AN ROINN OIDEACHAIS

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LEAVING CERTIFICATE EXAMINATION, 1992

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CHEMISTRY — ORDINARY LEVEL

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MONDAY, 22 JUNE — AFTERNOON, 2.00 to 5.00

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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.

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Relative atomic masses: H = 1, C =12, N = 14, O = 16, Cl = 35.5, Ca = 40, Fe = 56.
Molar volume at S.T.P. = 22.4 dm³.

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1. Answer *eleven* of the following items (a), (b), (c), etc. All items carry the same marks. *Keep your answers short.*

   (a) What is the oxidation number of sulphur in H_2SO_4?

   (b) Define (i) oxidation, (ii) reduction, in terms of electron transfer.

   (c) Name and write the structural formula of an aromatic compound.

   (d) What is the percentage composition (w/v) of a solution containing 4.0 g of sodium hydroxide in 200 cm³ of solution?

   (e) An atom has an electronegativity value of 3.5 and combines with another atom of electronegativity value of 2.5. What type of bond would you expect to be formed? Give a reason for your answer.

   (f) What is *eutrophic* water?

   (g) Identify the conjugate acid-base pairs in the following reaction:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

   (h) What is meant by *relative atomic mass*?

   (i) What is the pH of a 0.01 M solution of sodium hydroxide, at 25 °C?

   (j) What product is formed at (i) the cathode, (ii) the anode, when molten lead bromide is electrolysed using inert electrodes?

   (k) What is the systematic (IUPAC) name for $CH_3CH_2CH{=}CHCH_3$?

   (l) State Avogadro's law.

   (m) How would an increase in temperature affect the equilibrium position of:

$$H_2 + I_2 \rightleftharpoons 2HI \qquad \Delta H = negative$$
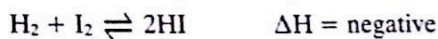
   (n) What chemicals would you use to confirm the presence of chloride ions in water?

   (o) What is *catalytic cracking*?   (11 ×6)

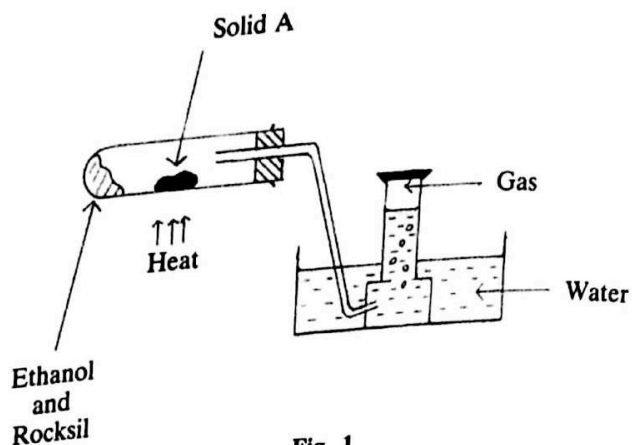2. A hydrocarbon gas was prepared using the apparatus shown below.

Fig. 1

The ethanol was placed in a test tube as shown in **Fig. 1**. Solid A was placed half way along the test tube, and was heated gently. The gas produced was collected. When production was complete the delivery tube was immediately removed. A jar of the gas was burnt. Bromine in 1,1,1-trichloroethane was added to a second jar.
(12)

   (i) Name the solid **A** and the gas produced. (6)

   (ii) Write down the structural formula for the gas. (6)

   (iii) Why was the delivery tube removed immediately gas production was complete? (6)

   (iv) Describe the flame produced when the gas was burnt. What conclusion do you draw? (9)

   (v) What is observed when limewater is poured into the jar after combustion and the jar is well shaken? Explain. (9)

   (vi) What happens when the solution of bromine is added to the second jar? What conclusion do you draw? Write an equation for the reaction occurring. (18)

   (vii) Give one <u>major</u> use for the gas produced in this experiment. (6)

