SCOTTISH CERTIFICATE OF EDUCATION

CHEMISTRY

Higher Grade—PAPER I

Friday, 11th May—9.30 a.m. to 11.00 a.m.

READ CAREFULLY

1. Check that the answer sheet provided is for Chemistry Higher I.
2. Fill in the details required on the answer sheet.
3. In this paper a question is answered by indicating the choice A, B, C or D (or E in the case of questions 49 and 50) by a stroke made in INK in the appropriate place in the answer sheet—see the sample question below.
4. For each question there is only ONE correct answer.
5. Reference may be made to the booklets of Science Data and Mathematical Tables provided (1982 editions).
6. Rough working, if required, should be done only on this question paper, or on the rough working sheet provided—NOT on the answer sheet.

SAMPLE QUESTION

To show that the ink in a ball-point pen consists of a mixture of dyes, the method of separation would be

    A   fractional distillation

    B   chromatography

    C   fractional crystallisation

    D   filtration.

The correct answer is B—chromatography. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown in the example on the answer sheet.

If after you have recorded your answer you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus if you want to change an answer **D** to an answer **B**, your answer sheet would look like this:
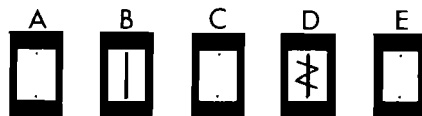

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) to the RIGHT of the box of your choice, thus:
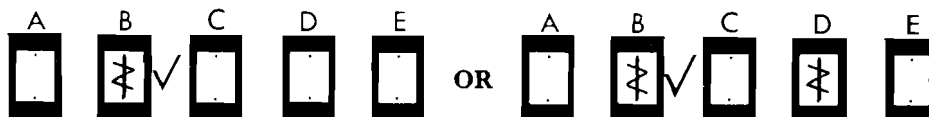
1. Which of the following does **not** contain covalent bonds?

   A   Hydrogen gas

   B   Helium gas

   C   Nitrogen gas

   D   Solid sulphur

2. When a mineral was strongly heated in air, a gas was given off with a relative molecular mass of 44. The metal oxide produced was not reduced on heating in a stream of hydrogen. The mineral could have been

   A   copper carbonate

   B   lead sulphide

   C   zinc sulphide

   D   magnesium carbonate.

3. Which of the following covalent substances does **not** react with water forming ions?

   A   HBr

   B SO_2

   C NH_3

   D   CO

4. Suppose that a new metal (I) oxide has been prepared. 128 g of this oxide is strongly heated and hydrogen gas is passed over it. When the oxide is completely reduced, 112 g of the metal remain. If the relative atomic mass of oxygen is 16, what is the relative atomic mass of the metal?

   A   56

   B   64

   C   112

   D   224

5. 1 mole of hydrogen gas is reacted with 1 mole of iodine vapour. After t seconds, 0·8 mole of hydrogen remains. The number of moles of hydrogen iodide formed at t seconds is

   A   0·2

   B   0·4

   C   0·8

   D   1·6

6. Which of the processes outlined below is most likely to result in the production of calcium?

   A   Electrolysis of an aqueous solution of calcium chloride

   B   The passing of hydrogen over heated calcium oxide

   C   Electrolysis of molten calcium chloride

   D   Addition of magnesium to an aqueous solution of calcium chloride

7. 64 g of copper is added to 1 litre of M silver nitrate solution. Which one of the following statements represents one of the results of this action?

   A   The resulting solution is colourless.

   B   All the copper dissolves.

   C   64 g of silver is displaced.

   D   1 mole of silver is displaced.

8. In which of the following changes has a positive ion been oxidised?

   A   Iron (II) to iron (III)

   B   Nickel (III) to nickel (II)

   C   Nitrate to nitrite

   D   Sulphide to sulphite

9. In which of the situations below would the corrosion of **the iron nail** be most rapid?
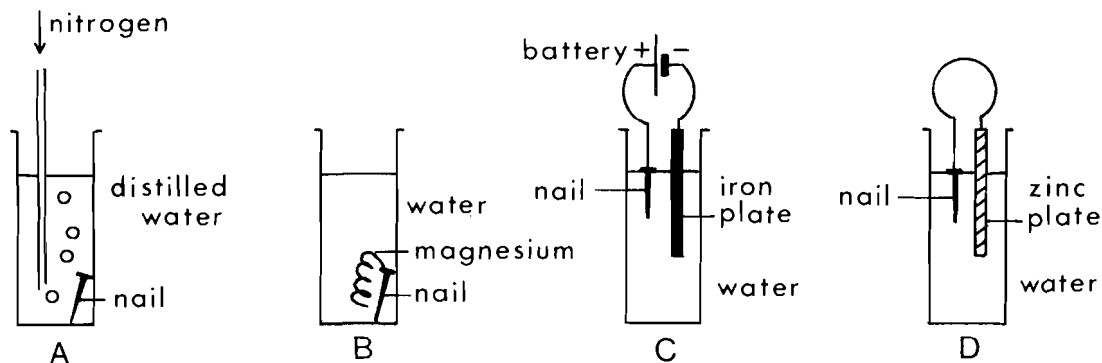
10. An element does **not** conduct electricity. When it is burned in oxygen and the product is added to water, the resulting solution has a pH less than 7. The element could be

A silicon

B sodium

C sulphur

D aluminium.

