FOR OFFICIAL USE

Total Section B

X012/301

NATIONAL QUALIFICATIONS 2001

THURSDAY, 24 MAY 9.00 AM – 11.30 AM

CHEMISTRY HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

Reference may be made to the Chemistry Higher and Advanced Higher Data Booklet (1999 edition).

SECTION A—Part 1 Questions 1–30 and Part 2 Questions 31–35

Instructions for completion of **Part 1** and **Part 2** are given on pages two and seven respectively.

SECTION B

1 All questions should be attempted.

2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.

3 Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written.

4 Additional space for answers and rough work will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this book.

5 The size of the space provided for an answer should not be taken as an indication of how much to write. It is not necessary to use all the space.

6 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SCOTTISH QUALIFICATIONS AUTHORITY

SECTION A

PART 1

Check that the answer sheet provided is for Chemistry Higher (Section A).

Fill in the details required on the answer sheet.

In questions 1 to 30 of this part of the paper, an answer is given by indicating the choice A, B, C or D by a stroke made in INK in the appropriate place in Part 1 of the answer sheet—see the sample question below.

For each question there is only ONE correct answer.

Rough working, if required, should be done only on this question paper, or on the rough working sheet provided—**not** on the answer sheet.

At the end of the examination the answer sheet for Section A **must** be placed **inside** this answer book.

This part of the paper is worth 30 marks.

SAMPLE QUESTION

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

A fractional distillation

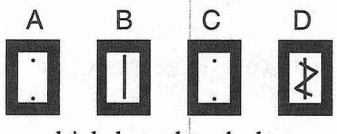
B chromatography

C fractional crystallisation

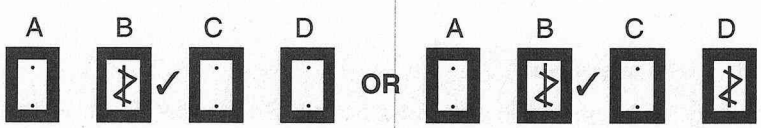
D filtration.

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. A negatively charged particle with electronic configuration 2, 8 could be

   A a fluoride ion

   B a sodium atom

   C an aluminium ion

   D a neon atom.

2. Which gas would dissolve in water to form an alkali?

   A HBr

   B NH_3

   C CO_2

   D CH_4

3. $20\,cm^3$ of $0{\cdot}3\ mol\,l^{-1}$ sodium hydroxide solution can be exactly neutralised by

   A $20\,cm^3$ of $0{\cdot}3\ mol\,l^{-1}$ sulphuric acid

   B $20\,cm^3$ of $0{\cdot}6\ mol\,l^{-1}$ sulphuric acid

   C $10\,cm^3$ of $0{\cdot}6\ mol\,l^{-1}$ sulphuric acid

   D $10\,cm^3$ of $0{\cdot}3\ mol\,l^{-1}$ sulphuric acid.

4. A mixture of sodium bromide and sodium sulphate is known to contain 5 mol of sodium and 2 mol of bromide ions.

   How many moles of sulphate ions are present?

   A 1·5

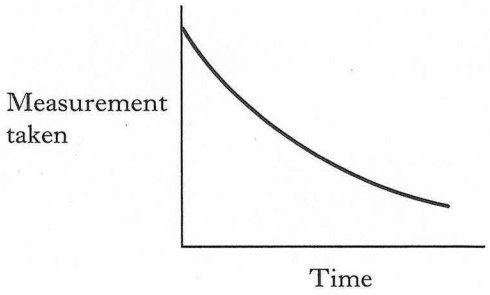
   B 2·0

   C 2·5

   D 3·0

5. Excess marble chips (calcium carbonate) were added to $25\,cm^3$ of hydrochloric acid, concentration $2\ mol\,l^{-1}$.

   Which measurement, taken at regular intervals and plotted against time, would give the graph shown below?



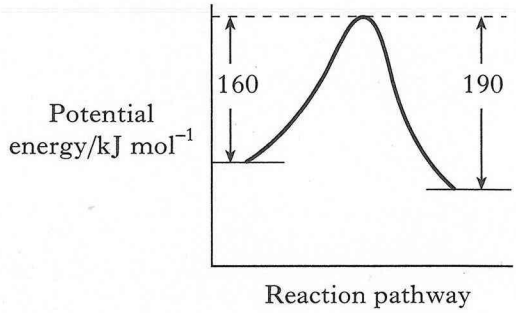
   A Temperature

   B Volume of gas produced

   C pH of solution

   D Mass of the beaker and contents

6. The following potential energy diagram is for an uncatalysed reaction.



   When a catalyst is used the activation energy of the forward reaction is reduced to $35\,kJ\ mol^{-1}$.

   What is the activation energy of the catalysed reverse reaction, in $kJ\ mol^{-1}$?

   A 35

   B 65

   C 125

   D 155

7. The enthalpy of neutralisation in an acid/alkali reaction is **always** the energy released in

   A the neutralisation of one mole of acid

   B the neutralisation of one mole of alkali

   C the formation of one mole of water

   D the formation of one mole of salt.