3. A student analysing a water sample found that one cubic decimetre:

   (i) contained 0.2 g suspended solids;

   (ii) contained 1.6 g dissolved solids;

   (iii) required 120 cm³ of 0.05 M hydrochloric acid to neutralise the hydrogencarbonate present.

$$Ca(HCO_3)_2 + 2HCl = CaCl_2 + 2CO_2 + 2H_2O$$
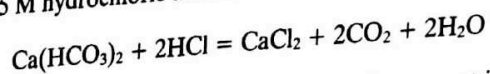
(a) Express the amount of (i) suspended solids, (ii) dissolved solids, present in parts per million. (9)

(b) Calculate the concentration of calcium hydrogencarbonate in (i) moles per dm³, (ii) grams per dm³. (12)

(c) Outline a chemical test for the hydrogencarbonate ion. (12)

(d) What type of hardness does the titration measure? Mention one way of water softening. (9)

(e) Outline the experimental procedures for determination of the mass of suspended solids, and the mass of dissolved solids. (18)

(f) What substance is used to cause flocculation in a water treatment plant? (6)

4. (a) State, briefly, the contributions of Dobereiner, Newlands and Mendeleef to the development of the periodic table. (18)

(b) What is meant by (i) a period, (ii) a group?
What have elements in a group got in common? (15)

(c) Give two characteristic properties, and the names, of two transition elements. (12)

(d) Copy the table below and fill in the blank spaces. (15)

Symbol for Atom/Ion	Cl^-		Ne	Na^+
No. Protons	17	12		
No. Electrons		10		
Electron Configuration				
Oxidation Number				

(e) What is the spectroscopic evidence for the existence of energy levels? (6)

5. The apparatus in **Fig. 2** was used to investigate the rate of catalytic decomposition of hydrogen peroxide by manganese (IV) oxide. The volume of oxygen gas produced was measured using a gas syringe.
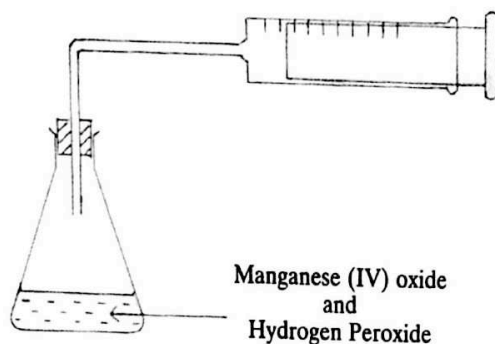

Manganese (IV) oxide
and
Hydrogen Peroxide

Fig. 2

The following results were obtained in the experiment:

Time/Minute	0	2	4	6	8	10	12
Vol./cm^3	0	36	60	64	84	86	86

(a) How would you ensure that the reaction was started at a precisely known time? (9)

(b) Sketch the apparatus for an alternative method of collecting and measuring the volume of gas produced. (12)

(c) Plot a graph of the results above. (12)

(d) Which reading appears unreliable? What value would you expect? (9)

(e) What was the volume of gas collected at 5 minutes? (6)

(f) What time was required for the production of 50 cm^3 of the gas? (6)

(g) Give two changes in conditions which would slow down the speed of the reaction. (12)

6. The formulae of five organic compounds are given below:

C_2H_5OH CH_3CHO CH_3COOH CH_3COCH_3 C_6H_{14}
A   B   C   D   E
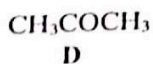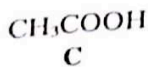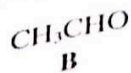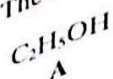
(i) Name the four compounds A, B, C and D.   (12)

(ii) Name the homologous series to which each of the *five* compounds belong.   (15)

(iii) Draw structural formulae to represent two possible isomers of E.   (6)

(iv) Indicate the functional groups present in each of A, B, C and D.   (12)

(v) What reagent(s) may be used to convert A and B? Give an application of this reaction outside the laboratory.   (9)

