

FOR OFFICIAL USE

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**0500/402**Total  
Marks

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NATIONAL  
QUALIFICATIONS  
2004MONDAY, 10 MAY  
10.50 AM – 12.20 PMCHEMISTRY  
STANDARD GRADE  
Credit Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

- All questions should be attempted.
- Necessary data will be found in the Data Booklet provided for Chemistry at Standard Grade and Intermediate 2.
- The questions may be answered in any order but all answers are to be written in this answer book, and must be written clearly and legibly in ink.
- Rough work, if any should be necessary, as well as the fair copy, is to be written in this book.  
Rough work should be scored through when the fair copy has been written.
- Additional space for answers and rough work will be found at the end of the book.
- 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.
- 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.

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1. The grid shows the formulae of six oxides.

A	$H_2O$	B	$NO_2$	C	$K_2O$
D	$CaO$	E	$CO$	F	$SO_2$

- (a) Identify the oxide produced by the sparking of air in car engines.

A	B	C
D	E	F

- (b) Identify the **two** oxides produced by burning hydrocarbons.

A	B	C
D	E	F

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2. The names of some hydrocarbons are shown in the grid.

A	B	C
cyclobutane	cyclopentane	butane
D	E	F
propane	ethane	butene

- (a) Identify the hydrocarbon which is a liquid at 25 °C.  
You may wish to use the data booklet to help you.

A	B	C
D	E	F

- (b) Identify the **two** isomers.

A	B	C
D	E	F

- (c) Identify the hydrocarbon that reacts quickly with bromine solution.

A	B	C
D	E	F

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3. The grid shows the names of some soluble compounds.

A	B	C
magnesium bromide	sodium bromide	lithium hydroxide
D	E	F
sodium iodide	potassium sulphate	lithium chloride

- (a) Identify the base.

A	B	C
D	E	F

1

- (b) Identify the **two** compounds whose solutions would form a precipitate when mixed.

You may wish to use the data booklet to help you.

A	B	C
D	E	F

1

- (c) Identify the compound with a formula of the type  $\mathbf{XY}_2$ , where  $\mathbf{X}$  is a metal.

A	B	C
D	E	F

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4. A pupil carried out the following experiments.

<p><b>A</b></p> <p>30 °C</p> <p>2 mol/l HCl</p> <p>zinc powder</p>	<p><b>B</b></p> <p>30 °C</p> <p>1 mol/l HCl</p> <p>magnesium lump</p>	<p><b>C</b></p> <p>20 °C</p> <p>1 mol/l HCl</p> <p>zinc powder</p>
<p><b>D</b></p> <p>20 °C</p> <p>2 mol/l HCl</p> <p>zinc powder</p>	<p><b>E</b></p> <p>20 °C</p> <p>1 mol/l HCl</p> <p>magnesium powder</p>	<p><b>F</b></p> <p>30 °C</p> <p>2 mol/l HCl</p> <p>magnesium powder</p>

(a) Identify the **two** experiments which can be used to investigate the effect of concentration on the rate of the reaction.

A	B	C
D	E	F

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(b) Identify the experiment with the fastest reaction rate.

A	B	C
D	E	F

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5. The table contains information about some substances.

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Substance	Melting point/°C	Boiling point/°C	Conducts as	
			a solid	a liquid
A	455	1567	no	yes
B	80	218	no	no
C	1492	2897	yes	yes
D	1407	2357	no	no
E	645	1287	no	yes
F	98	890	yes	yes

(a) Identify the **two** ionic compounds.

A
B
C
D
E
F

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(b) Identify the substance which exists as a covalent network.

A
B
C
D
E
F

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6. The grid shows information about some particles.

A	${}^{34}_{16}\text{S}^{2-}$	B	${}^{24}_{12}\text{Mg}^{2+}$	C	${}^{39}_{19}\text{K}$
D	${}^{40}_{19}\text{K}$	E	${}^{40}_{20}\text{Ca}$	F	${}^{35}_{17}\text{Cl}^{-}$

- (a) Identify the **two** particles which are isotopes.