[Turn over

8. Which entry in the table shows the trends in the electronegativity values of the elements in the Periodic Table?

	Across a period	Down a group
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

9. Which type of structure is found in a fullerene?

A Ionic lattice

B Metallic lattice

C Covalent network

D Covalent molecular

10. Which type of bonding can be described as intermolecular?

A Covalent bonding

B Hydrogen bonding

C Ionic bonding

D Metallic bonding

11. An element melts at about room temperature and forms an oxide which reacts with water to form a solution with a pH less than 7.

Which statement is most likely to be true?

A The element conducts electricity.

B The oxide contains covalent bonds.

C The oxide has a high melting point.

D The element has a covalent network structure.

12. Which gas occupies the largest volume?

(Assume all measurements are made at the same temperature and pressure.)

A 0·32 g of oxygen

B 0·44 g of carbon dioxide

C 0·20 g of hydrogen

D 0·80 g of argon

13. In which reaction is the volume of products less than the volume of reactants?

A $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

B $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

C $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

D $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

14. The Avogadro Constant is the same as the number of

A molecules in 16 g of oxygen

B electrons in 1 g of hydrogen

C atoms in 24 g of carbon

D ions in 1 litre of sodium chloride solution, concentration 1 mol l^{-1}.

15. Biogas is produced under anaerobic conditions by the fermentation of biological materials.

What is the main constituent of biogas?

A Butane

B Ethane

C Methane

D Propane

16. Which equation represents a reaction which takes place during reforming?

A $C_6H_{14} \rightarrow C_6H_6 + 4H_2$

B $C_4H_8 + H_2 \rightarrow C_4H_{10}$

C $C_2H_5OH \rightarrow C_2H_4 + H_2O$

D $C_8H_{18} \rightarrow C_4H_{10} + C_4H_8$

17. Which compound has isomeric forms?

A Methanol

B Propane

C C_2HCl_3

D $C_2H_4Cl_2$

18. What is the product when one mole of ethyne reacts with one mole of chlorine?

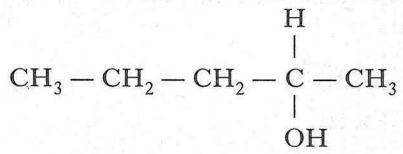
A 1,1-dichloroethene

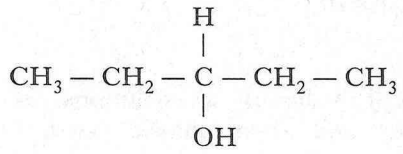
B 1,1-dichloroethane

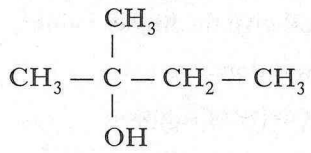
C 1,2-dichloroethene

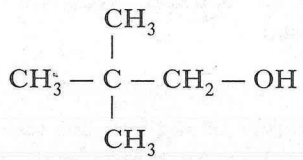
D 1,2-dichloroethane

19. Which structural formula represents a primary alcohol?

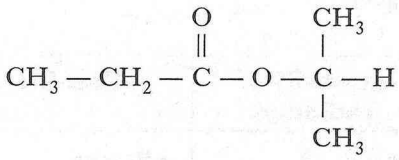
A 

B 

C 

D 

20. An ester has the structural formula:



On hydrolysis, the ester would produce

A ethanoic acid and propan-1-ol

B ethanoic acid and propan-2-ol

C propanoic acid and propan-1-ol

D propanoic acid and propan-2-ol.

21. The dehydration of butan-2-ol can produce two isomeric alkenes, but-1-ene and but-2-ene.

Which alkanol can similarly produce, on dehydration, a pair of isomeric alkenes?

A Propan-2-ol

B Pentan-3-ol

C Hexan-3-ol

D Heptan-4-ol

22. Ozone has an important role in the upper atmosphere because it

A reflects ultraviolet radiation

B reflects certain CFCs

C absorbs ultraviolet radiation

D absorbs certain CFCs.

23. Which statement can be applied to polymeric esters?

A They are used for flavourings, perfumes and solvents.

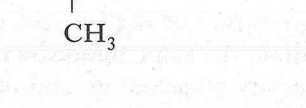
B They are condensation polymers made by the linking up of amino acids.

C They are manufactured for use as textile fabrics and resins.

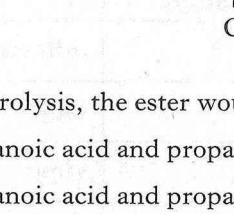
D They are cross-linked addition polymers.

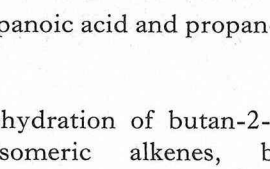
24. In α-amino acids the amino group is on the carbon atom adjacent to the acid group.

Which of the following is an α-amino acid?

A 

B 

C 

D. 

[Turn over

25. Which compound is **not** a raw material in the chemical industry?

A Benzene

B Water

C Iron oxide

D Sodium chloride

26. Which of the following is produced by a batch process?

A Sulphuric acid from sulphur and oxygen

B Aspirin from salicylic acid

C Iron from iron ore

D Ammonia from nitrogen and hydrogen

27. $Cl_2(g) + H_2O(\ell) \rightleftharpoons Cl^-(aq) + ClO^-(aq) + 2H^+(aq)$

The addition of which substance would move the above equilibrium to the right?

