

FOR OFFICIAL USE

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**X012/201**

Section B      Total  
Marks

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NATIONAL  
QUALIFICATIONS  
2004

WEDNESDAY, 2 JUNE  
9.00 AM – 11.00 AM

CHEMISTRY  
INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

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Surname

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Date of birth

Day   Month   Year

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Scottish candidate number

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Number of seat

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Necessary data will be found in the Chemistry Data Booklet for Standard Grade and Intermediate 2 (1999 Edition).

**Section A—Questions 1 to 30**

Instructions for completion of **Section A** are given on page two.

**Section B**

All questions should be attempted.

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.

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. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this book.

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.

## SECTION A

1. Which of the following gases is a noble gas?

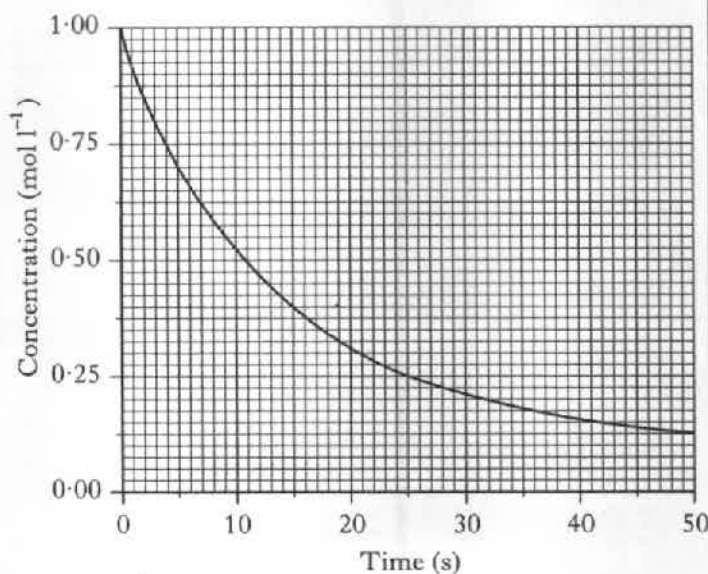
- A Nitrogen
- B Fluorine
- C Oxygen
- D Neon

2. When hydrogen chloride gas is dissolved in water a solution containing hydrogen ions and chloride ions is formed.

Which equation correctly shows the state symbols for this change?

- A  $\text{HCl(g)} + \text{H}_2\text{O(l)} \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
- B  $\text{HCl(l)} + \text{H}_2\text{O(aq)} \rightarrow \text{H}^+(\text{l}) + \text{Cl}^-(\text{l})$
- C  $\text{HCl(aq)} + \text{H}_2\text{O(l)} \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
- D  $\text{HCl(g)} + \text{H}_2\text{O(l)} \rightarrow \text{H}^+(\text{l}) + \text{Cl}^-(\text{l})$

3. The graph below shows the variation of concentration of a reactant with time as a reaction proceeds.



During the first 25 s, the average reaction rate, in  $\text{mol l}^{-1} \text{s}^{-1}$ , is

- A 0.04
- B 0.03
- C 0.02
- D 0.01.

4. The table shows the times taken for 0.5 g of magnesium to react completely with acid under different conditions.

Acid concentration ( $\text{mol l}^{-1}$ )	Temperature ( $^{\circ}\text{C}$ )	Reaction time (s)
0.1	20	80
0.1	25	60
0.2	30	20
0.2	40	10

The time for 0.5 g of magnesium to react completely with  $0.2 \text{ mol l}^{-1}$  acid at  $25^{\circ}\text{C}$  will be

- A less than 10 s
- B between 10 s and 20 s
- C between 20 s and 60 s
- D more than 80 s.

5. An atom has atomic number 26 and mass number 56.

The number of electrons in the atom is

- A 26
- B 30
- C 56
- D 82.

6. Metallic bonds are due to

- A pairs of electrons being shared equally between atoms
- B pairs of electrons being shared unequally between atoms
- C the attraction of oppositely charged ions for each other
- D the attraction of positively charged ions for delocalised electrons.

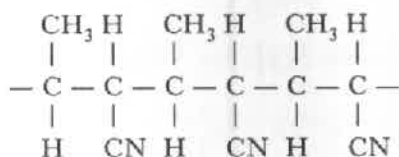
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7. During the electrolysis of silver(I) nitrate solution, silver ions,  $\text{Ag}^+(\text{aq})$ ,
- A gain electrons at the negative electrode
  - B lose electrons at the negative electrode
  - C gain electrons at the positive electrode
  - D lose electrons at the positive electrode.

8. Which of the following could be the molecular formula of a cycloalkane?

- A  $\text{C}_7\text{H}_{16}$
- B  $\text{C}_7\text{H}_{14}$
- C  $\text{C}_7\text{H}_{12}$
- D  $\text{C}_7\text{H}_{10}$

9. Part of a polymer structure is shown.



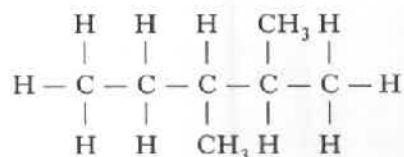
Which of the following gases could **not** be produced when this polymer is burned?

- A CO
- B  $\text{CO}_2$
- C HCl
- D HCN

10. The conversion of an oil into a hardened fat involves the

- A addition of water
- B removal of water
- C addition of hydrogen
- D removal of hydrogen.