A	B	C
D	E	F

- (b) Identify the **two** particles with the same electron arrangement as argon.

A	B	C
D	E	F

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7. The grid contains information about the particles found in atoms.

A	charge = zero	B	relative mass almost zero	C	charge = 1-
D	found inside the nucleus	E	charge = 1+	F	relative mass = 1

Identify the **two** terms which can be applied to electrons.

A	B	C
D	E	F

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8. Glucose, sucrose and starch are carbohydrates.

Identify the **two** correct statements.

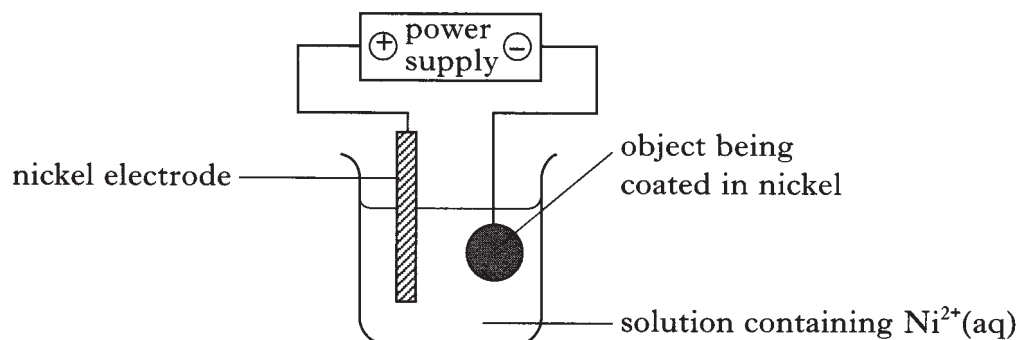
A	Glucose molecules join together with the loss of water.
B	Starch is a polymer made from sucrose molecules.
C	Sucrose turns warm Benedict's solution orange.
D	Glucose is an isomer of sucrose.
E	Starch dissolves easily in water.
F	Sucrose can be hydrolysed.

A
B
C
D
E
F

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9. The diagram shows how an object can be coated in nickel.



The following reactions take place at the electrodes.



Identify the **two** correct statements.

A	Nickel ions move towards the nickel electrode.
B	The mass of the nickel electrode decreases.
C	The process is an example of galvanising.
D	Oxidation occurs at the nickel electrode.
E	Electrons flow through the solution.

A
B
C
D
E

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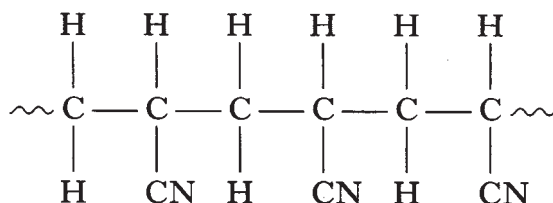
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## PART 2

A total of 40 marks is available in this part of the paper.

10. The structure of part of a polyacrylonitrile molecule is shown below.



- (a) Draw the structural formula for the monomer used to make polyacrylonitrile.

- (b) Name a toxic gas produced when polyacrylonitrile burns.

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11. Some Euro coins are made from a hard-wearing alloy called Nordic Gold.



- (a) What is an alloy?

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- (b) The composition of Nordic Gold is shown in the table.

Metal	copper	aluminium	zinc	tin
% by mass	89	5	5	1

One of the coins has a mass of 5.74 g.

- (i) Calculate the mass, in grams, of aluminium in the coin.  
**Show your working clearly.**

\_\_\_\_\_ g

1

- (ii) Calculate the number of moles of aluminium in the coin.  
**Show your working clearly.**

\_\_\_\_\_ mol

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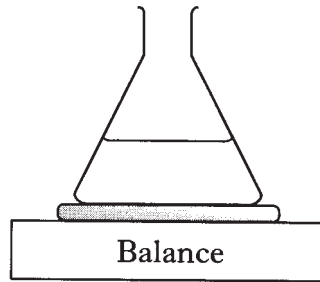
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12. A group of pupils investigated the speed of reaction between marble chips (calcium carbonate) and hydrochloric acid, concentration 1 mol/l.

