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Section B	Total Marks	<input type="text"/>
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X012/201

NATIONAL
QUALIFICATIONS
2003

FRIDAY, 23 MAY
1.00 PM – 3.00 PM

CHEMISTRY
INTERMEDIATE 2

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

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—Questions 1 to 15

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

Read carefully

1. Check that the answer sheet provided is for Chemistry Intermediate 2 (Section A).
2. Fill in the details required on the answer sheet.
3. 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 of the answer sheet—see the sample question below.
4. For each question there is only ONE correct answer.
5. Rough working, if required, should be done only on this question paper, or on the rough working sheet provided—not on the answer sheet.
6. At the end of the examination the answer sheet for Section A must be placed inside the front cover of this answer book.

This part of the paper is worth 30 marks.

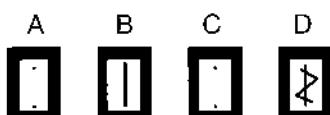
SAMPLE QUESTION

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

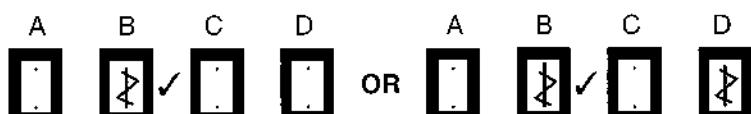
- A fractional distillation
- B chromatography
- C fractional crystallisation
- D filtration.

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:



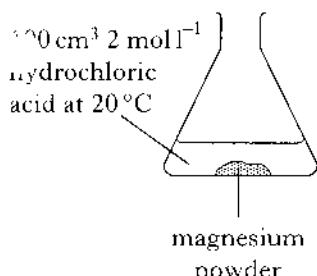
SECTION A

1. Which of the following compounds contains both a transition metal ion and a halide ion?

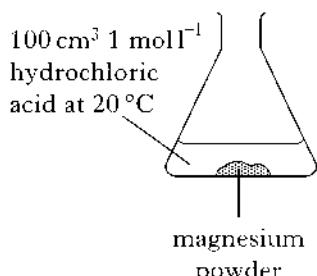
A Aluminium bromide
 B Cobalt chloride
 C Iron oxide
 D Sodium fluoride

2. Magnesium was reacted with dilute hydrochloric acid under different conditions. In each experiment an **excess** of magnesium was added.

Reaction 1



Reaction 2



Which line in the table correctly describes **Reaction 2** when compared to **Reaction 1**?

	Rate of reaction	Volume of gas produced
A	faster	less
B	faster	the same
C	slower	less
D	slower	the same

3. An atom is neutral because

A the number of protons equals the number of neutrons
 B the number of electrons equals the number of protons
 C the number of electrons equals the number of protons plus neutrons
 D the number of neutrons equals the number of protons plus electrons.

4. Which of the following is the electron arrangement for an atom of an alkali metal?

A 2,8,1
 B 2,8,2
 C 2,8,3
 D 2,8,4

5. Different isotopes of the same element have identical

A nuclei
 B mass numbers
 C atomic numbers
 D numbers of neutrons.

6. A metal **X** reacts with oxygen to form an oxide, $\mathbf{X}_2\mathbf{O}_3$. During the reaction each atom of metal **X**

A gains two electrons
 B gains three electrons
 C loses two electrons
 D loses three electrons.

7. Which of the following elements conducts electricity?

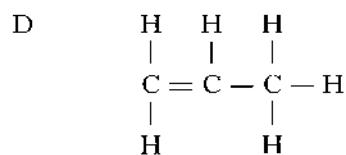
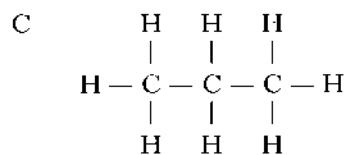
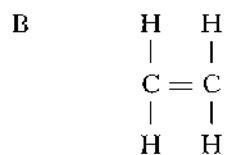
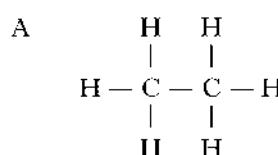
A Bromine
 B Mercury
 C Oxygen
 D Sulphur

8. The formula for potassium sulphate is

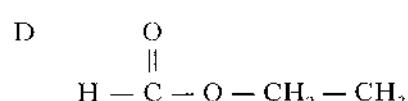
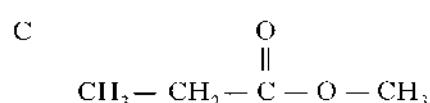
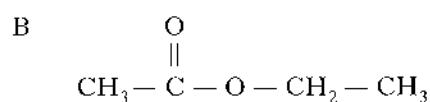
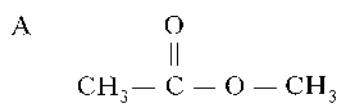
A $\mathbf{P}_2\mathbf{S}\mathbf{O}_3$
 B $\mathbf{K}_2\mathbf{S}\mathbf{O}_4$
 C $\mathbf{P}_2\mathbf{S}\mathbf{O}_4$
 D $\mathbf{K}_2\mathbf{S}$.