(vi) Outline how either *one* of the compounds C or D may be prepared in the laboratory.   (12)

7. (a) Explain the difference between *exothermic* and *endothermic* reactions. Give an example of an endothermic reaction.   (15)

(b) What is meant by *heat of combustion*? Describe, with the aid of a diagram, how you would measure the heat of combustion of a substance such as glucose.   (27)

(c) A cylinder contains butane which has a heat of combustion of -2880 kJ mol^{-1}. Calculate the kilogram calorific value for butane.   (18)

(d) Why is the determination of the melting point of a compound useful in quality control?   (6)

8. Where in Ireland is ammonia manufactured?   (12)

(a) What is the source of (i) nitrogen, (ii) hydrogen, used in the process?   (12)

(b) Write a balanced equation for the reaction between nitrogen and hydrogen.   (9)

(c) State *three* ways in which the rate of reaction is speeded up in the manufacture of ammonia.

(d) The fertiliser ammonium nitrate is made from ammonia and nitric acid.
    (i) Write an equation for the reaction.
    (ii) Calculate the number of tonnes of ammonium nitrate that can be produced from 34 tonnes of ammonia.   (18)

(e) Write down in your answer book the missing words or phrases in the following passage:

In the ......(1)...... process for the manufacture of sulphuric acid, the gas sulphur dioxide is obtained by ......(2)...... . The mixture of gases is pased over a heated catalyst called ......(3)...... and the compound ......(4)...... is formed. This compound is absorbed in ......(5)...... . On dilution with water, sulphuric acid is produced.   (15)

9. (a) Give *one* example in each case of (i) a linear molecule, (ii) a trigonal (planar) molecule, (iii) a tetrahedral molecule. (18)

Explain any *one* of the shapes using electron pair repulsion theory.

(b) Give *one* example in each case of an oxide which is (i) acidic, (ii) basic, (iii) amphoteric, (iv) neutral. (12)

(c) The table below gives some properties of four substances **A, B, C, D**.

Substance	Melting Point /°C	Boiling Point /°C	Electrical Conduction		Solubility in Water
			Solid	Molten	
A	1455	2837	Good	Good	Insoluble
B	−56	−28	Poor	Poor	Insoluble
C	685	1324	Poor	Good	Soluble
D	−89	118	Poor	Poor	Insoluble

Name *each* of the substances which fit the following descriptions. (There may be more than one substance fitting each description).

(i) a solid at room temperature,

(ii) a liquid at room temperature,

(iii) a gas at 150 °C,

(iv) a covalent compound,

(v) a metal,

(vi) an ionic compound. (36)

10. Answer any <u>two</u> of the following:

(a) A compound, on analysis, is found to contain 38.4 % carbon, 4.8 % hydrogen and 56.8 % chlorine by mass.

(i) Calculate its empirical formula, using the above information. Show your method clearly. (12)

(ii) If the compound is a polymer, give its name and the structure of its repeat unit. (12)

(iii) Write a note on the properties and industrial and domestic importance of poly(tetrafluoroethene), giving a common name for it. (9)

(b) The process of iron production in the blast furnace may be represented by:

$$2Fe_2O_{3(l)} + 3C_{(s)} \longrightarrow 4Fe_{(l)} + 3CO_{2(g)}.$$

(i) What other substance is normally added to the blast furnace? Explain its purpose. (12)

(ii) Calculate the amount of iron (III) oxide which would be needed to produce 224 tonnes of iron. (12)

(iii) Name *two* substances, emitted form the blast furnace, which are considered to be pollutants. State why. (9)

(c) Describe a laboratory experiment to determine the chemical formula of a compound (e.g. MgO, CuI, CuS). Use the headings (i) apparatus, (ii) procedure, (iii) calculation of result. (33)

(d) (i) Using a diagram, give an account of the carbon cycle.

(ii) How do you think a substantial increase in the amount of atmospheric carbon dioxide would affect the cycle? (33)