Questions 11 and 12 refer to equal volumes of molar solutions of the compounds

A sodium iodide

B hydrochloric acid

C sodium hydroxide

D ammonium hydroxide.

11. Which solution is the best conductor of electricity?

12. Which solution contains the fewest ions?

13. What are the major products of the electrolysis of a molar aqueous solution of magnesium bromide?

A Magnesium and bromine

B Hydrogen and bromine

C Magnesium and oxygen

D Hydrogen and oxygen

14. Barium chloride solution would **not** give a precipitate with a solution of a

A carbonate

B sulphate

C sulphite

D nitrate.

15. Dilute sulphuric acid (2 M) is dropped on to a mixture of copper turnings and copper carbonate. Which of the following would be the most likely composition of the gas evolved?

A Carbon dioxide only

B Hydrogen only

C Hydrogen + carbon dioxide

D Carbon dioxide + sulphur dioxide

16. The composition of air by volume is approximately $\frac{1}{5}$ oxygen, $\frac{4}{5}$ nitrogen. When air is passed through red-hot carbon, the following reaction occurs:

$$2C(s) + O_2(g) \rightarrow 2CO(g)$$
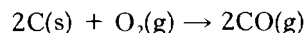
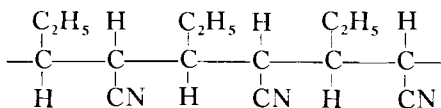If all of the oxygen is converted to carbon monoxide, what is the composition, by volume, of the gas produced?

A $\frac{1}{5}$ carbon monoxide, $\frac{4}{5}$ nitrogen

B $\frac{1}{3}$ carbon monoxide, $\frac{2}{3}$ nitrogen

C $\frac{2}{5}$ carbon monoxide, $\frac{3}{5}$ nitrogen

D $\frac{1}{2}$ carbon monoxide, $\frac{1}{2}$ nitrogen

[Turn over

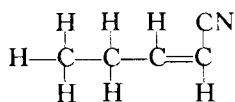**17.** Which of the following statements about CH_4 is **false**?

A   It has a tetrahedral molecule.

B   It has hydrogen bonding between molecules.

C   It is formed naturally by decay of vegetation.

D   It reacts with chlorine in the presence of light.

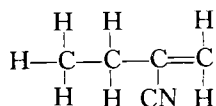**18.**

```
    C₂H₅ H    C₂H₅ H    C₂H₅ H
  |   |   |   |   |   |   |
— C —— C —— C —— C —— C —— C —
  |   |   |   |   |   |
  H   CN  H   CN  H   CN
```

Which of the following compounds could polymerise to give a structure, a portion of which is shown above?

A
```
      H   H   H   CN
      |   |   |   |
  H — C — C — C = C
      |   |       |
      H   H       H
```
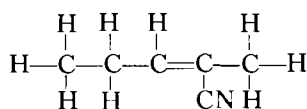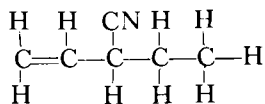
B
```
      H   H       H
      |   |       |
  H — C — C — C = C
      |   |   |   |
      H   H   CN  H
```

C
```
      H   H   H       H
      |   |   |       |
  H — C — C — C = C — C — H
      |   |       |   |
      H   H       CN  H
```

D
```
      H   H   CN  H   H
      |   |   |   |   |
      C = C — C — C — C — H
      |       |   |   |
      H       H   H   H
```

19. $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g);$
$\triangle H$ (for the forward reaction) $= +92 \cdot 4 \text{ kJ mol}^{-1}$

The conditions favouring the decomposition of ammonia are

A   low pressure and low temperature

B   high pressure and low temperature

C   low pressure and high temperature

D   high pressure and high temperature.

20. Sparks were passed for several minutes between electrodes placed in a flask filled with an unknown gas or gases. When sparking was stopped a little water was added and shaken up with the contents of the flask. A small piece of magnesium metal was then added and brisk effervescence took place.

Initially the flask could have contained
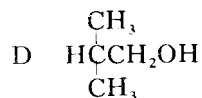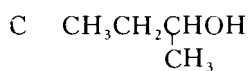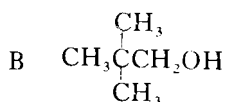
A   hydrogen and oxygen

B   nitrogen and hydrogen

C   ammonia

D   air.

21. A sample of copper powder was contaminated with zinc dust. Pure copper was obtained from it by heating with excess of acid, filtering and washing. Which of the following acids was used?

A   Dilute nitric acid

B   Concentrated nitric acid

C   Dilute hydrochloric acid

D   Concentrated sulphuric acid

22. When a substance is heated with soda-lime, it releases ammonia. When burned it produces carbon dioxide and water vapour. **From this evidence alone,** what is the most precise description you may make of the substance?

A   A nitrogen compound

B   An organic nitrogen compound

C   A compound built up from amino acids

D   A protein

Questions 23, 24 and 25 refer to the compounds of which the formulae are given below.