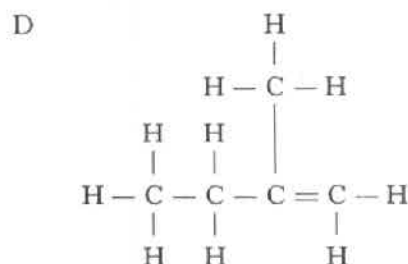
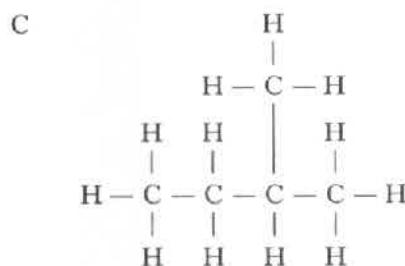
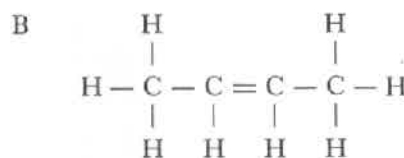
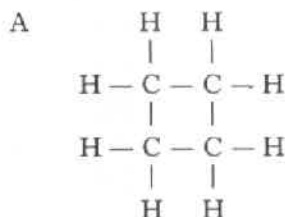
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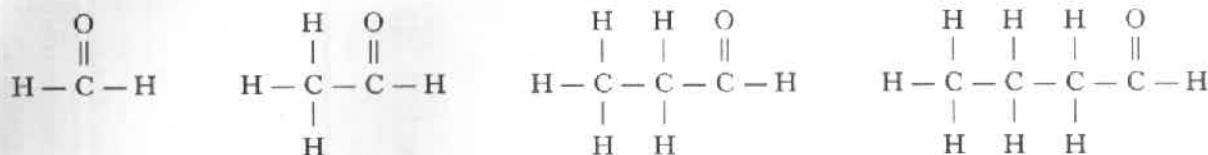
The name of the above compound is

- A 2,3-dimethylpentane
- B 3,4-dimethylpentane
- C 2,3-dimethylpropane
- D 3,4-dimethylpropane.

12. Which of the following compounds belongs to the same homologous series as the compound with the molecular formula  $\text{C}_3\text{H}_8$ ?



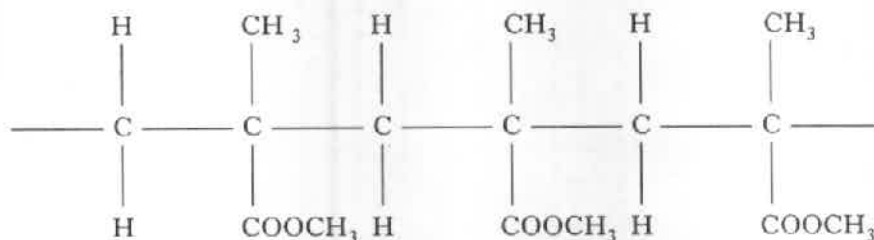
13. The first four members of the alkanal homologous series are:



The general formula for this homologous series is

- A  $\text{C}_n\text{H}_{2n-2}\text{O}$   
 B  $\text{C}_n\text{H}_{2n}\text{O}$   
 C  $\text{C}_n\text{H}_{2n+1}\text{O}$   
 D  $\text{C}_n\text{H}_{2n+2}\text{O}$
14. Industrial ethanol can be manufactured from ethene by
- A condensation  
 B dehydration  
 C hydration  
 D hydrolysis.

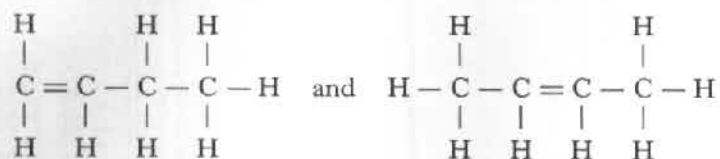
15. The structure below shows a section of an addition polymer.



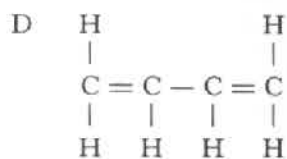
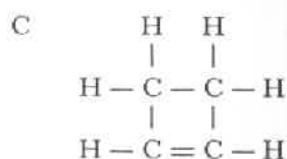
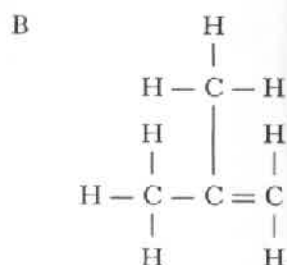
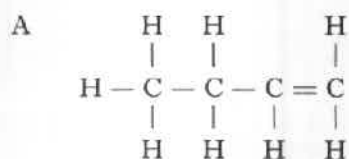
Which molecule is used to make this polymer?

- A  $\begin{array}{c} \text{CH}_3 \quad \text{H} \\ | \quad | \\ \text{C} = \text{C} \\ | \quad | \\ \text{H} \quad \text{COOCH}_3 \end{array}$
- B  $\begin{array}{c} \text{H} \quad \text{CH}_3 \\ | \quad | \\ \text{C} = \text{C} \\ | \quad | \\ \text{H} \quad \text{COOCH}_3 \end{array}$
- C  $\begin{array}{c} \text{CH}_3 \quad \text{COOCH}_3 \\ | \quad | \\ \text{C} = \text{C} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$
- D  $\begin{array}{c} \text{H} \quad \text{CH}_3 \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{COOCH}_3 \end{array}$

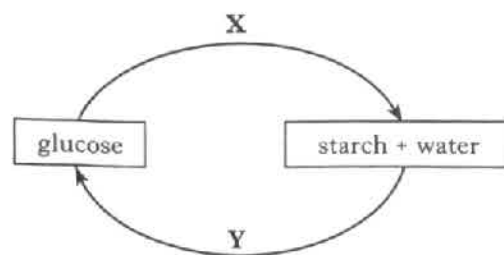
16. Two isomers of butene are



Which of the following structures represents a third isomer of butene?



