

## AN ROINN OIDEACHAIS

## LEAVING CERTIFICATE EXAMINATION, 1989

## CHEMISTRY — ORDINARY LEVEL

FRIDAY, 16 JUNE — MORNING, 9.30 to 12.30


**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, N = 14, O = 16, Na = 23, S = 32, Cl = 35.5  
Molar volume at S.T.P. = 22.4 dm<sup>3</sup>

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, etc.) of copper (atomic number 29).
- (b) In the general gas equation  $PV = nRT$ , what does  $n$  represent?
- (c) An atom has an electronegativity value of 0.9 and another atom has an electronegativity value of 3.0. When these two atoms combine what type of bond would you expect to be formed between them? Give a reason for your answer.
- (d) Name or sketch the shape of *two* of the following molecules: BF<sub>3</sub>, CH<sub>4</sub>, HCl.
- (e) What volume of oxygen, measured at S.T.P., is liberated when 17 g of hydrogen peroxide is heated?
- $$2\text{H}_2\text{O}_{2(\text{aq})} \longrightarrow 2\text{H}_2\text{O}_{(\text{l})} + \text{O}_{2(\text{g})}$$
- (f) Give one example of *either* an ionic *or* a molecular crystal stating one of its physical properties.
- (g) Define an acid in terms of the Brønsted-Lowry theory.
- (h) State the effect of an increase in pressure on the equilibrium  $\text{N}_{2(\text{g})} + 3\text{H}_{2(\text{g})} \rightleftharpoons 2\text{NH}_{3(\text{g})}$ .
- (i) What is the systematic (IUPAC) name for CH<sub>3</sub>CH = CHCH<sub>3</sub>?
- (j) For what purpose is chromatography used?
- (k) What is the oxidation number of sulphur in HSO<sub>3</sub><sup>-</sup>?
- (l) What does the circle represent in the following structure shown for benzene?
- 
- (m) What weight of sodium chloride and what volume of water would be required to make 100 cm<sup>3</sup> of a 5% w/v solution of sodium chloride in water?
- (n) Name *one* way in which corrosion may be prevented.
- (o) Write the structural formula for propanone.

(11 × 6)



2. Answer the following questions which relate to experimental procedures in titration experiments.

(a) Point out *one* error in each of the following two statements.

(i) A 0.1 M solution of sodium carbonate was prepared by dissolving 10.6 g of sodium carbonate in 1,000 cm<sup>3</sup> of water. (6)

(ii) Before the titration began the burette, pipette and conical flask were all washed with small portions of the solution that each was to contain. (6)

(b) (i) Why should the sides of a conical flask be washed down with deionised water during a titration? (6)

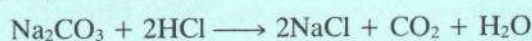
Why does the addition of water not cause an error in the titration value? (6)

(ii) Why is it advisable to shake all solutions before using them in a titration experiment? (6)

(c) 25.0 cm<sup>3</sup> of a 0.1 M sodium carbonate solution was titrated with a solution of hydrochloric acid. The following readings were obtained.

Final reading (cm <sup>3</sup> )	26.0	35.3	37.9	41.3
Initial reading (cm <sup>3</sup> )	0.2	10.0	12.7	16.0
Volume used (cm <sup>3</sup> )	25.8	25.3	25.2	25.3

The equation for the reaction involved is



(i) Why should the average of the 4 titres i.e. 25.4 cm<sup>3</sup> not be used in calculating the molarity of the hydrochloric acid solution? (12)

(ii) Calculate the molarity of the hydrochloric acid solution. (18)

What is the concentration of the hydrochloric acid solution in g dm<sup>-3</sup>? (6)

3. Ethanoic acid (CH<sub>3</sub>COOH) can be prepared by the oxidation of ethanol using the apparatus shown followed by distillation.