A $CH_3CH_2CH_2CH_2OH$

B
$$CH_3\overset{\overset{\textstyle CH_3}{|}}{\underset{\underset{\textstyle CH_3}{|}}{C}}CH_2OH$$

C
$$CH_3CH_2\overset{}{\underset{\underset{\textstyle CH_3}{|}}{C}}HOH$$

D
$$H\overset{\overset{\textstyle CH_3}{|}}{\underset{\underset{\textstyle CH_3}{|}}{C}}CH_2OH$$

23. Which of the above is a secondary alcohol?

24. Which of the above is an isomer of pentan-3-ol?

25. Which of the above can be oxidised to butanoic acid?

26. Which one of the following substances would act as a soap?

A   Calcium stearate

B   Stearic acid

C   Potassium stearate

D   Ethyl stearate

27. PVC (polyvinylchloride) is

A   a man-made polymer produced by the condensation polymerisation of a synthetic monomer

B   a natural polymer modified by the addition of various side groups

C   a man-made polymer produced by the condensation polymerisation of a natural monomer

D   a man-made polymer produced by the addition polymerisation of a synthetic monomer.

28. Which of the following would suffer the least deflection in a mass spectrometer?

A $^1_1H^+$

B $^1_1H_2{}^+$

C $^4_2He^{2+}$

D $^7_3Li^+$
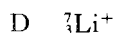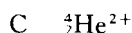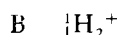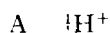
29. Isotopes have identical

A   nuclei

B   electron arrangement

C   numbers of neutrons

D   mass numbers.

30. What is the result of an atom losing a β-particle?

	Atomic number	Mass number
A	increased	no change
B	decreased	no change
C	no change	increased
D	no change	decreased

[Turn over

31. When some lead pellets containing radioactive lead are placed in a solution of lead nitrate, radioactivity soon appears in the solution. Compared to the pellets the solution will show

A   different intensity of radiation and different half-life

B   the same intensity of radiation but different half-life

C   different intensity of radiation but the same half-life

D   the same intensity of radiation and the same half-life.

32. The mass spectrum below was obtained from an 8-day old sample of an α-emitting radioactive isotope.
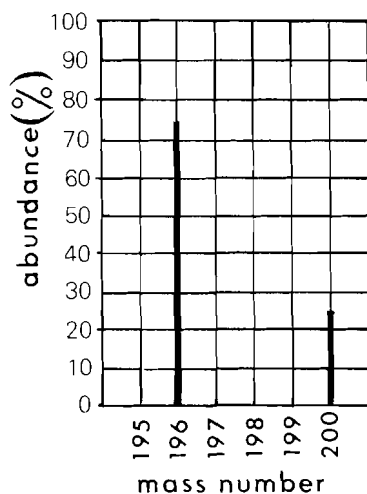
What is the half-life of the isotope?

A   2 days

B   4 days

C   8 days

D   12 days

33. Which of the following is the strongest reducing agent?

A $Zn(s)$

B $H^+(aq)$

C $Cu(s)$

D $Ag(s)$

Questions 34 and 35 refer to the experiment illustrated below.
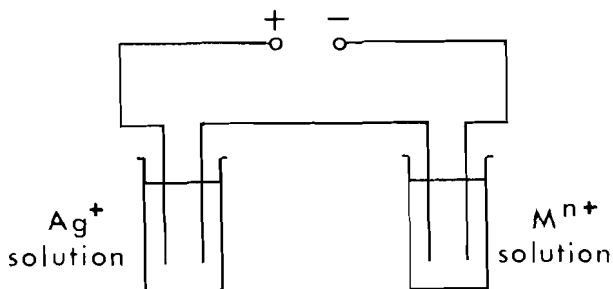
The metals Ag and 'M' are deposited by electrolysis

34. It took 54 hours to deposit 1 mole of Ag. How long would it take to deposit 1 mole of 'M'?

A   54 hours

B   54n hours

C   54/n hours

D   You cannot say without knowing the relative atomic masses of Ag and 'M'.

35. It took 30 minutes to deposit 1 g of Ag. How long would it take to deposit 1 g of 'M'?

A   30 minutes

B   30n minutes

C   30/n minutes

D   You cannot say without knowing the relative atomic masses of Ag and 'M'.

36. How many litres of hydrogen at s.t.p. are needed to reduce 1 mole of iron(III) oxide to the metal?

A   6·0

B   22·4

C   44·8

D   67·2

37. Two identical samples of zinc are added to an excess of 2 M and 1 M sulphuric acid respectively. Which of the following is the same for the two samples?

A   The total mass lost

B   The total time for the reaction

C   The initial reaction rate

D   The average rate of evolution of gas

38. Which of the following properties of the Group I elements would be represented by the graph below?
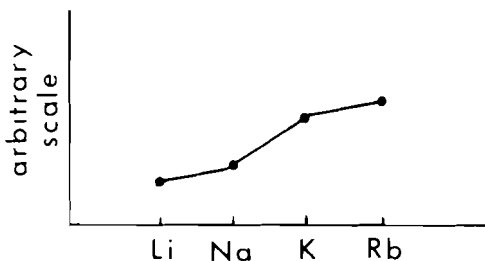
A   The first ionisation energy

B   The melting point

C   The atomic radius

D   The electronegativity

39. Which electron arrangement represents the atom of the most active non-metal?

A   2,6

B   2,8,6

C   2,7

D   2,8,7

Questions 40 and 41 refer to the following substances:

A   Potassium fluoride

B   Solid argon

C   Sodium

D   Solid tetrachloromethane

40. Which is a solid of low melting point with high electrical conductivity?

41. Which is a non-conducting solid which becomes a good conductor on melting?

42. The reaction whose enthalpy change ($\triangle H$) is the first ionisation energy of fluorine is

A $F(g) \rightarrow F^+(g) + e$

B $\frac{1}{2}F_2(g) \rightarrow F^+(g) + e$

C $F^-(g) \rightarrow F(g) + e$

D $F^-(g) \rightarrow \frac{1}{2}F_2(g) + e$

Questions 43 and 44 refer to the following diagram in which the heavy line represents the reaction $2SO_2 + O_2 \rightarrow 2SO_3$

reaction pathway
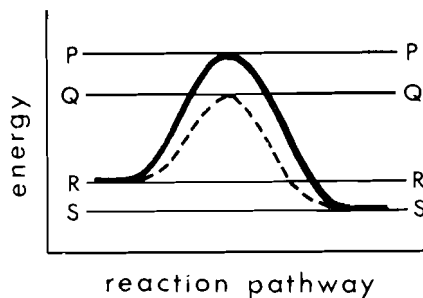
43. Which of the following represents the enthalpy of reaction?

A   RP

B   PS

C   RS

D   QS

44. What does QP represent?

A   Energy of activation for reaction without a catalyst

B   Enthalpy of reaction for reaction without a catalyst

C   Bond dissociation energy

D   None of these

45. The following equilibrium is set up when equal volumes of 0.1 M solutions of silver nitrate and iron(II) sulphate are mixed.

$$Ag^+(aq) + Fe^{2+}(aq) \rightleftharpoons Ag(s) + Fe^{3+}(aq)$$

Some of the deposited silver could be dissolved by adding a solution of

A   iron(III) sulphate

B   sulphuric acid

C   silver nitrate

D   iron(II) sulphate.

46. Which of the following is the structural formula of an alkanoic acid?

A $CH_3CH_2-C{\overset{H}{\underset{O}{\Large\diagdown}}}$

B $CH_3-O{\overset{O-CH_3}{\underset{O}{\Large\diagdown}}}$

C $CH_3-C{\overset{CH_3}{\underset{O}{\Large\diagdown}}}$

D $CH_3-C{\overset{OH}{\underset{O}{\Large\diagdown}}}$

47. Which of the following has empirical formula CH_2 and will readily decolourise bromine water?

A   Propyne

B   Butene

C   Cyclopentane

D   Cyclohexane

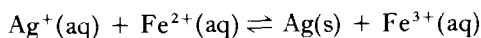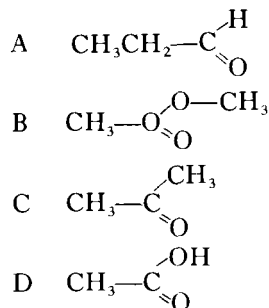**48.** Which of the following compounds is the most basic?

A CH_3COONH_4

B $C_2H_5NH_2$

C $C_2H_5NH_3Cl$

D NH_2CH_2COOH

In Questions 49 and 50 more than one response may be correct.

Answer A   if responses 1, 2 and 3 are correct

        B   if responses 1 and 3 are correct

        C   if responses 2 and 4 are correct

        D   if response 4 only is correct

        E   if some other response or combination of responses is correct.

49. For a given element, which of the following can be worked out from information obtained using the mass spectrometer?

1   The number of isotopes present

2   The most common isotope

3   The mass numbers of the isotopes

4   The relative atomic mass

50. The equation for the production of sulphur trioxide is

$$O_2(g) + 2SO_2(g) \rightleftharpoons 2SO_3(g);$$
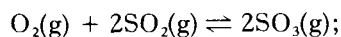
$\triangle H$ for the forward reaction is negative.

When the system is in equilibrium this means that

1   sulphur trioxide is continuously decomposing

2   the mass of sulphur dioxide remains constant

3   if the pressure is increased, more SO_3 will be formed

4   if the temperature is changed, there will be **no** change in the relative amounts of the three chemicals present.

[END OF QUESTION PAPER]

SCOTTISH CERTIFICATE OF EDUCATION

CHEMISTRY

Higher Grade—PAPER II

Friday, 11th May—1.30 p.m. to 4.00 p.m.

Marks may be deducted for bad spelling and bad punctuation, and for writing that is difficult to read.

Working should be shown in all answers involving calculations.

Necessary tables and data will be found in the booklets of Mathematical Tables and Science Data (1982 editions).

PART A

All questions should be attempted. It should be noted, however, that some questions contain a choice.

It is suggested that about one hour be spent on this part of the paper.