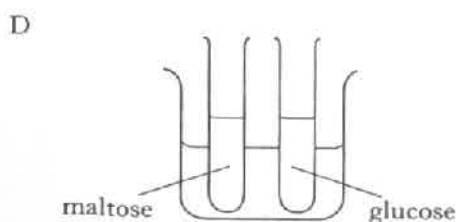
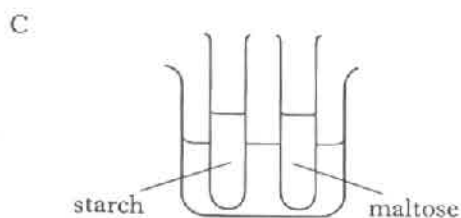
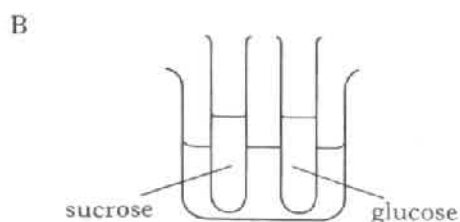
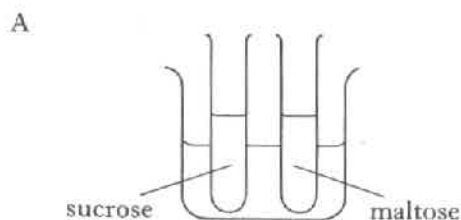
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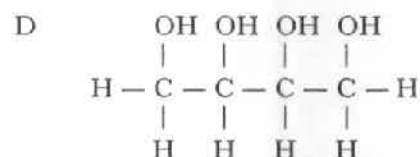
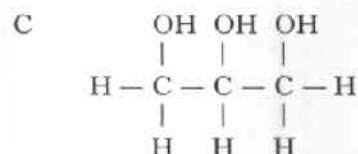
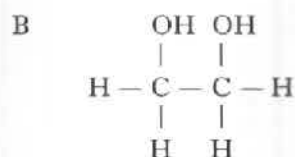
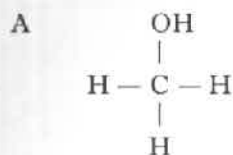
Which line in the table correctly describes reactions X and Y?

	Reaction X	Reaction Y
A	condensation	hydration
B	condensation	hydrolysis
C	dehydration	hydration
D	dehydration	hydrolysis

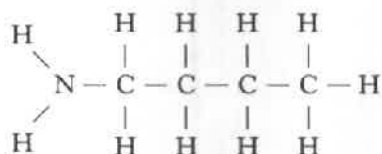
18. In which of the following experiments would both carbohydrates give an orange precipitate when heated with Benedict's solution?



19. Which structure represents a molecule of glycerol?



20. Which type of compound is represented by the structure shown?



- A Amine  
 B Protein  
 C Amino acid  
 D Carboxylic acid
21. 0.5 mol of pure citric acid was dissolved in water and the solution made up to 250 cm<sup>3</sup>.  
 What was the concentration of the solution formed?
- A 0.25 mol l<sup>-1</sup>  
 B 0.5 mol l<sup>-1</sup>  
 C 1.0 mol l<sup>-1</sup>  
 D 2.0 mol l<sup>-1</sup>

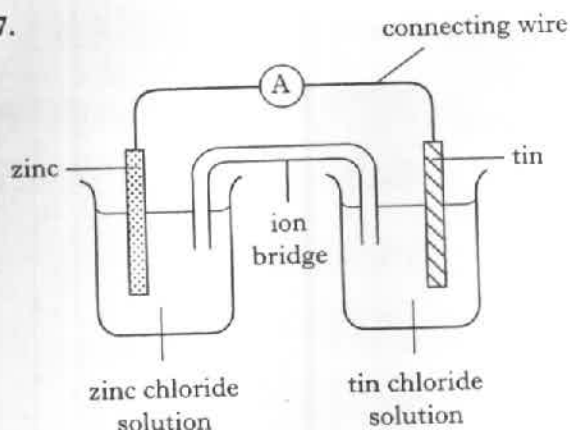


This ion-electron equation represents

- A oxidation of iron(III) ions  
 B oxidation of iron(II) ions  
 C reduction of iron(III) ions  
 D reduction of iron(II) ions.
23. Which of the following oxides, when shaken with water, would leave the pH unchanged?  
 (You may wish to use page 5 of the data booklet to help you.)
- A Carbon dioxide  
 B Copper oxide  
 C Sodium oxide  
 D Sulphur dioxide
24. Which of the following compounds is a base?
- A Magnesium carbonate  
 B Magnesium chloride  
 C Magnesium nitrate  
 D Magnesium sulphate
25. Which of the following solutions, when added to copper chloride solution, produces a precipitate?  
 (You may wish to use page 5 of the data booklet to help you.)
- A Calcium bromide solution  
 B Lithium sulphate solution  
 C Magnesium nitrate solution  
 D Sodium hydroxide solution
26. Which of the following gases reacts with an alkaline solution?
- A Nitrogen dioxide  
 B Ammonia  
 C Oxygen  
 D Argon

[Turn over

27.



In the cell shown above, electrons flow through

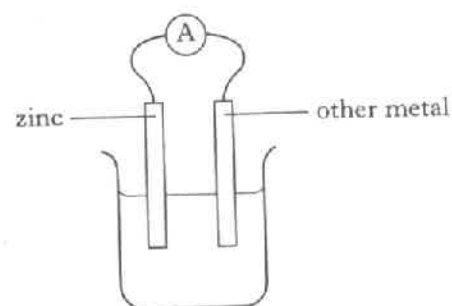
- A the solution from tin to zinc
- B the solution from zinc to tin
- C the connecting wire from tin to zinc
- D the connecting wire from zinc to tin.

28. Which of the following solutions will react with iron metal?

(You may wish to use page 7 of the data booklet to help you.)

- A Magnesium chloride
- B Tin chloride
- C Sodium chloride
- D Zinc chloride

29. Four cells were made by joining copper, iron, silver and tin to zinc.



Which line in the table shows the voltage of the cell containing iron joined to zinc?

(You may wish to use page 7 of the data booklet to help you.)