A Hydrogen

B Hydrogen chloride

C Sodium chloride

D Sodium hydroxide

28. The concentration of $H^+(aq)$ ions in a solution is 1×10^{-4} mol l^{-1}.

What is the concentration of $OH^-(aq)$ ions, in mol l^{-1}?

A 1×10^{-4}

B 1×10^{-7}

C 1×10^{-10}

D 1×10^{-14}

29. Equal volumes of solutions of ethanoic acid and hydrochloric acid, of equal concentrations, are compared.

In which of the following cases does the ethanoic acid give the higher value?

A pH of solution

B Conductivity of solution

C Rate of reaction with magnesium

D Volume of sodium hydroxide solution neutralised

30. Two 1 g samples of radium and radium oxide both contain the same radioisotope of radium. The intensity of radiation and half-life of the radioisotope in each sample are compared.

Which entry in the table is a correct comparison?

	Intensity of radiation	**Half-life**
A	same	different
B	same	same
C	different	same
D	different	different

SECTION A

PART 2

In questions 31 to 35 of this part of the paper, an answer is given by circling the appropriate letter (or letters) in the answer grids provided on Part 2 of the answer sheet.

In some questions, two letters are required for full marks.

If more than the correct number of answers is given, marks may be deducted.

In some cases the number of correct responses is NOT identified in the question.

This part of the paper is worth 10 marks.

SAMPLE QUESTION

A CH_4	B H_2	C CO_2
D CO	E C_2H_6	F N_2

(*a*) Identify the diatomic **compound(s)**.

A	B	C
(D)	E	F

The one correct answer to part (*a*) is D. This should be circled.

(*b*) Identify the **two** substances which burn to produce **both** carbon dioxide **and** water.

(A)	B	C
D	(E)	F

As indicated in this question, there are **two** correct answers to part (*b*). These are A and E.
Both answers are circled.

(*c*) Identify the substance(s) which can **not** be used as a fuel.

A	B	(C)
D	E	(F)

There are **two** correct answers to part (*c*). These are C and F.
Both answers are circled.

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 circle the answer you now consider to be correct. Thus, in part (*a*), if you want to change an answer **D** to an answer **A**, your answer sheet would look like this:

(A)	B	C
~~(D)~~	E	F

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) in the box of the answer of your choice, thus:

~~(A)~~	B	C
✓ ~~(D)~~	E	F

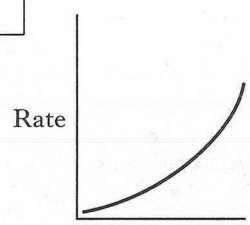
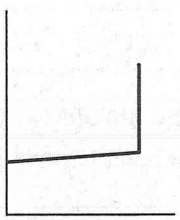
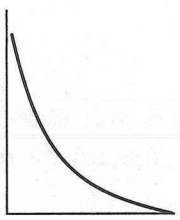
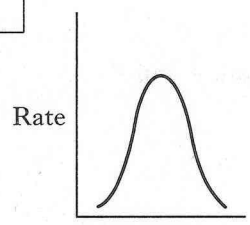
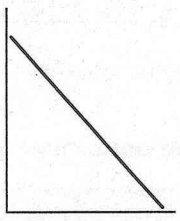
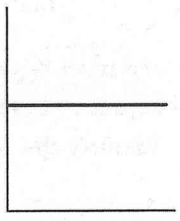
31. The properties of substances depend on their structures and bonding.

A hydrogen	B phosphorus	C sodium
D lithium hydroxide	E hydrogen fluoride	F hydrogen iodide

(*a*) Identify the substance with hydrogen bonding between the molecules.

(*b*) Identify the **two** substances with pure covalent bonding in the molecules.

32. The grid shows the possible effect of temperature change on reaction rate.

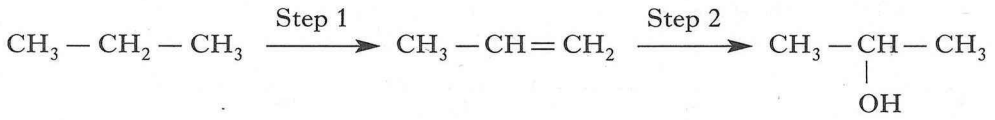
A 	B 	C 
D 	E 	F 

Identify the graph which shows how the rate of reaction varies with temperature in

(*a*) the decomposition of hydrogen peroxide solution using catalase, an enzyme found in potatoes,

(*b*) the radioactive decay of phosphorus-32.

33. Propan-2-ol can be prepared from propane as follows.



A condensation	B cracking	C dehydration
D hydration	E hydrolysis	F oxidation

(*a*) Identify the name of the type of reaction taking place at Step 1.

(*b*) Identify the name of the type of reaction taking place at Step 2.

34. Identify the statement(s) which can be applied to the role of a catalyst in a reversible reaction.

A	It decreases the enthalpy change for the reaction.
B	It decreases the time required for equilibrium to be established.
C	It alters the equilibrium position.
D	It lowers the activation energy of the backward reaction.
E	It increases the rate of the forward reaction more than the backward reaction.

[Turn over

35. Sodium sulphite is a salt of sulphurous acid, a weak acid.
Identify the statement(s) which can be applied to sodium sulphite.
You may wish to refer to the data booklet.