They used excess hydrochloric acid to make sure all the calcium carbonate had been used up.

The pupils used a balance to measure the mass lost during the reaction.



The results are shown in the table.

<b>Time/minutes</b>	0	0.5	1.0	2.0	3.0	4.0	5.0
<b>Mass lost/g</b>	0	0.30	0.50	0.70	0.76	0.79	0.80

- (a) Why is mass lost during the reaction?

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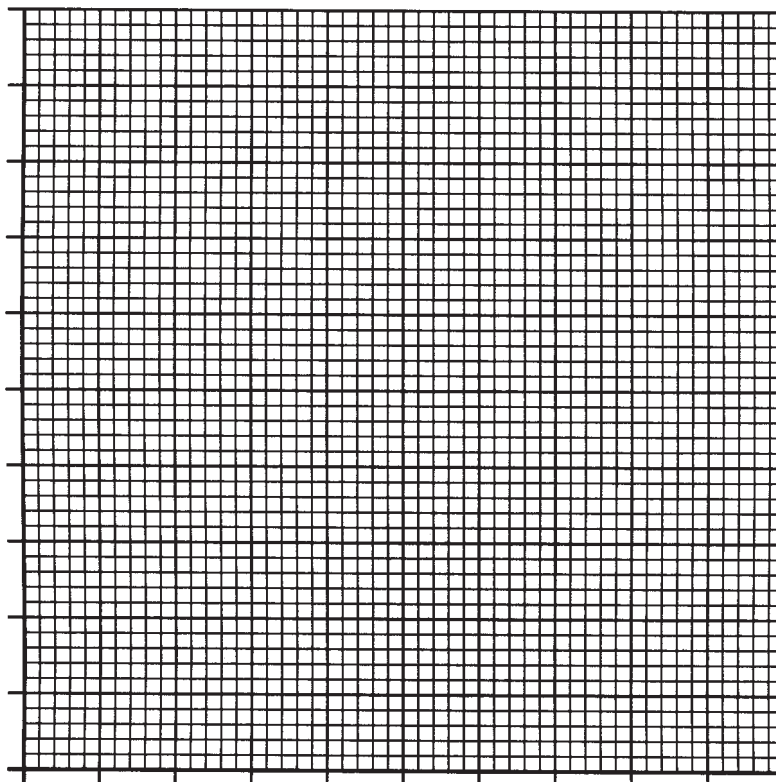
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**12. (continued)**

(b) Draw a line graph of the results.

*Use appropriate scales to fill most of the graph paper.*

(Additional graph paper, if required, will be found on page 26.)



(c) The experiment was repeated using the same volume of hydrochloric acid, but with a concentration of 2 mol/l.

What mass loss would have been recorded?

\_\_\_\_\_ g

(d) Name the salt produced when marble chips react with hydrochloric acid.

\_\_\_\_\_

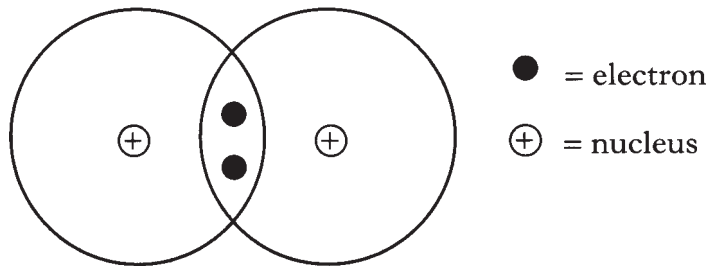
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13. In a hydrogen molecule the atoms share two electrons in a covalent bond.



- (a) Explain how the covalent bond holds the two hydrogen atoms together.