Cell	Voltage (V)
A	1.5
B	1.1
C	0.6
D	0.3

30. Which of the following metals must be obtained from its ore by electrolysis?

- A Aluminium
- B Copper
- C Iron
- D Gold

**Candidates are reminded that the answer sheet for Section A MUST be placed INSIDE the front cover of this answer book.**

Marks

**SECTION B**

**50 marks are available in this section of the paper.**

1. The nuclide notation for an isotope of hydrogen is  ${}^1_1\text{H}$ .

(a) An isotope of bromine has atomic number 35 and mass number 81.

(i) Complete the nuclide notation for this isotope of bromine.

**Br**

1

(ii) How many neutrons are there in this isotope?

\_\_\_\_\_

1

(b) Bromine has two isotopes. One has a mass number of 81 and the other has a mass number of 79.

The relative atomic mass of bromine is 80.

What does this tell you about the percentage of each isotope in bromine?

\_\_\_\_\_

\_\_\_\_\_

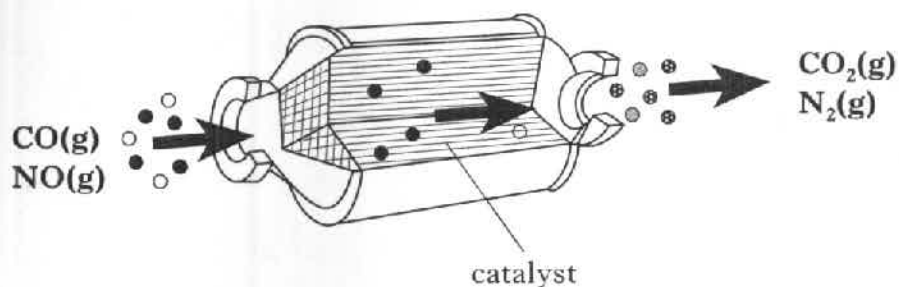
1

(3)



Marks

2. In a catalytic converter, harmful gases are changed to less harmful gases by passing them over a solid catalyst as shown in the diagram.



- (a) Balance the equation for this reaction.



- (b) Why can the catalyst be described as a heterogeneous catalyst?

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1  
(2)

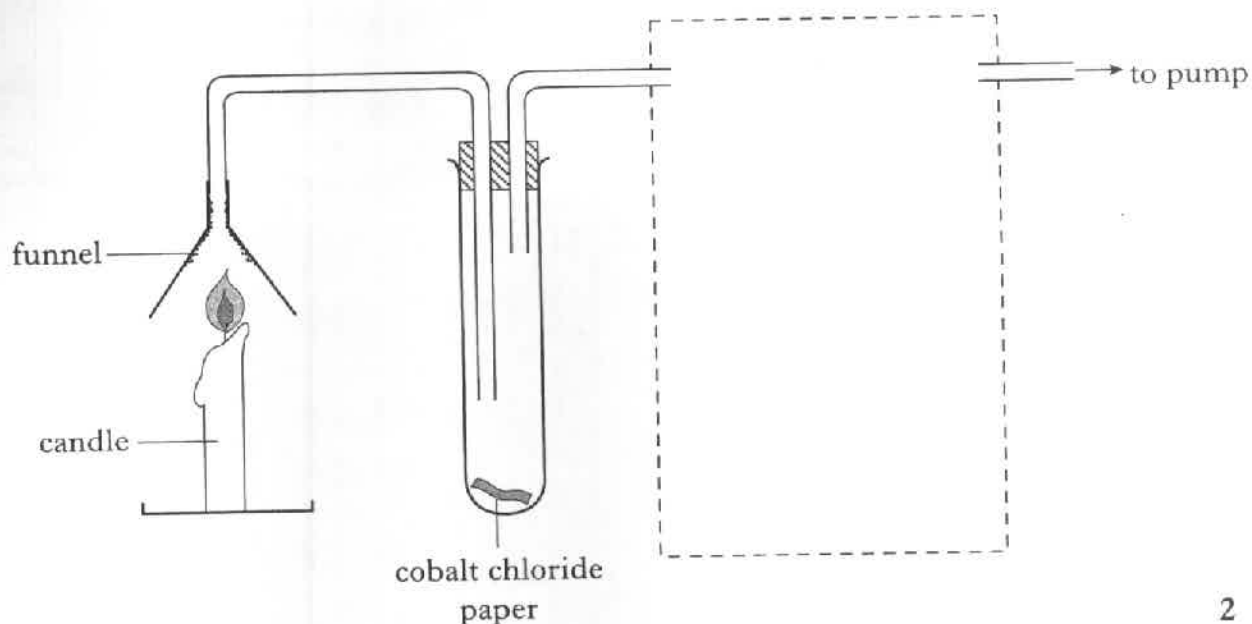
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Marks

3. Candle wax is a hydrocarbon.

Blue cobalt chloride paper and limewater can be used to detect products formed when candle wax is burned.

- (a) Complete and label the diagram to show the arrangement you would use.



- (b) Name the product detected using the blue cobalt chloride paper.

\_\_\_\_\_

- (c) As the candle burns the funnel becomes coated with soot.  
Why does this happen?

\_\_\_\_\_

\_\_\_\_\_

2

1

1

(4)

Marks

4. Hydrogen reacts with chlorine to form hydrogen chloride.

- (a) Draw a diagram to show how the **outer** electrons are shared in a molecule of hydrogen chloride.

1

- (b) Chlorine has a greater attraction than hydrogen for the bonded electrons in a hydrogen chloride molecule.

What term is used to describe this type of covalent bond?

1

(2)

[Turn over

Marks

5. Urea is a chemical which is present in urine.

(a) Urea has the formula  $\text{H}_2\text{NCONH}_2$ .

Draw the full structural formula for urea.

1

(b) An adult male, on average, excretes 30 g of urea each day.

How many moles are there in 30 g of urea?

1

(c) Urea can be hydrolysed to form carbon dioxide and ammonia.



This reaction was carried out with different concentrations of urea and the relative rates of hydrolysis were calculated.