A	It can be prepared by a precipitation reaction.
B	It can be prepared by the reaction of sulphurous acid with sodium carbonate.
C	In solution, the pH is lower than a solution of sodium sulphate.
D	In redox reactions in solution, the sulphite ion acts as a reducing agent.
E	In redox reactions in solution, the sodium ions are oxidised.

Candidates are reminded that the answer sheet MUST be returned INSIDE this answer book.

DO NOT WRITE IN THIS MARGIN

Marks

SECTION B

1. Technetium-99, which has a long half-life, is produced as a radioactive waste product in nuclear reactors. One way of reducing the danger of this isotope is to change it into technetium-100 by bombardment with particles, as shown by the nuclear equation.

$$^{99}_{43}\text{Tc} + \mathbf{X} \rightarrow {}^{100}_{43}\text{Tc}$$

(*a*) Identify particle **X**.

1

(*b*) Technetium-100 decays by beta-emission.
Write a balanced nuclear equation for this reaction.

1

(*c*) Technetium-100 has a half-life of 16 s.
If a sample of technetium-100 is left for 48 s, what fraction of the sample would remain?

1

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. Steam reforming of coal produces a mixture of carbon monoxide and hydrogen.

(*a*) What name is given to this mixture of carbon monoxide and hydrogen?

1

(*b*) This mixture could be used to produce methane, as shown by the following equilibrium.

$$CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g) \qquad \Delta H = -206\,kJ\,mol^{-1}$$

Give **two** reasons why the yield of methane can be increased by cooling the reaction mixture from 400 °C to 80 °C.

2

(3)

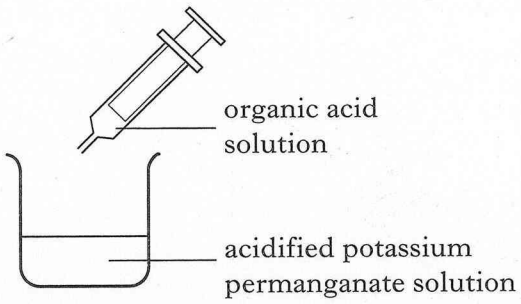
DO NOT WRITE IN THIS MARGIN

Marks

3. The effect of temperature changes on reaction rate can be studied using the reaction between an organic acid solution and acidified potassium permanganate solution.

$$5(COOH)_2(aq) + 6H^+(aq) + 2MnO_4^-(aq) \longrightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(\ell)$$

The apparatus required is shown in the diagram.



(*a*) Name the organic acid.

1

(*b*) Describe how the reaction time can be measured.

1

(*c*) The headings for a set of results are shown below.

Temperature of reaction/°C	Reaction time/s	Reaction rate/

Complete the headings by entering the correct unit in the **third** column. 1

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

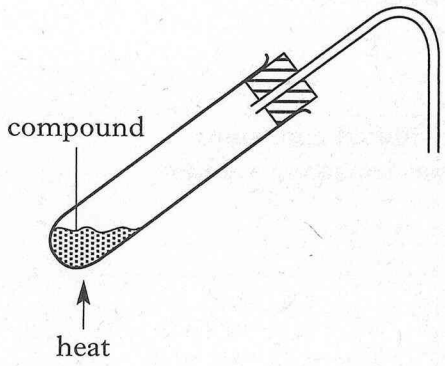
Marks

4. A student heated a compound which gave off carbon dioxide and water vapour.

Lumps of calcium chloride were used to absorb the water vapour first, and the carbon dioxide was then collected **in such a way that its volume could be measured**.

(*a*) Complete the diagram below to show the absorption of water vapour and collection of carbon dioxide.

Label the diagram clearly.



2

(*b*) The volume of carbon dioxide collected was 240 cm^3.

Calculate the number of molecules in this volume.

(Take the molar volume of carbon dioxide to be 24 litres mol^{-1}.)

1

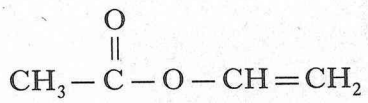
(3)

DO NOT WRITE IN THIS MARGIN

Marks

5. Vinyl acetate is the monomer for the preparation of polyvinylacetate (PVA) which is widely used in the building industry.

Vinyl acetate has the structural formula:



(*a*) Draw part of the structure of polyvinylacetate, showing **three** monomer units joined together.

1

(*b*) Vinyl acetate and hexane have the same relative formula mass.

Explain why you would expect vinyl acetate to have a higher boiling point than hexane.