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- (b) The hydrogen molecule can be represented more simply as



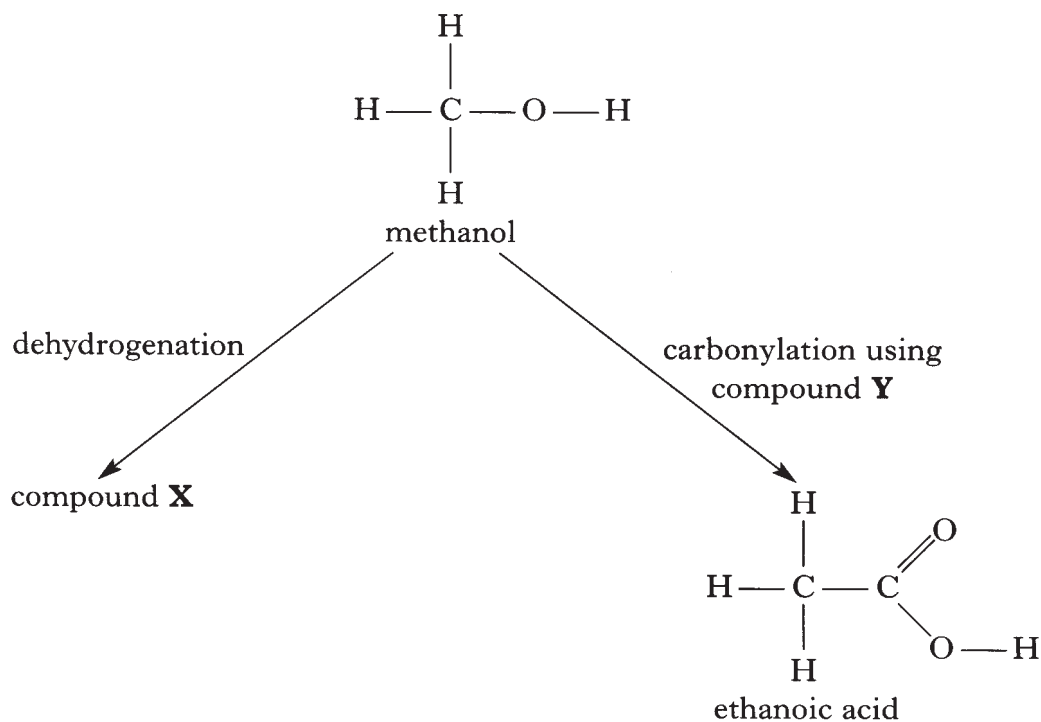
- (i) Showing **all** outer electrons, draw a similar diagram to represent a molecule of ammonia,  $\text{NH}_3$ .

- (ii) Draw another diagram to show the **shape** of an ammonia molecule.

Marks

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14. Methanol can take part in many chemical reactions.



- (a) (i) Compound X has the molecular formula  $\text{CH}_2\text{O}$ .  
Draw the full structural formula for compound X.

- (ii) Methanol is changed to compound X by dehydrogenation.  
Suggest what is meant by **dehydrogenation**.

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- (b) In carbonylation, methanol reacts with compound Y forming only ethanoic acid.  
Suggest a name for compound Y.

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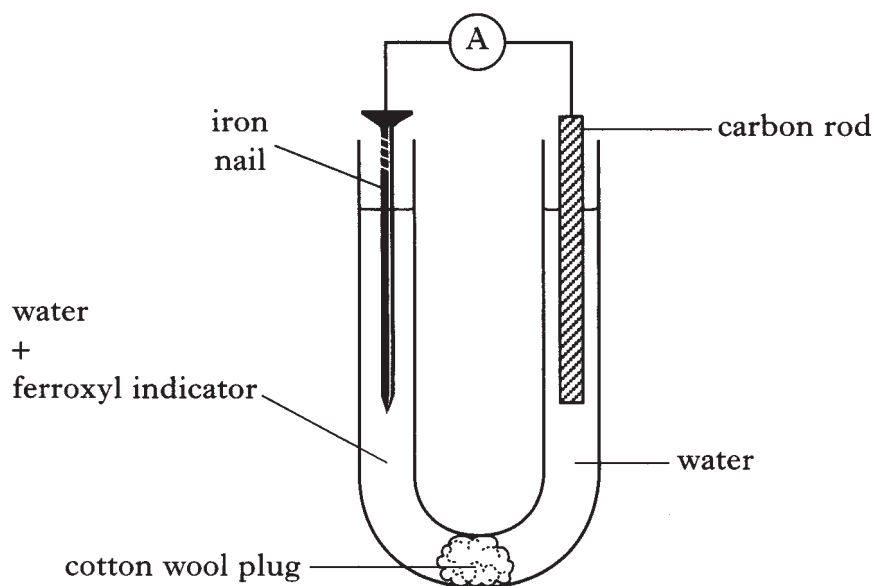
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15. Gemma and Laura set up the simple cell shown below.