### Results

Concentration of urea ( $\text{mol l}^{-1}$ )	Relative rate
0.05	4.4
0.10	5.9
0.30	7.7
0.40	8.0
0.50	8.1

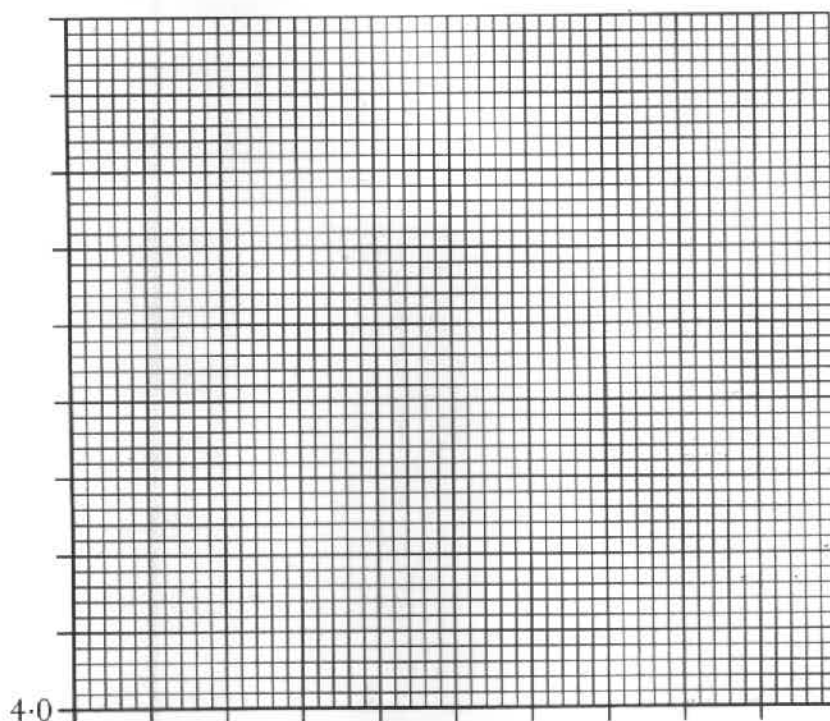
Marks

5. (c) (continued)

- (i) Plot these results as a line graph.

Use appropriate scales to fill most of the graph paper.

(Additional graph paper, if required, can be found on page 27.)



2

- (ii) Using your graph, estimate the concentration of urea which gives a relative rate of 7.2.

\_\_\_\_\_  $\text{mol l}^{-1}$

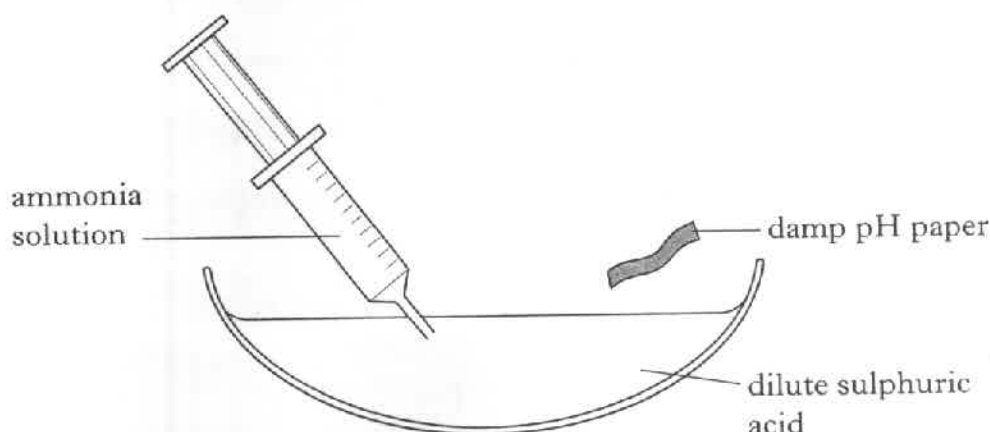
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6.

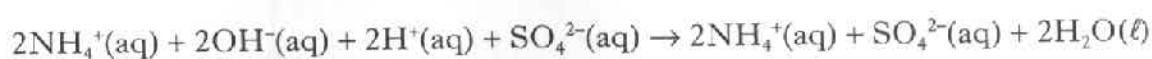
**"Making Ammonium Sulphate in the lab"**



**Method**

1. Add 20 cm<sup>3</sup> of dilute sulphuric acid to the evaporating basin.
2. Add dilute ammonia solution a little at a time. Stop adding the ammonia solution when ammonia gas is detected using the pH paper.
3. Evaporate the solution to half its original volume.
4. Set aside until crystals form.

(a) The chemical equation for the reaction is



Rewrite the equation omitting the spectator ions.

\_\_\_\_\_

1

(b) How will ammonia gas affect damp pH paper?

\_\_\_\_\_

\_\_\_\_\_

1

(c) State a use for ammonium sulphate.

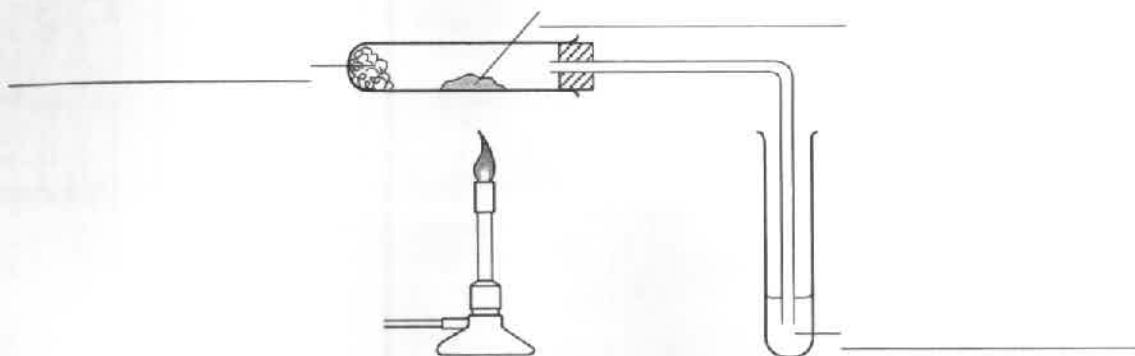
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1

(3)

Marks

7. The diagram below shows the apparatus used in the **PPA, "Cracking"**.  
Liquid paraffin is cracked using an aluminium oxide catalyst.  
Bromine solution is used to show that some of the products are unsaturated.