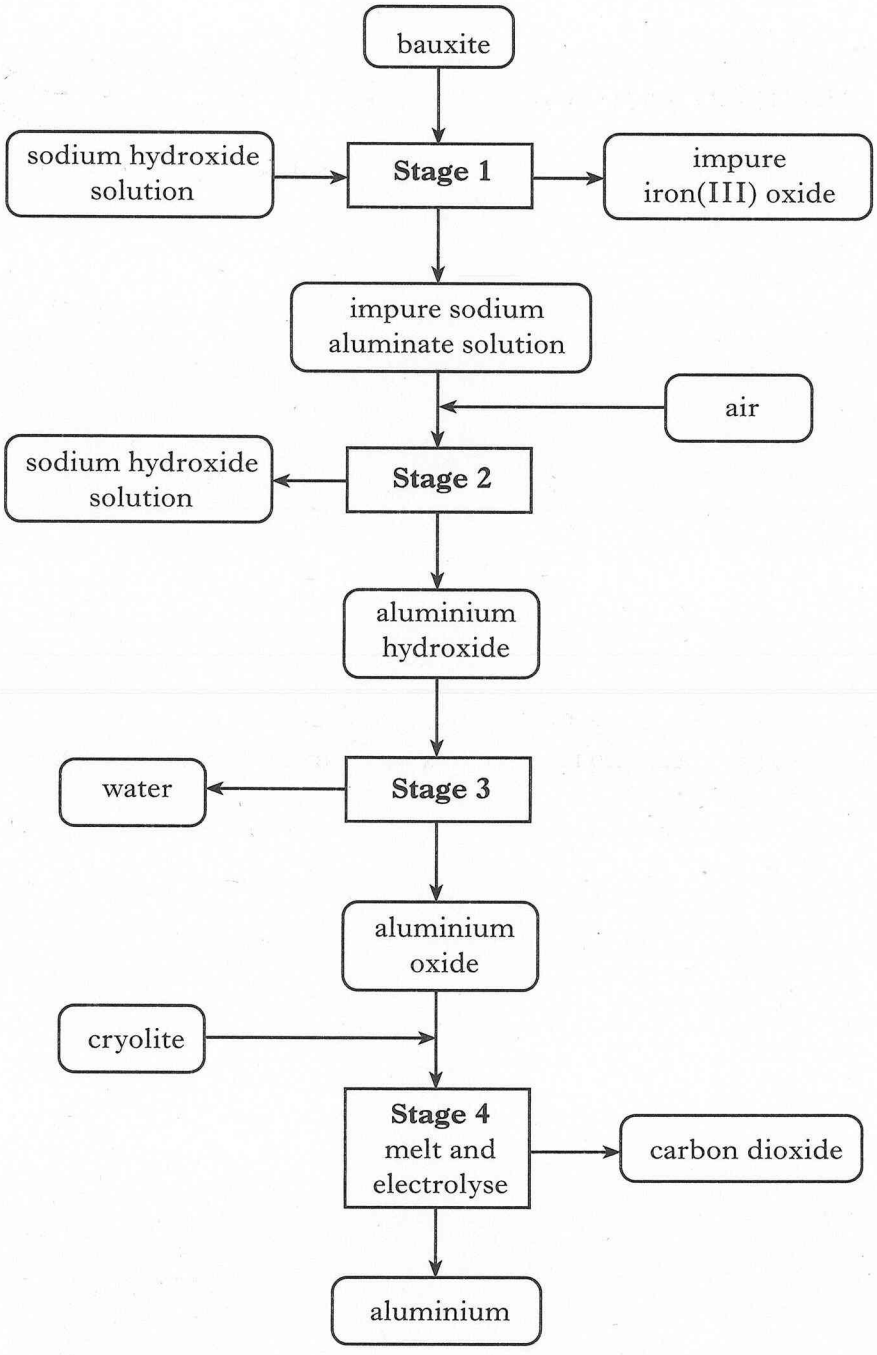
2

(3)

[Turn over

Marks

6. Aluminium is extracted from bauxite. This ore contains aluminium oxide along with iron(III) oxide and other impurities. The process is shown in the flow diagram.



(*a*) Add an arrow to the flow diagram to show how the process could be made more economical. **1**

Marks

6. (continued)

(*b*) In **Stage 1** of the process, aluminium oxide reacts with sodium hydroxide solution.

State whether aluminium oxide is behaving as an acidic oxide or as a basic oxide in this reaction.

1

(*c*) What type of reaction takes place during **Stage 3**?

1

(*d*) During **Stage 4**, aluminium is manufactured in cells by the electrolysis of aluminium oxide dissolved in molten cryolite.

What mass of aluminium is produced each hour, if the current passing through the liquid is 180 000 A?

Show your working clearly.

3

(*e*) In **Stage 4**, the carbon blocks that are used as positive electrodes must be regularly replaced.

Suggest a reason for this.

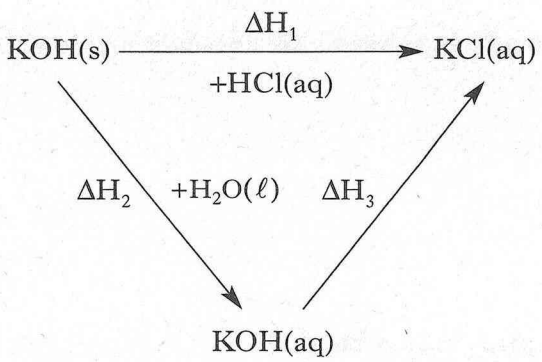
1

(7)

DO NOT WRITE IN THIS MARGIN

Marks

7. Potassium hydroxide can be used in experiments to verify Hess's Law. The reactions concerned can be summarised as follows.



(*a*) State Hess's Law.

1

(*b*) Complete the list of measurements that would have to be made in order to calculate ΔH_2.

(i) Mass of potassium hydroxide

(ii)

(iii)

(iv) **1**

(*c*) What solution must be added to the potassium hydroxide solution in order to calculate ΔH_3?

