and the conjugate acid-base pairs.

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

$$NH_3 + HCl \rightleftharpoons NH_4^+ + Cl^-$$

(*b*) Compare the reactions of each of the following metals: calcium, copper, zinc with (i) water, (ii) oxygen, (iii) dilute acid. From the experimental results arrange the metals in order of *increasing* chemical activity.

10. Answer any *two* of the following.

(*a*) Define pH.

(i) Show that the pH of a 0·05 M solution of sulphuric acid is 1.

(ii) Find the pH of a solution containing 0·4 g of sodium hydroxide per litre (dm^3).

(*b*) Name a covalent molecule and show the formation of the covalent bond. Give *two* general properties of covalent compounds.
State one example in each case of (i) a molecular crystal, (ii) a metallic crystal.

(*c*) 10 g of potassium hydrogen carbonate ($KHCO_3$) reacts with hydrochloric acid according to the equation:

$$KHCO_3 + HCl \rightarrow KCl + CO_2 + H_2O$$

(i) How many moles of $KHCO_3$ does 10 g represent?

(ii) What mass of water is obtained?

(iii) What is the volume of carbon dioxide liberated at S.T.P.?

(*d*) Choose *three* of the following:

$$BF_3, \quad BeH_2, \quad CH_4, \quad H_2O$$

and in the case of each molecule chosen

(i) discuss how the electron pair repulsion theory can be used to assign shapes to these molecules,

(ii) sketch and state the shape of each of the molecules.