- (a) Label the diagram of the apparatus used to crack liquid paraffin. 1
- (b) What safety precaution should be taken before heating is stopped?

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1  
(2)

[Turn over

Marks

8. Lawn fertiliser can contain iron(II) sulphate to kill moss in the lawn.

- (a) Iron(II) sulphate can be made by reacting iron(II) oxide with dilute sulphuric acid.



Name this type of chemical reaction.

1

- (b) What mass of iron(II) sulphate can be made from 144 kg of iron(II) oxide?

kg

2  
(3)

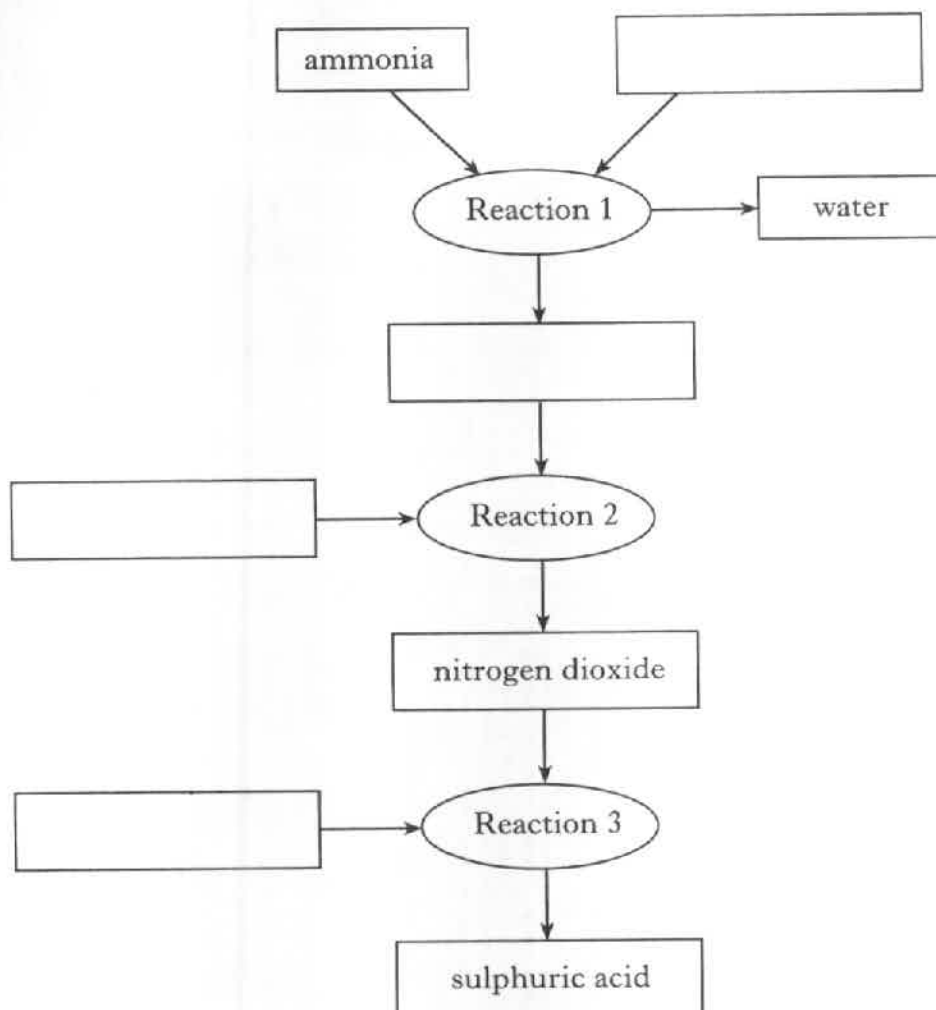


Marks

9. "A method of making sulphuric acid"

Oxidise ammonia to produce nitrogen monoxide. Water will also be produced in the reaction. React the nitrogen monoxide with more oxygen to form nitrogen dioxide. The sulphuric acid can then be produced by reacting the nitrogen dioxide with sulphurous acid.

(a) Complete the flow chart to show this process.



2

(b) When nitrogen dioxide reacts with sulphurous acid to produce sulphuric acid, nitrogen monoxide will also be produced. This can be recycled.

Add a line to the flow chart to show nitrogen monoxide being recycled.

1

(c) Sulphuric acid is a strong acid and sulphurous acid is a weak acid. Why is sulphuric acid described as a strong acid?

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1

(4)

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Marks

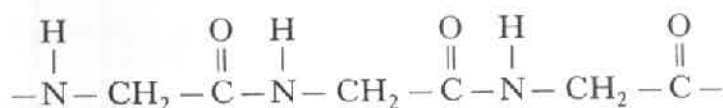
10. Jelly is made from a protein called gelatin.

(a) Name the type of monomers which join together to form proteins.

\_\_\_\_\_

1

(b) A section of the gelatin structure is shown below.



(i) Circle a peptide link in this section of the gelatin structure.

1

(ii) Draw the structure of the monomer which makes this section of the gelatin structure.

1

(c) Papain, an enzyme found in pineapple juice, can hydrolyse gelatin.

When papain is heated to a high temperature it no longer hydrolyses the gelatin. Suggest why.