1

(3)

DO NOT WRITE IN THIS MARGIN

Marks

8. Calcium hydroxyapatite makes up 95% of tooth enamel.

(*a*) Tooth decay is caused when tooth enamel is attacked by acid in the mouth.

(i) One of the acids which attacks tooth enamel is 2-hydroxypropanoic acid, which has the molecular formula $C_3H_6O_3$.
Draw a structural formula for this acid.

1

(ii) Calcium hydroxyapatite reacts with acid in the mouth as shown by the following balanced equation.

$$Ca_{10}(PO_4)_6(OH)_2 + 8H^+ \longrightarrow 10Ca^{2+} + 2H_2O + 6HPO_4^{x-}$$

calcium hydroxyapatite

What is the value of x?

1

(iii) The pH of a solution in the mouth is 5.
What is the concentration of hydrogen ions, in mol l^{-1}, in this solution?

1

(*b*) Tooth enamel also contains a fibrous protein called collagen.

(i) Describe a difference between a fibrous and a globular protein.

1

(ii) Name the **four** elements present in all proteins.

1

(5)

DO NOT WRITE IN THIS MARGIN

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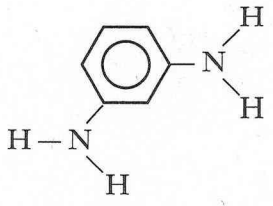
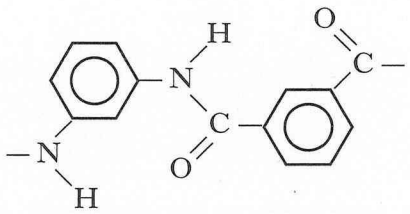
9. (*a*) Kevlar and Nomex are examples of recently manufactured polymers. Their properties are different because they are made from different monomers.

The diamine monomer used to make Nomex is 1,3-diaminobenzene.



1,3-diaminobenzene

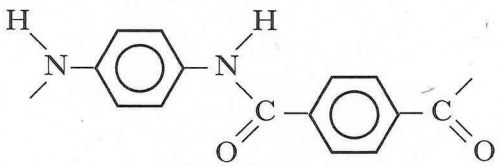
This reacts with the other monomer to form the repeating unit shown.



(i) Draw a structural formula for the other monomer.

1

(ii) The repeating unit in Kevlar is:



Name the diamine used to make Kevlar.

1

(*b*) Another recently manufactured polymer is polyvinylcarbazole.

Give the unusual property of polyvinylcarbazole which makes it suitable for use in photocopiers.

1

(3)

DO NOT WRITE IN THIS MARGIN

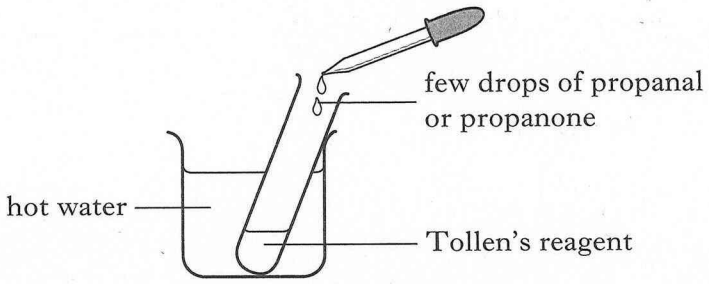
Marks

10. (*a*) Propanone and propanal both contain the same functional group.

(i) Name this functional group.

1

(ii) The diagram shows how to distinguish between propanone and propanal.



Explain what is observed in the reaction between propanal and Tollen's reagent.

2

(*b*) The equation for the enthalpy of formation of propanone is:

$$3C(s) + 3H_2(g) + \tfrac{1}{2}O_2(g) \longrightarrow C_3H_6O(\ell)$$

Use the following information on enthalpies of combustion to calculate the enthalpy of formation of propanone.

$$C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -394 \text{ kJ mol}^{-1}$$
$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(\ell) \quad \Delta H = -286 \text{ kJ mol}^{-1}$$
$$C_3H_6O(\ell) + 4O_2(g) \rightarrow 3CO_2(g) + 3H_2O(\ell) \quad \Delta H = -1804 \text{ kJ mol}^{-1}$$

Show your working clearly.

2

(5)

DO NOT WRITE IN THIS MARGIN

Marks

11. (*a*) Mordenite is a porous, crystalline material with a surface area of over $500\,m^2g^{-1}$.

It is used in an isomerisation reaction, part of a sequence which converts pentane into 2-methylbutane for blending into petrol.

$$\text{pentane} \longrightarrow \text{pent-2-ene} \xrightarrow{\text{isomerisation}} \text{2-methylbut-2-ene} \longrightarrow \text{2-methylbutane}$$

(i) Draw a structural formula for 2-methylbut-2-ene.

1

(ii) What role does mordenite play in the isomerisation reaction?

1

(iii) Why is 2-methylbutane a more suitable component than pentane when used in unleaded petrol?

1

(*b*) Mordenite consists mainly of silicon dioxide.

Name the structure and type of bonding in silicon dioxide.

1

(4)

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Marks

12. On crossing the Periodic Table, there are trends in the sizes of atoms and ions.

(*a*) Why is the atomic size of chlorine less than that of sodium?