[Turn over

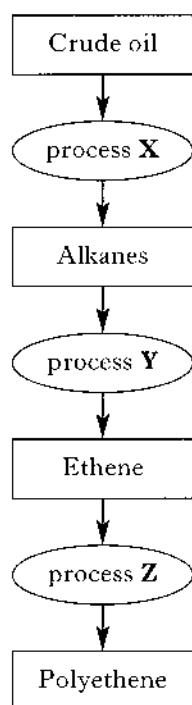
9. Which of the following compounds has an isomer?



10. Which of the following is a structural formula for methyl ethanoate?



11. The flow diagram shows the manufacture of polythene from hydrocarbons in crude oil.



Which line in the table identifies the processes X, Y and Z?

	Process X	Process Y	Process Z
A	distillation	cracking	hydrolysis
B	cracking	combustion	polymerisation
C	polymerisation	distillation	hydrolysis
D	distillation	cracking	polymerisation

12. Ethanol vapour can be dehydrated by passing it over hot aluminium oxide.

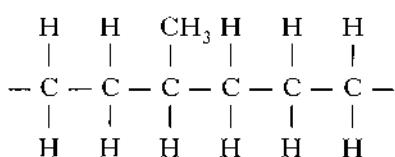
Which of the following compounds would be produced?

A Ethane
B Ethene
C Ethanoic acid
D Ethyl ethanoate

13. Which of the following polymers readily dissolves in water?

A Poly(ethene)
B Perspex
C Poly(ethenol)
D Kevlar

14. Part of the structure of an addition polymer is shown below. It is made using two different monomers.



Which pair of alkenes could be used as monomers?

- A Ethene and propene
- B Ethene and butene
- C Propene and butene
- D Ethene and pentene

15. Which of the following correctly shows all of the elements always present in carbohydrates and proteins?

	Carbohydrates	Proteins
A	C, H and O	C, H and N
B	C and H	C, H and O
C	C, H, O and N	C and H
D	C, H and O	C, H, O and N

16. Which of the following substances dissolves in water to give a solution of pH greater than 7?

- A Ammonia
- B Carbon dioxide
- C Sulphur dioxide
- D Sodium chloride

17. 0.25 mol of potassium hydroxide was dissolved in water and the solution made up to 500 cm³.

What was the concentration, in mol l⁻¹, of the solution which was formed?

- A 0.0005
- B 0.125
- C 0.5
- D 2.0

18. Which of the following statements is true for lithium hydroxide solution?

- A It has a pH less than 7.
- B It contains no H⁺(aq) ions.
- C It is an example of a strong base.
- D It reacts with an acid to form hydrogen gas.

19. Which of the following reacts with dilute hydrochloric acid to give hydrogen gas?

- A Copper
- B Gold
- C Magnesium
- D Mercury

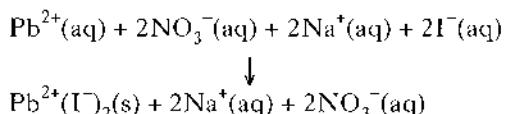
Questions 20 and 21 refer to the following reaction.

When lead(II) nitrate solution is added to sodium iodide solution a precipitate of lead(II) iodide is formed.

20. A sample of precipitate can be separated from the mixture by

- A condensation
- B distillation
- C evaporation
- D filtration.

21. The equation for the reaction is:



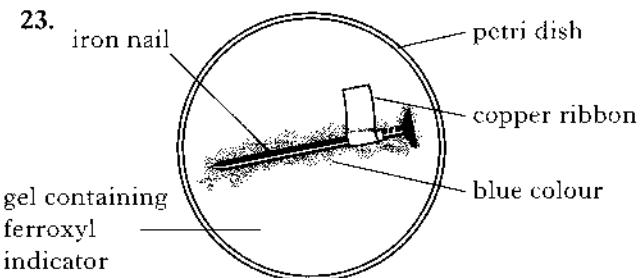
The spectator ions present in this reaction are

- A Na⁺(aq) and NO₃⁻(aq)
- B Na⁺(aq) and I⁻(aq)
- C Pb²⁺(aq) and NO₃⁻(aq)
- D Pb²⁺(aq) and I⁻(aq).