Marks

1. What is the name and structure of the alkanoic acid which is an isomer of ethyl methanoate? **(2)**

2. ANSWER **EITHER** A **OR** B
   A. Refer to page 8 of the Data Booklet and calculate the number of atoms of xenon present in 1 litre of dry air at s.t.p. **(4)**

   OR
   B. Calculate the number of electrons contained in $2 \cdot 8$ g of nitrogen gas. **(4)**

3. By consulting page 3 of the Data Booklet, write nuclear equations for the stages in the radioactive decay of ^{238}U to ^{234}Pa. **2**

   Explain why relatively large amounts of ^{238}U can be found in nature while only traces of ^{234}Pa occur. **1**

   (3)

4. What is the nature of the bonding and structure of silicon dioxide? **(2)**

5. The following is part of a protein chain (the bond angles are not correctly shown):

$$\begin{array}{ccccccccc} & CH_3 & & & & & CH_3 & & \\ & | & & & & & | & & \\ -N-CH-C-N-CH_2-C-N-CH-C-N-CH_2-C- \\ | & & \| & | & & \| & | & & \| & | & & \| \\ H & & O & H & & O & H & & O & H & & O \end{array}$$

Draw the structure of two amino acids obtained on hydrolysis of this protein. **(2)**

6. Write equations, with appropriate enthalpy values, for the standard enthalpies of combustion of methane, ethyne and hydrogen. (Refer to Data Booklet pages 2 and 10.)

   Hence calculate the enthalpy change for the reaction:
   $$2 \, CH_4(g) \rightarrow C_2H_2(g) + 3H_2(g)$$
   (6)

7. Draw a labelled diagram of apparatus in which ammonia gas is produced from concentrated ammonia solution, passed over heated copper(II) oxide and the nitrogen gas collected. **(3)**

8.

1 CsF	2 $C Cl_4$	3 $C_6H_5CH_3$	4 S
5 $C_2H_5NH_2$	6 H_2O	7 Cu	8 H_2
9 PBr_5	10 $CH_3-CH=CH_2$	11 KCl	12 $C_6H_{12}O_6$

The formulae for certain substances are shown in the grid above.

Answer the questions which follow by giving the grid number.

Choose one substance, in each case, which

(*a*) is a mono-substituted benzene derivative;

(*b*) reacts with water to produce an acid solution;

(*c*) is capable of condensation polymerisation;

(*d*) has a type of bonding not exhibited by any other substance in the grid.   **(4)**

9. On mixing a solution of silver nitrate with dilute hydrochloric acid a white precipitate is immediately formed.

(*a*) Write an ionic equation for the reaction.   **1**

(*b*) Why is this a fast reaction?   **1**

(*c*) The precipitate darkens rapidly. Why?   **1**

          (3)

10. Draw a labelled diagram of two half cells, one of which is a standard hydrogen electrode, correctly connected to produce an e.m.f. of 0·34 volts. (See Data Booklet page 6.)

Give the ion-electron equations for the reactions occurring in the two half cells and indicate the direction of electron flow in the external circuit.   **(5)**
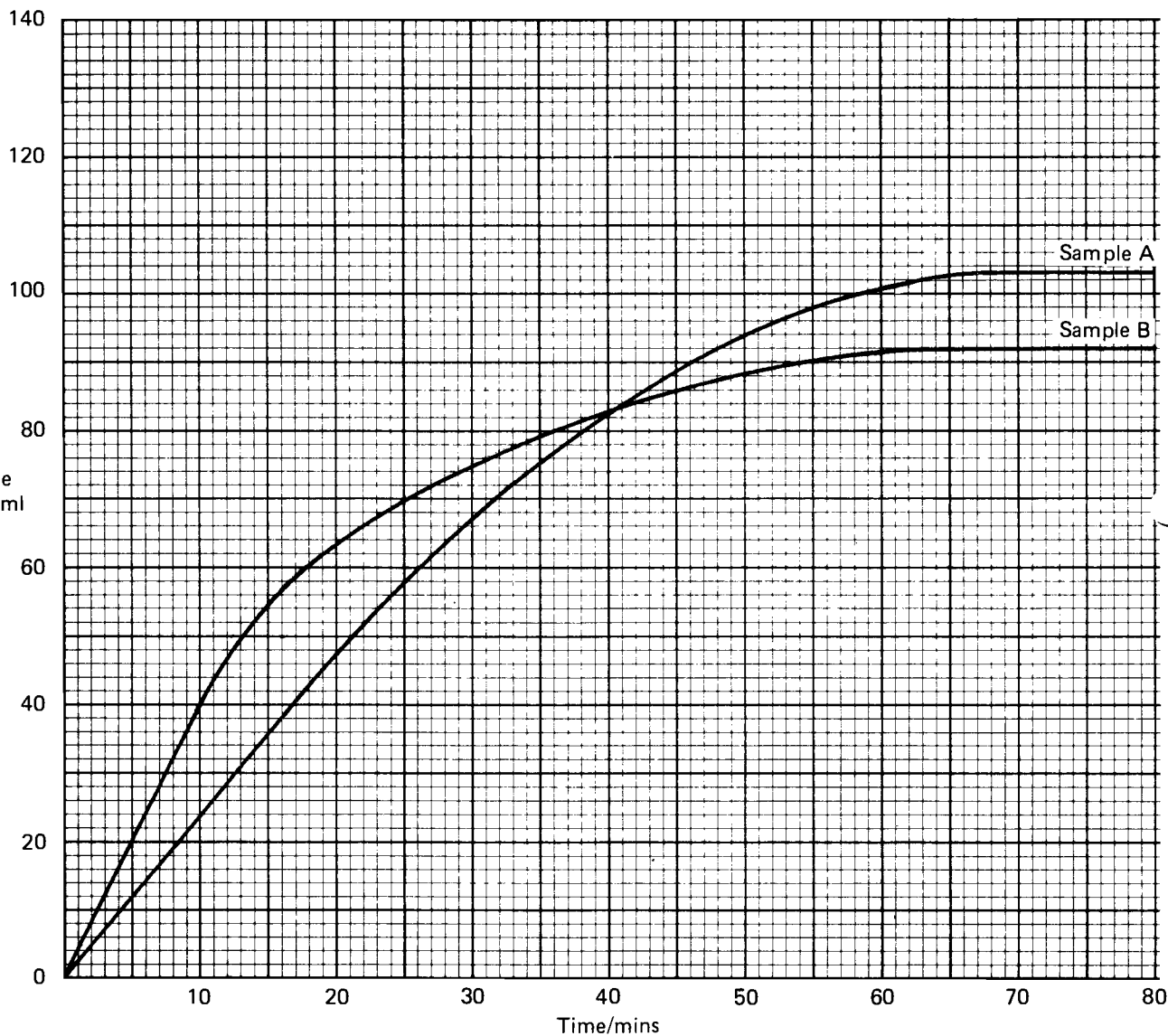
11. Explain the following observations:

Aqueous sodium iodide gives no colour with starch solution. After reaction with chlorine, aqueous sodium iodide gives a blue-black colour with starch solution.

No colour is obtained, however, if the starch solution has been previously heated with hydrochloric acid.   **(3)**

[Turn over

12.

The graph shows the evolution of gas, with time, when two 0·5 g samples of calcium carbonate, each containing insoluble impurities, are reacted with excess dilute hydrochloric acid at s.t.p.

(a) According to the graph, after what time does evolution of gas cease with sample B?   **1**

(b) Which of the two samples has (i) the higher purity?   **1**

(ii) the smaller particle size?   **1**

(c) Write the equation for the reaction and calculate which of the samples has a purity of 92%.   **3**

(6)

13.

A
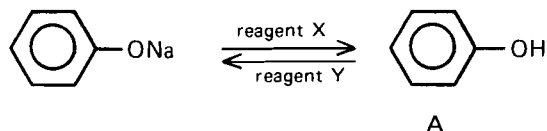
(a) What are reagents X and Y? — 2

(b) Why is compound A soluble in water? — 1

(3)

14. Answer **EITHER** A **or** B

A. The following table shows approximate ionisation enthalpies (energies), in $kJ\,mol^{-1}$, of five elements A, B, C, D, E.

Element	1st I.E.	2nd I.E.	3rd I.E.	4th I.E.
A	520	7300	11500	—
B	2100	3900	6100	9400
C	580	1800	2800	11500
D	740	1450	7700	10500
E	420	3050	4500	5900

Which of these elements

(a) will be in Group II of the periodic table? — 1

(b) will be in the same group of the periodic table? — 1

(c) will be the least reactive? — 1

(d) would require the least energy to convert one mole of gaseous atoms into ions carrying three positive charges? — 1

(4)

OR

B.

Reaction		Enthalpy change/$kJ\,mol^{-1}$
1	$F(g) \longrightarrow F^-(g)$	-333
2	$O(g) \longrightarrow O^-(g)$	-141
3	$O^-(g) \longrightarrow O^{2-}(g)$	X

(a) Give two reasons why reaction 1 is more exothermic than reaction 2. — 2

(b) Would you expect reaction 3 to be endothermic or exothermic? Explain. — 2
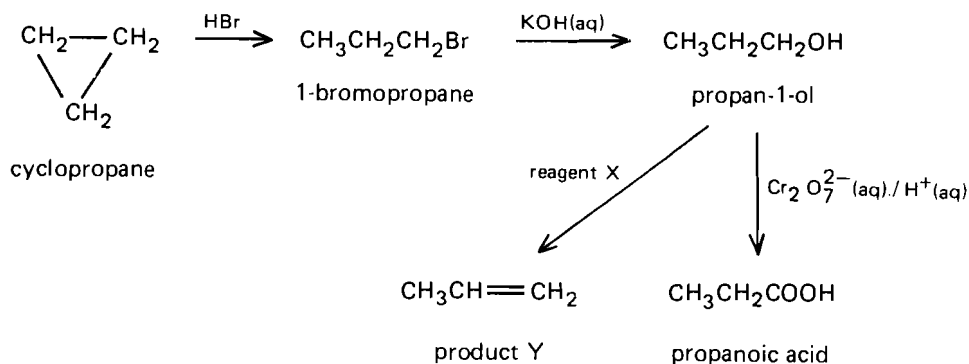
(4)

[Turn over

PART B

All three questions should be attempted. Each question contains a choice.

Candidates are advised to spend about 1½ hours on this part.

Marks

15. Answer **EITHER** A **OR** B.

A. Study the reaction scheme below and answer the questions following.

(a) What is the bond angle between the carbon atoms in the cyclopropane ring system? **1**

(b) Given that the enthalpy change for conversion of cyclopropane to 1-bromopropane is -3 kJ mol^{-1}, calculate the mean bond enthalpy of the C–C bond in cyclopropane using the mean bond enthalpies on page 7 of the Data Booklet. **3**

(c) Suggest why the ring system opens easily to give a straight chain compound. **1**

(d) Which types of chemical reactions are shown in the formation of
   (i) 1-bromopropane?
   (ii) propan-1-ol? **2**

(e) Name reagent X and product Y. **2**

(f) (i) One of the by-products of the oxidation of propan-1-ol to propanoic acid is an ester. Name the ester and give its structure. **2**
   (ii) Ester formation is less when the propan-1-ol is slowly dripped into excess of the oxidising agent. Explain. **1**
   (iii) Assuming 60% conversion, what mass of propan-1-ol would give 1·48 g of propanoic acid? **3**

(g) Cyclopropane also reacts with bromine. Write an equation for the reaction and name the product. **2**

(17)

OR

B.   *Identification of an organic compound.*

(a) A simplified mass spectrum for a pure organic liquid X is shown below.