1

(*b*)

Ion	**Ionic radius/pm**
Si^{4+}	42
P^{3-}	198

Why is there a large increase in ionic radius on going from Si^{4+} to P^{3-}?

1

(2)

[Turn over

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Marks

13. Ammonium chloride (NH_4Cl) is soluble in water.

(*a*) How does the pH of a solution of ammonium chloride compare with the pH of water?

1

(*b*) A student dissolved 10·0 g of ammonium chloride in 200 cm^3 of water and found that the temperature of the solution fell from 23·2 °C to 19·8 °C.

Calculate the enthalpy of solution of ammonium chloride.

Show your working clearly.

2

(3)

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Marks

14. (*a*) Some carbon monoxide detectors contain crystals of hydrated palladium(II) chloride. These form palladium in a redox reaction if exposed to carbon monoxide.

$$CO(g) + PdCl_2.2H_2O(s) \longrightarrow CO_2(g) + Pd(s) + 2HCl(g) + H_2O(\ell)$$

Write the ion-electron equation for the reduction step in this reaction.

1

(*b*) Another type of detector uses an electrochemical method to detect carbon monoxide.

At the positive electrode:

$$CO(g) + H_2O(\ell) \longrightarrow CO_2(g) + 2H^+(aq) + 2e^-$$

At the negative electrode:

$$O_2(g) + 4H^+(aq) + 4e^- \longrightarrow 2H_2O(\ell)$$

Combine the two ion-electron equations to give the overall redox equation.

1

(2)

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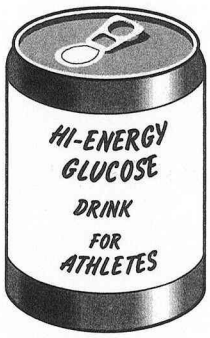
15. Sugars, such as glucose, are often used as sweeteners in soft drinks.



The glucose content of a soft drink can be estimated by titration against a standardised solution of Benedict's solution. The copper(II) ions in Benedict's solution react with glucose as shown.

$$C_6H_{12}O_6(aq) + 2Cu^{2+}(aq) + 2H_2O(\ell) \longrightarrow Cu_2O(s) + 4H^+(aq) + C_6H_{12}O_7(aq)$$

(*a*) What change in the ratio of atoms present indicates that the conversion of glucose into the compound with molecular formula $C_6H_{12}O_7$ is an example of oxidation?

1

(*b*) In one experiment, $25{\cdot}0\,cm^3$ volumes of a soft drink were titrated with Benedict's solution in which the concentration of copper(II) ions was $0{\cdot}500\ mol\,l^{-1}$. The following results were obtained.

Titration	Volume of Benedict's solution/cm^3
1	18·0
2	17·1
3	17·3

Average volume of Benedict's solution used = $17{\cdot}2\,cm^3$.

(i) Why was the first titration result not used in calculating the average volume of Benedict's solution?

1

DO NOT WRITE IN THIS MARGIN

Marks

15. (*b*) (continued)

(ii) Calculate the concentration of glucose in the soft drink, in mol l^{-1}.
Show your working clearly.

2

(*c*) In some soft drinks, sucrose is used instead of glucose.
Why can the sucrose concentration of a soft drink **not** be estimated by this method?

1

(5)