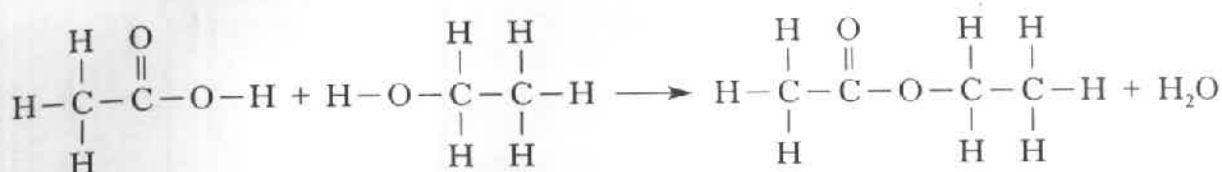
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1

(4)

Marks

11. Ethyl ethanoate can be made by reacting ethanoic acid and ethanol.



- (a) Name this type of chemical reaction.

\_\_\_\_\_

1

- (b) A method of making ethyl ethanoate from ethanol **only**, has been developed.



- (i) Name substance **X**.

\_\_\_\_\_

1

- (ii) This method was developed for use in countries where ethanol is made from a renewable source.

Name this source of ethanol.

\_\_\_\_\_

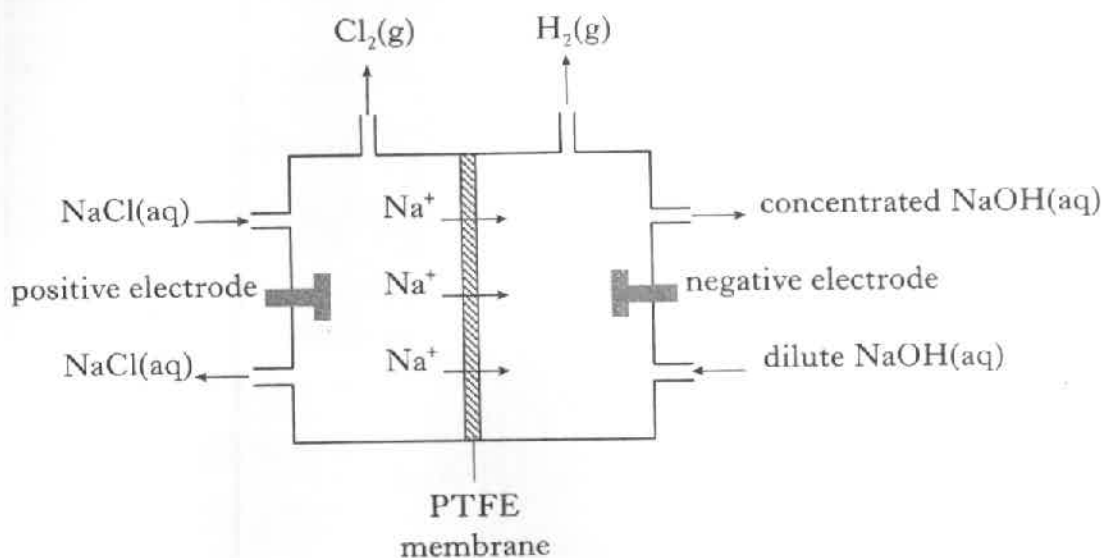
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(3)

[Turn over

Marks

12. A membrane cell can be used to produce **chlorine, hydrogen and sodium hydroxide** from sodium chloride solution.

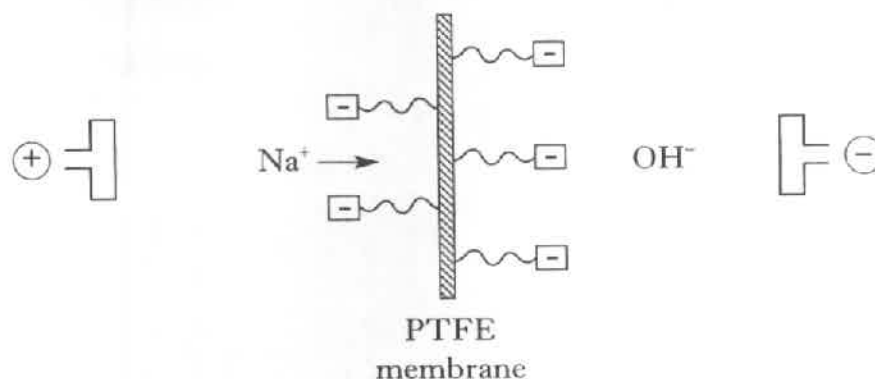


Electrode	Ion-electron equation
positive	$2\text{Cl}^- \longrightarrow \text{Cl}_2 + 2\text{e}^-$
negative	$2\text{H}_2\text{O} + 2\text{e}^- \longrightarrow 2\text{OH}^- + \text{H}_2$

- (a) Combine the ion-electron equations to produce a redox equation.

1

- (b) The membrane is made up of layers of poly(tetrafluoroethene) (PTFE) with negatively charged groups attached. Sodium ions pass through the membrane towards the negative electrode.



Suggest a reason why hydroxide ions ( $\text{OH}^-$ ) will not pass through the membrane towards the positive electrode.

1

- (c) PTFE can be re-shaped on heating.

What name is given to plastics which can be re-shaped on heating?

1

13. (a) The explosive, TNT, is a covalent compound with a low melting point. Which type of covalent structure does TNT have?

Marks

1

- (b) The equation shows the reaction when the compound, TNT, explodes.



Using the equation, name the elements that **must** be present in TNT.