(i) Why is the ethanol solution added drop-by-drop? (6)

(ii) To which point A or B should the water supply be connected? (6)

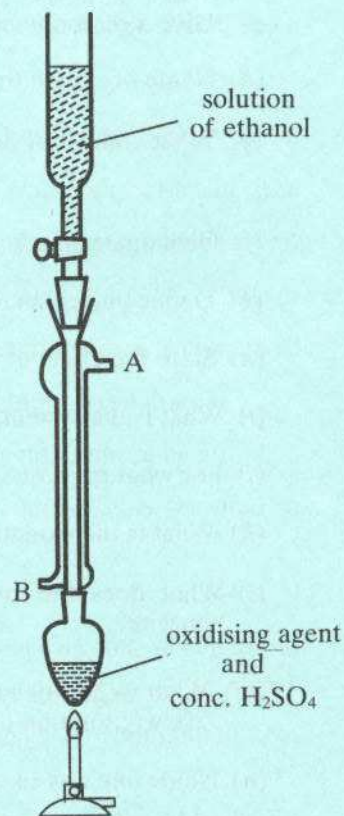
(iii) What oxidising agent is normally used? (6)

(iv) What precautions should be taken in the preparation of the concentrated sulphuric acid solution? (6)

(v) Why is the mixture strongly refluxed after all the ethanol has been added? (6)

(vi) Name two impurities you would expect to obtain when the ethanoic acid is distilled. (12)

Describe any two reactions that demonstrate the acidic nature of ethanoic acid and give a balanced equation in any *one* case. (24)



4. (a) What is meant by (i) heat of reaction, (ii) heat of neutralisation? (12)

(b) Describe, with the aid of a diagram, how you would measure the heat of neutralisation of a strong acid by a strong base. (24)

If the temperature rises by 6.5° C when 50 cm<sup>3</sup> of a 1.0 M hydrochloric acid solution and 50 cm<sup>3</sup> of a 1.0 M sodium hydroxide solution are mixed calculate the heat of neutralisation of hydrochloric acid. (Take specific heat capacity of the sodium chloride solution formed as 4,200 J/kg K). (21)

(c) Why is the value of the heat of neutralisation of a strong acid by a strong base always constant? (9)



5. Marble is a naturally occurring form of calcium carbonate.

Give the name of one other naturally occurring form of calcium carbonate. (6)

In an experiment 50 g of small marble chips were added to a conical flask containing excess hydrochloric acid. The rate of the chemical reaction was measured by recording the volume of carbon dioxide liberated every 10 seconds as shown below.

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100	110
Vol. of CO <sub>2</sub> (cm <sup>3</sup> )	0	20	35	47	56	64	69	73	77	79	80	80

(i) Write an equation for the reaction. (6)

(ii) How could you show that the gas liberated was carbon dioxide? (6)

(iii) Using graph paper, plot a graph of volume of gas liberated (vertical axis) against time (horizontal axis). (12)

(iv) After what time would 40 cm<sup>3</sup> of carbon dioxide have been liberated? (9)

(v) Why does the rate of reaction gradually slow down? (9)

(vi) If the reaction were repeated (a) using a single lump of marble of mass 50 g, (b) at a much higher temperature, would it take a longer or shorter time for the reaction to go to completion? Give a reason for your answer in each case. (18)

6. (a) The gases ethane and ethene are both hydrocarbons which are members of different homologous series.

(i) Explain the underlined terms. (12)

(ii) Ethane is a saturated hydrocarbon. What is meant by the term saturated? (6)

(iii) When a solution of bromine in 1,1,1-trichloroethane is added to ethene it is decolourised. This is a test for an unsaturated hydrocarbon. What is meant by the term unsaturated? Name another chemical test that can be used to confirm the presence of an unsaturated hydrocarbon stating what would be observed. (18)

(iv) Name any polymer obtained from ethene or any other alkene. (6)

(b) Chloroalkanes are important chemicals used in industry as solvents.