Relative abundance

mass/charge
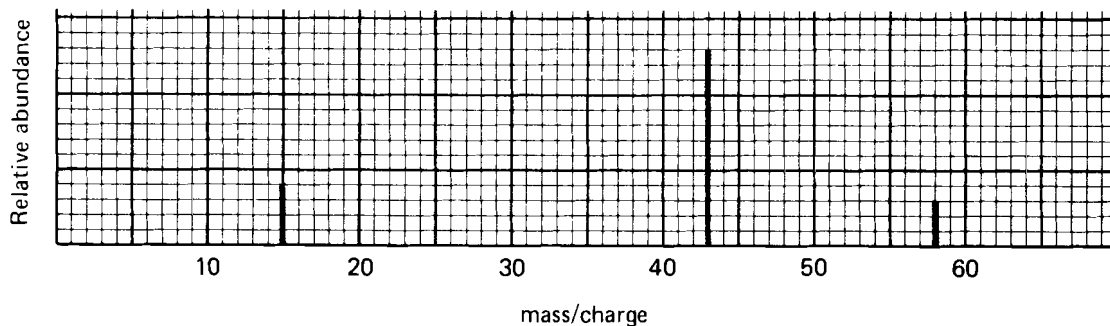
(i) Suggest why there is more than one peak in the spectrum.   1

(ii) From the spectrum what is the relative molecular mass of X?   1

(b) 0·193 g of X, containing only carbon, hydrogen and oxygen, was subjected to combustion analysis producing 0·440 g of carbon dioxide and 0·180 g of water.

(i) Calculate the masses of carbon and hydrogen in the carbon dioxide and water respectively.   2

(ii) Calculate the empirical formula of X.   3

(iii) What is the molecular formula of X?   1

(iv) Suggest two possible structures for X.   2

(c) Liquid X was then subjected to the following tests.

Test	Reagent	Observation
A	sodium metal	no reaction
B	bromine water	no reaction
C	2,4-dinitrophenylhydrazine (test for carbonyl group)	orange precipitate (positive result)
D	ammoniacal silver nitrate (Tollens' reagent)	no reaction

(i) What can be said about the structure of X from:

(1) test A alone,

(2) test B alone,

(3) test D alone,

(4) tests C and D taken together?   4

(ii) What precaution should be taken in the use of the reagent in test A?   1

(d) The orange precipitate obtained from test C was filtered, recrystallised from ethanol and its melting point taken. Why should the derivative be recrystallised?   1

(e) State one additional piece of experimental information which could be used to help identify liquid X.   1

(17)

16. Answer **EITHER** A **OR** B.

   A.   The following flow diagram outlines the manufacture of sodium carbonate by the Solvay Process.
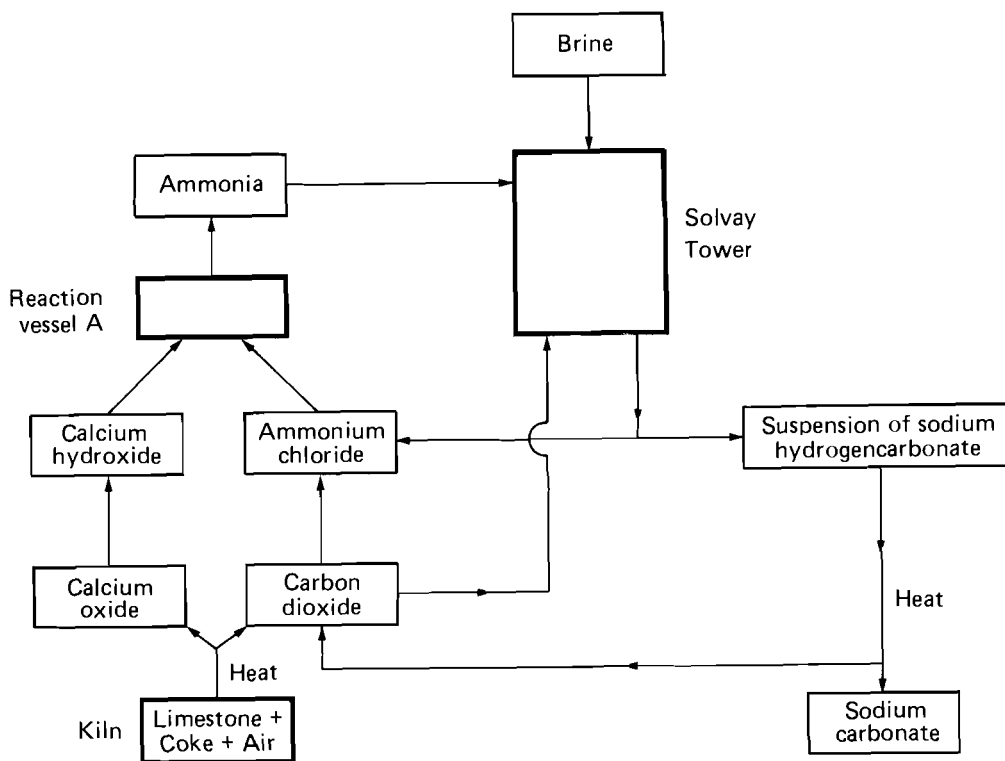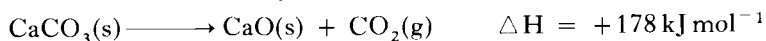