[Turn over

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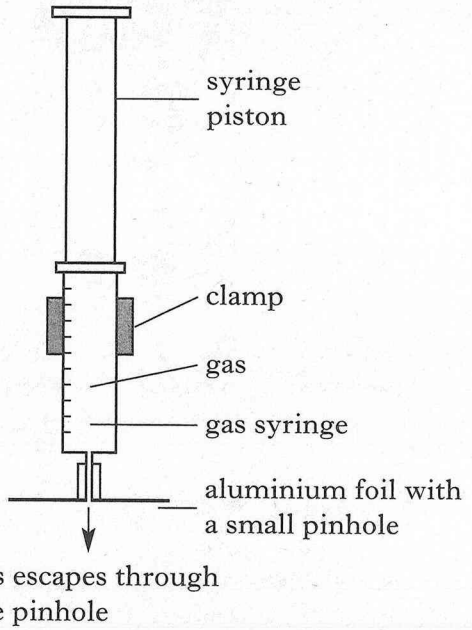
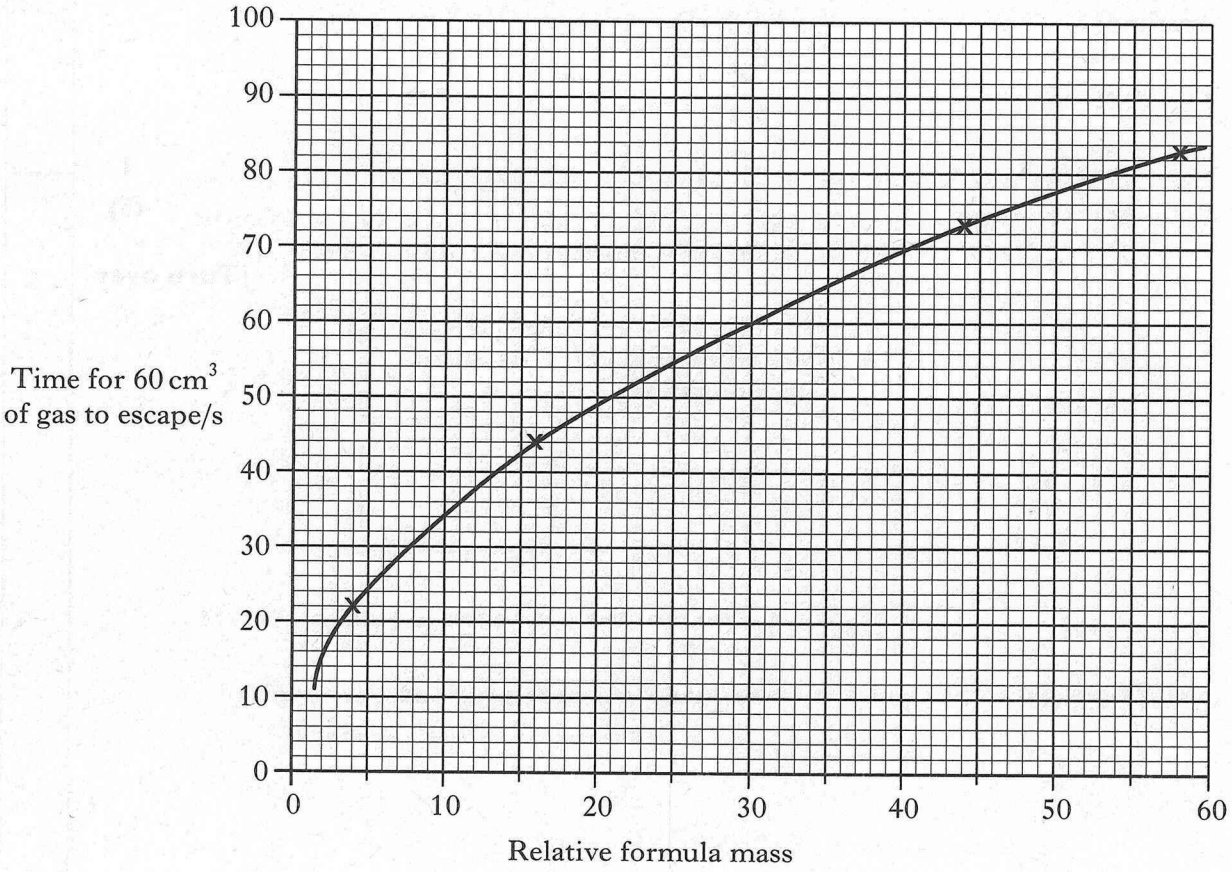
Marks

16. In experiments with four different gases, a syringe was held vertically as shown with the weight of the syringe piston applying a downward pressure on the gas. The times taken for 60 cm^3 of helium, methane, carbon dioxide and butane to escape through the pinhole were measured and the graph shows the results plotted against relative formula mass.





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Marks

16. (continued)

(*a*) Calculate the average rate of escape from the syringe of 60 cm^3 of methane, in $cm^3 s^{-1}$.

1

(*b*) Name a hydrocarbon gas which would take 56 s to escape.

1

(*c*) The error in a measurement decreases as the actual size of the measurement increases.

Suggest **one** way of reducing the error in each of the time measurements.

1

(3)

[Turn over for Question 17 on *Page thirty*

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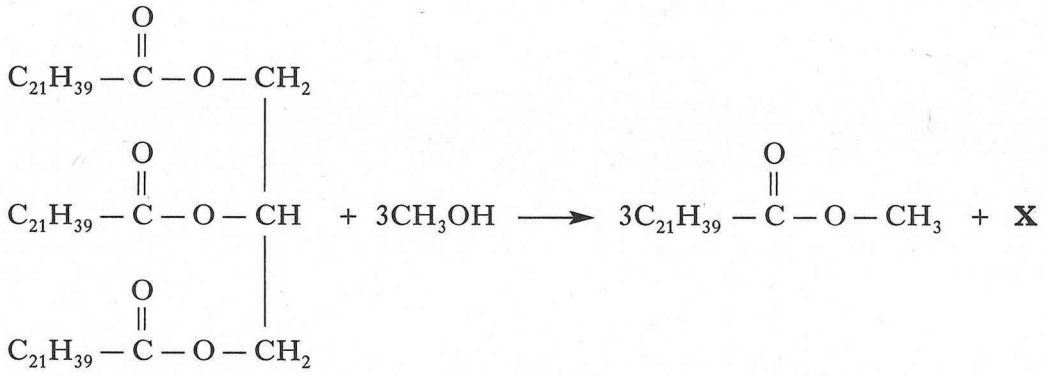
17. Biodiesel is a mixture of esters which can be made by heating rapeseed oil with methanol in the presence of a catalyst.



a triglyceride in rapeseed oil | methanol | a component of biodiesel

(*a*) Name compound **X**.

1

(*b*) A typical diesel molecule obtained from crude oil has the molecular formula $C_{16}H_{34}$ (hexadecane).

Other than the ester group, name a functional group present in biodiesel molecules which is **not** present in hexadecane.

1

(*c*) Vegetable oils like rapeseed oil are converted into fats for use in the food industry.

What name is given to this process?

1

(3)

[*END OF QUESTION PAPER*]