After two days the iron nail had rusted and the ferroxy indicator had turned blue.

- (a) **On the diagram**, clearly mark the path and direction of electron flow.
- (b) The reaction taking place at the carbon rod produces hydroxide ions. How could Gemma and Laura have shown that hydroxide ions were present?

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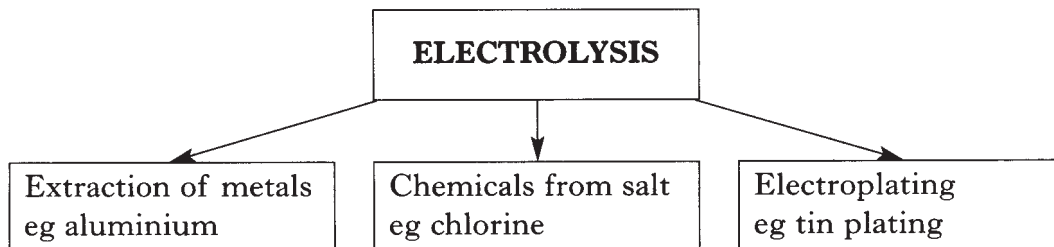
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16. Electrolysis is a common industrial process. Some uses of electrolysis are shown in the diagram.



- (a) State what is meant by electrolysis.

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- (b) Aluminium is extracted by electrolysis of its molten oxide since aluminium oxide does not react when heated with carbon.

Why does aluminium oxide **not** react with hot carbon?

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- (c) Chlorine is produced by the electrolysis of sodium chloride solution.

Write the ion-electron equation for the formation of chlorine.

You may wish to use the data booklet to help you.

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- (d) Tin plated iron rusts very rapidly if the plating is scratched.

Explain why the iron rusts so rapidly.

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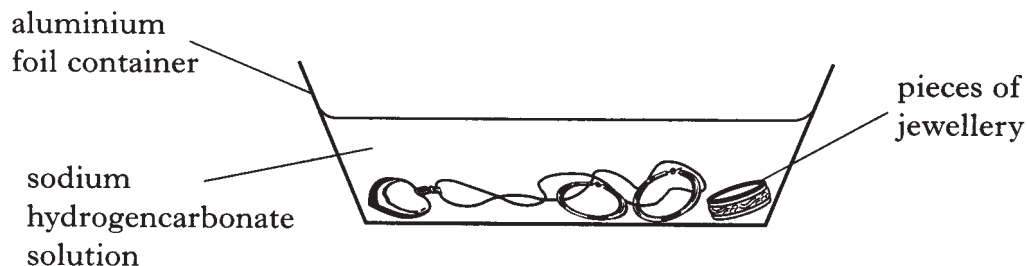
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17. Silver jewellery slowly tarnishes in air. This is due to the formation of silver(I) sulphide,  $\text{Ag}_2\text{S}$ .

The silver(I) sulphide can be converted back to silver as follows.

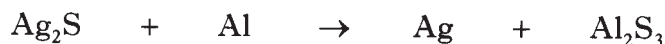


- (a) Write the ionic formula for sodium hydrogencarbonate.

You may wish to use the data booklet to help you.

\_\_\_\_\_

- (b) The equation for the reaction which takes place in the aluminium container is:



- (i) Balance this equation.

- (ii) Name the type of chemical reaction which takes place.