  (a) The main reaction takes place in the Solvay Tower. By inspection of the flow diagram:

      (i) which reagents enter the Solvay Tower?

      (ii) what are the products of the reaction in the Solvay Tower?   2

  (b) The reactions occurring in the kiln are:

$$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g) \qquad \triangle H = +178\,kJ\,mol^{-1}$$

$$C(s) + O_2(g) \longrightarrow CO_2(g) \qquad \triangle H = -393\,kJ\,mol^{-1}$$

     Give two reasons why this method of carbon dioxide production is preferred to the simple decomposition of limestone.   2

  (c) Write a balanced equation for the production of ammonia in the reaction vessel A.   2

  (d) The brine (sea water) used in the Solvay process is first purified by the addition of sodium carbonate.

      (i) What contaminant ion can be removed in this way?   1

      (ii) Write an ion equation for the reaction involved.   1

  (e) What is the essential feature of the Solvay process which makes it economical? Illustrate your answer from the flow diagram.   2

(f) Write a balanced equation for the conversion of sodium hydrogencarbonate to sodium carbonate.   **1**

(g) Explain why an aqueous solution of sodium carbonate is alkaline.   **3**

(h) Washing soda crystals have the formula $Na_2CO_3xH_2O$, where x is an integer. If $28 \cdot 6$ g of washing soda crystals were exactly neutralised by 100 cm^3 of 2M hydrochloric acid, calculate the value of x.   **3**
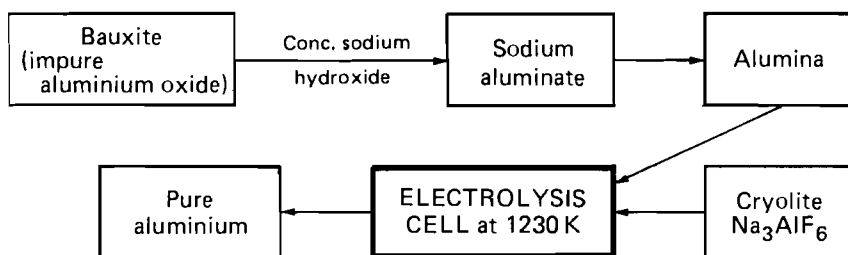
(17)

OR

B. The extraction and refining of aluminium can be described using a flow diagram.

(a) Give the formula for (i) alumina, 1

(ii) sodium aluminate. 1

(b) Despite being the third most abundant element in the earth's crust, aluminium was not produced on a large scale until the nineteenth century. Suggest a reason for this. 1

(c) What are the positive electrodes in the electrolysis cell made of and why do they have to be replaced at regular intervals? 2

(d) Write an ion-electron equation for the reaction occurring at the negative electrode in the electrolysis cell. 1

(e) What mass of aluminium could theoretically be produced if a current of 289500 A flows through the electrolysis cell for two minutes? 3

(f) Why is it possible to carry out the electrolysis at 1230 K if alumina normally melts at about 2300 K? 1

(g) Aluminium has a standard reduction electrode potential of $-1 \cdot 70$ V.

(i) What does this suggest about the "reactivity" of aluminium? 1

(ii) In the light of your answer give a reason why aluminium is used to make window frames. 1

Consider the following data concerning the compounds aluminium chloride and magnesium chloride.

	aluminium chloride	*magnesium chloride*
Action of heat	sublimes at 453 K	melts at 1690 K
Relative molecular mass (vapour phase)	267	95
Action with water	reacts (hydrolysed)	dissolves

Using the above data:

(h) Deduce the type of bonding in (i) aluminium chloride,

(ii) magnesium chloride. 2

(i) Give the formula for aluminium chloride in the vapour phase. 1

(j) Write a balanced equation for the reaction between aluminium chloride and water. 2

(17)

17. Answer **EITHER A OR** B.

Candidates are asked to pay particular attention in this question to the organisation and presentation of answers. Examiners will be marking the essay not simply to assess its scientific content, but also to give credit for relevant equations, organisation and presentation of material. In the last connection, the essential point is a due regard for normal English usage.

A.   Write an essay on "Sulphuric Acid".

Your answer should include reference to the following:

(a) Preparation.

(b) Chemical reactions of (i) dilute sulphuric acid,

(ii) concentrated sulphuric acid.

(c) Uses.   **(16)**

OR

B.   Write an essay on "Ethanol".

Your answer should include reference to the following:

(a) Laboratory and industrial preparation.

(b) Structure and physical properties.

(c) Chemical reactions.   **(16)**

[END OF QUESTION PAPER]