State *one* way in which chloroalkanes can be obtained from each of the following: (i) alkanes, (ii) alkenes, (iii) alcohols. Give an equation for the reaction involved in any *one* case. (24)

7. Answer the following questions with reference to the eight elements labelled (a) to (h) in the part of the Periodic Table shown below. (Mathematics Tables p. 44)

																1 (a)	2								
3	4															5	6 (b)	7	8	9	10 (c)				
11 (d)	12 (e)															13	14	15	16 (f)	17 (g)	18				
19	20	21	22	23	24	25	26 (h)	27	28	29	30	31	32	33	34	35	36								

(i) Which element is termed a noble gas? (6)

(ii) Which element is stored under oil? (6)

(iii) Which element has coloured compounds and a variable valence? (6)

(iv) Name an element which forms a basic oxide and an element which forms an acidic oxide. (6)

(v) Which element exists in allotropic forms? (6)

(vi) Why does element (e) displace element (h) from a solution of one of its salts? (6)

(vii) Give the chemical formula of the compound formed when element (a) combines with element (f). (6)

(viii) Why is the first ionisation energy value for element (d) lower than that for element (g)? (9)

(ix) Describe briefly how element (h) is extracted from its ore. (15)



8. (a) Describe how *either* ammonia *or* nitric acid is prepared industrially. (24)
- (b) Why are nitrogen compounds added to agricultural land? How might this affect water in rivers and lakes? (12)
- (c) Show, by calculation, which of the two fertilisers sodium nitrate,  $\text{NaNO}_3$ , *or* ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ , has the higher percentage of nitrogen. (18)
- (d) Outline a chemical test to show the presence of *either* nitrate ions in a solution of sodium nitrate *or* sulphate ions in a solution of ammonium sulphate. (12)
9. (a) What is the purpose of (i) chlorination, (ii) filtration, (iii) fluoridation, in the treatment of water? (18)
- (b) Name a salt which causes permanent hardness in water and describe, briefly, how this type of hardness can be removed.  
What causes temporary hardness and how can temporary hardness be removed? (21)
- (c) State briefly what happens in each of the three stages of sewage treatment (i) primary, (ii) secondary, (iii) tertiary. (27)

10. Answer any *two* of the following.

- (a) What is meant by (i) energy levels, (ii) atomic orbitals? Sketch the shape of a p orbital. (15)

Outline how the presence of energy levels in atoms may be used to explain the characteristic colour changes seen when a metal salt e.g. potassium chloride is heated in a Bunsen flame. (18)

- (b) Define pH. What is the normal range of the pH scale? (9)

What is the pH of (i) a 0.01 M solution of sodium hydroxide, (ii) a solution of hydrochloric acid containing 3.65 g in 500 cm<sup>3</sup> of solution? (18)

How can the pH change which occurs when dilute sodium hydroxide solution is added to dilute hydrochloric acid solution be shown in the laboratory? (6)

- (c) Write down in your answer book the missing words or equations 1 to 11 from the following passage.

When connected to a direct current (d.c.) power supply solid lead bromide ( $\text{PbBr}_2$ ) does not conduct electricity. When the solid is melted a current passes because \_\_\_\_\_ (1) \_\_\_\_\_ are produced. This passage of electricity decomposes the molten lead bromide into \_\_\_\_\_ (2) \_\_\_\_\_ and \_\_\_\_\_ (3) \_\_\_\_\_. Lead bromide is called the \_\_\_\_\_ (4) \_\_\_\_\_ and the decomposition using electricity is called \_\_\_\_\_ (5) \_\_\_\_\_. During the passage of electricity, \_\_\_\_\_ (6) \_\_\_\_\_ is produced at the anode and \_\_\_\_\_ (7) \_\_\_\_\_ is produced at the cathode. Oxidation is a \_\_\_\_\_ (8) \_\_\_\_\_ of electrons and occurs at the \_\_\_\_\_ (9) \_\_\_\_\_. The equation \_\_\_\_\_ (10) \_\_\_\_\_ represents the reaction at the anode and the equation \_\_\_\_\_ (11) \_\_\_\_\_ represents the reaction at the cathode.

(11 × 3)

- (d) A compound on analysis is found to contain 40% carbon, 6.7% hydrogen and 53.3% oxygen by mass. What is its empirical formula? (12)

If the molecular formula is the same as the empirical formula name the compound and give its structural formula. (12)

What would you observe if a solution of the compound was reacted with ammoniacal silver (I) nitrate (Tollens' reagent)? (9)