1

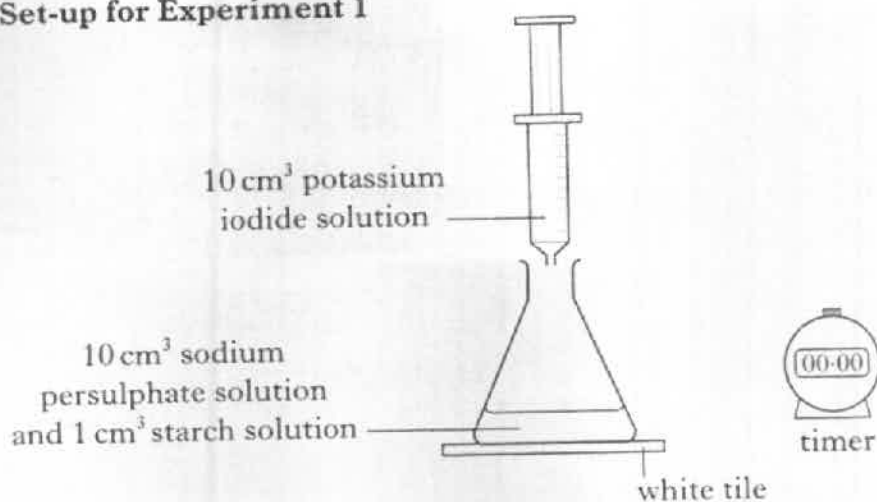
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Marks

14. In the Unit 1 PPA, "Effect of concentration on reaction rate", the reaction between sodium persulphate and potassium iodide solutions is studied.

**Set-up for Experiment 1**



**Results**

Experiment	1	2	3	4
Volume of sodium persulphate solution (cm <sup>3</sup> )	10	8	6	4
Volume of water (cm <sup>3</sup> )	0			
Reaction time (min)	2.1	2.7	3.5	5.6

- (a) Complete the table to show the volumes of water used in experiments 2, 3 and 4.
- (b) How would you know when to stop the timer in each experiment?

- (c) Why are volumes of sodium persulphate solution less than 4 cm<sup>3</sup> not used?

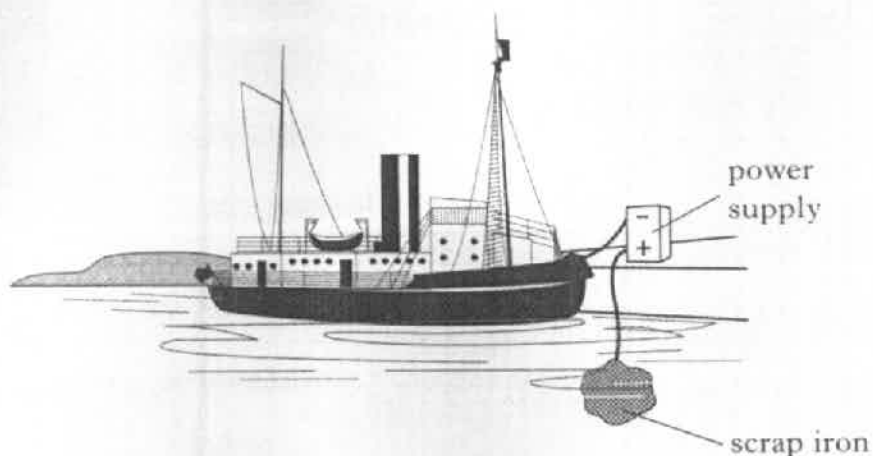
- (d) The formula for the persulphate ion is S<sub>2</sub>O<sub>8</sub><sup>2-</sup>.  
Write the formula for sodium persulphate.

Marks

15. Iron is used to make ships.

Sometimes when a ship docks in a harbour, it is connected to the negative terminal of a power supply. A lump of scrap iron is connected to the positive terminal.

This is used to prevent the iron in the ship from rusting.



- (a) (i) Why does connecting the ship to the negative terminal of the power supply prevent the iron in the ship from rusting?

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1

- (ii) Why is sea water able to complete the circuit?

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1

- (b) Suggest another method which could be used to protect the iron in the ship from rusting?

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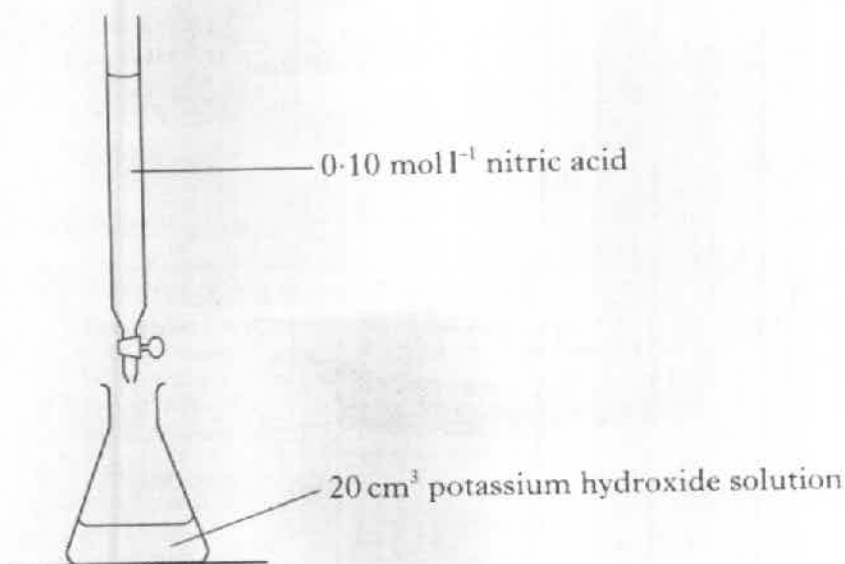
1

(3)

[Turn over for Question 16 on Page twenty-six]

Marks

16. A student carried out a titration to find the concentration of a potassium hydroxide solution using  $0.10 \text{ mol l}^{-1}$  nitric acid.



**Equation**



- (a) What must be added to the flask to show the end-point of the titration?

1

- (b) The average volume of nitric acid needed to neutralise the potassium hydroxide solution is  $24.6 \text{ cm}^3$ .

Calculate the concentration of the potassium hydroxide solution.

\_\_\_\_\_  $\text{mol l}^{-1}$

2  
(3)

[END OF QUESTION PAPER]