\_\_\_\_\_

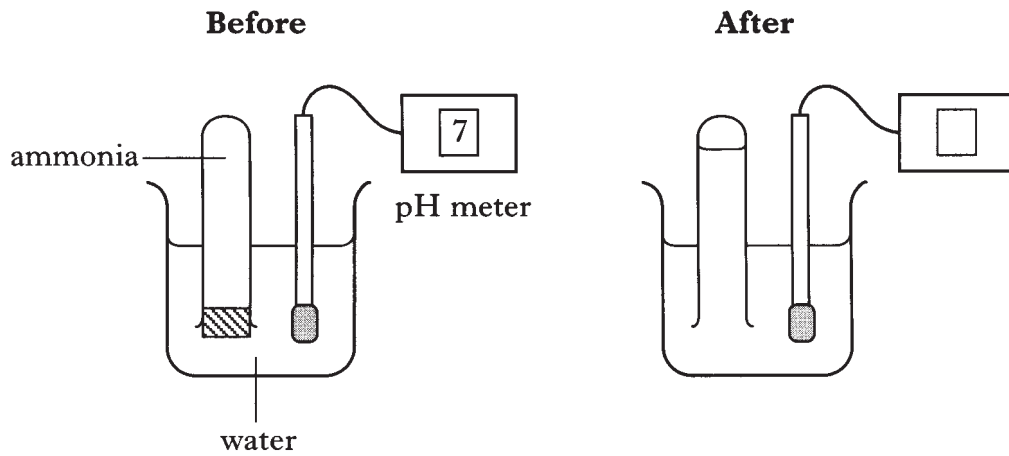
- (c) Calculate the percentage by mass of aluminium in  $\text{Al}_2\text{S}_3$ .

**Show your working clearly.**

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18. Fritz was investigating the properties of ammonia.



(a) Why did the water rise up the test tube when the stopper was removed?

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(b) When the stopper was removed the reading on the pH meter changed. Suggest what the new reading would have been.

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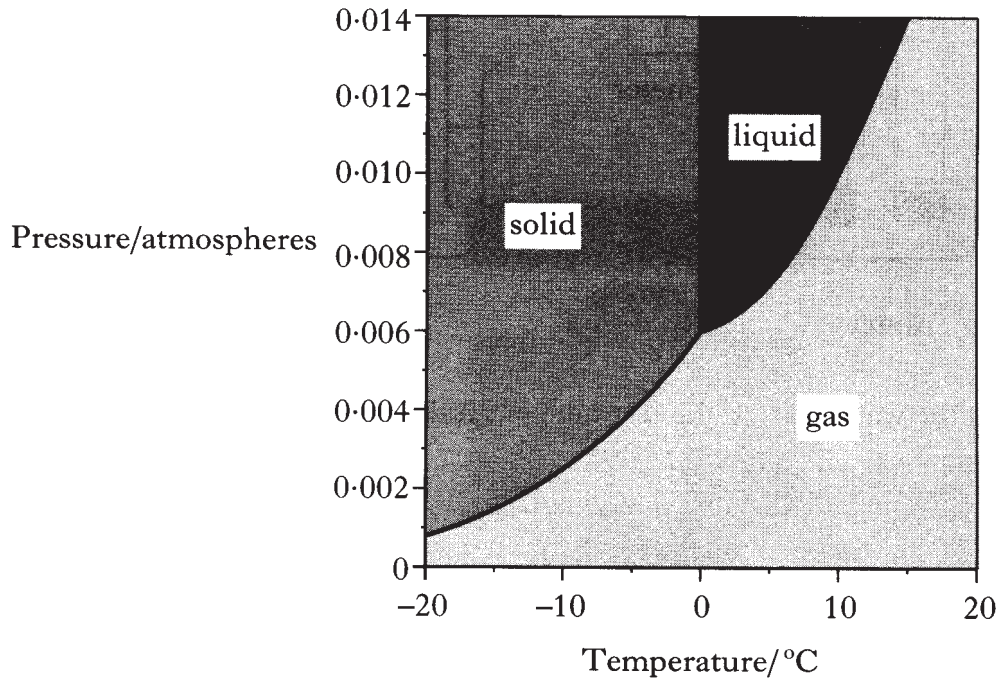
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19. Water can exist in three different states: solid, liquid and gas.  
The state depends on the temperature and pressure.  
The diagram below shows these relationships.



- (a) In which state would water exist at 15 °C and 0.007 atmospheres?

\_\_\_\_\_

- (b) Solid water at 0.004 atmospheres is allowed to warm up. The pressure is kept constant.

At what temperature would the solid water change into a gas?

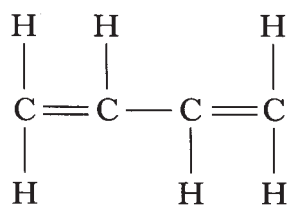
\_\_\_\_\_ °C

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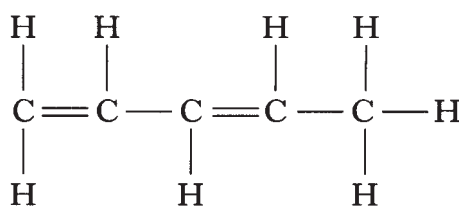
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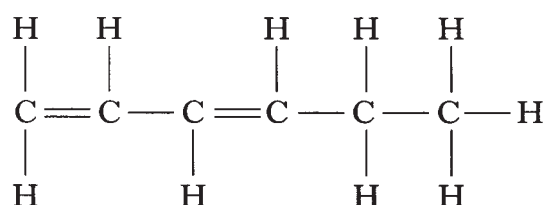
20. Dienes are a homologous series of hydrocarbons which contain two double bonds per molecule.



buta-1,3-diene



penta-1,3-diene



hexa-1,3-diene

- (a) What is meant by the term "homologous series"?

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- (b) Suggest a general formula for the dienes.

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- (c) Write the **molecular formula** for the product of the complete reaction of penta-1,3-diene with bromine.

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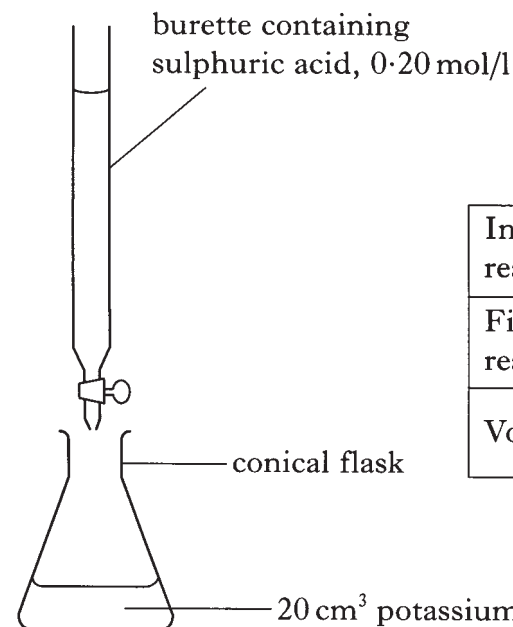
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- (d) Draw a full structural formula for an isomer of buta-1,3-diene which contains only **one** double bond per molecule.

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21. A pupil carried out a titration using the chemicals and apparatus shown below.



	Rough titre	1st titre	2nd titre
Initial burette reading/cm <sup>3</sup>	0.5	21.7	0.3
Final burette reading/cm <sup>3</sup>	21.7	42.4	20.8
Volume used/cm <sup>3</sup>	21.2	20.7	20.5

- (a) How would the pupil know when to stop adding acid from the burette?

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- (b) (i) What average volume should be used to calculate the number of moles of sulphuric acid needed to neutralise the potassium hydroxide solution?

\_\_\_\_\_ cm<sup>3</sup>

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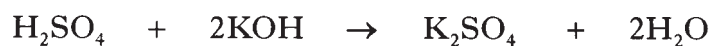
## 21. (b) (continued)

- (ii) Calculate the number of moles of sulphuric acid in this average volume.

**Show your working clearly.**

\_\_\_\_\_ mol

- (iii) The equation for the titration reaction is



Calculate the number of moles of potassium hydroxide in 20 cm<sup>3</sup> of the potassium hydroxide solution.

**Show your working clearly.**

\_\_\_\_\_ mol

[END OF QUESTION PAPER]