22. Which of the following metals would react with zinc chloride solution?

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

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



Which ion gives a blue colour with ferroxyl indicator?

- A $\text{OH}^-(\text{aq})$
- B $\text{Fe}^{2+}(\text{aq})$
- C $\text{Fe}^{3+}(\text{aq})$
- D $\text{Cu}^{2+}(\text{aq})$

24. An atom has 26 protons, 26 electrons and 30 neutrons. The atom will have

- A atomic number 26, mass number 56
- B atomic number 56, mass number 30
- C atomic number 30, mass number 26
- D atomic number 52, mass number 56.

25. Which of the following substances does **not** exist as diatomic molecules?

- A Bromine
- B Carbon monoxide
- C Oxygen
- D Water

26. The properties of fractions obtained from crude oil depend on the sizes of molecules in the fractions.

Compared with a fraction containing small molecules a fraction containing large molecules will

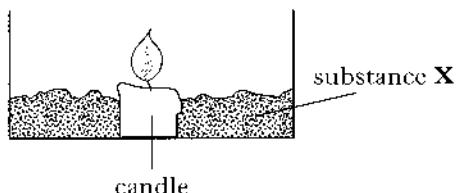
- A be more viscous
- B be more flammable
- C evaporate more readily
- D have a lower boiling point range.

27. During digestion starch is broken down to form glucose.

What name is given to this type of reaction?

- A Combustion
- B Condensation
- C Fermentation
- D Hydrolysis

28. When dilute hydrochloric acid is added to substance **X**, a gas is given off. This gas quickly puts out the candle flame.



Which of the following could be substance **X**?

- A Calcium hydroxide
- B Calcium carbonate
- C Calcium oxide
- D Calcium

29. The formula mass of ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$, is

- A 52
- B 64
- C 96
- D 110.

30. Which sugar will **not** be detected by the Benedict's test?

- A Fructose
- B Glucose
- C Maltose
- D Sucrose

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

[Turn over for SECTION B on *Page eight*]

SECTION B

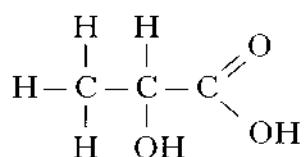
50 marks are available in this section of the paper.

1. Yogurt is made by fermenting fresh milk. Enzymes help to convert lactose in the milk to lactic acid.

(a) What is an enzyme?

1

(b) The structural formula for lactic acid is shown below.



Circle the carboxyl group in the lactic acid molecule.

1

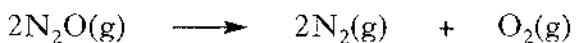
(c) Sugar can be added after fermentation has taken place to sweeten the yogurt.

Suggest why the sugar is added after the fermentation stage and not before.

1
(3)

2. Dinitrogen monoxide can be used to boost the performance of racing car engines.

When dinitrogen monoxide decomposes it forms a mixture of nitrogen and oxygen. The reaction is exothermic.



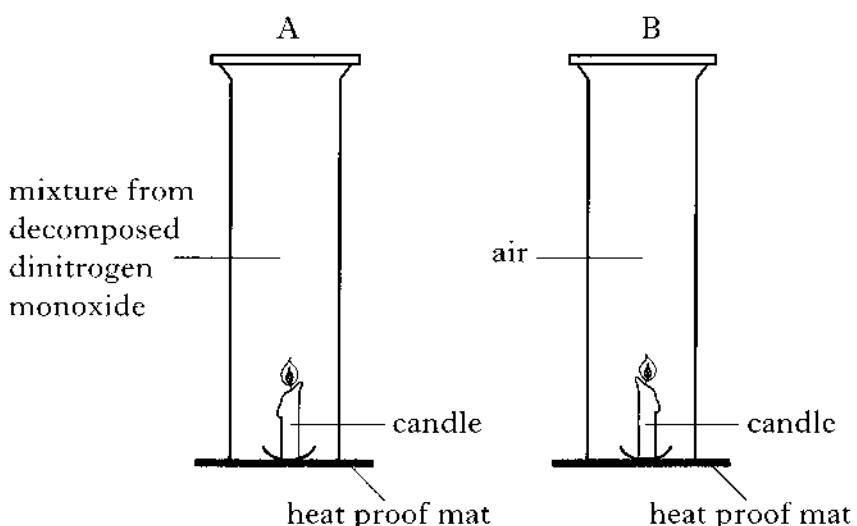
(a) What is meant by an exothermic reaction?

1

(b) How many moles of oxygen will be produced when four moles of dinitrogen monoxide are decomposed.

1

(c) An experiment was set up as shown below.

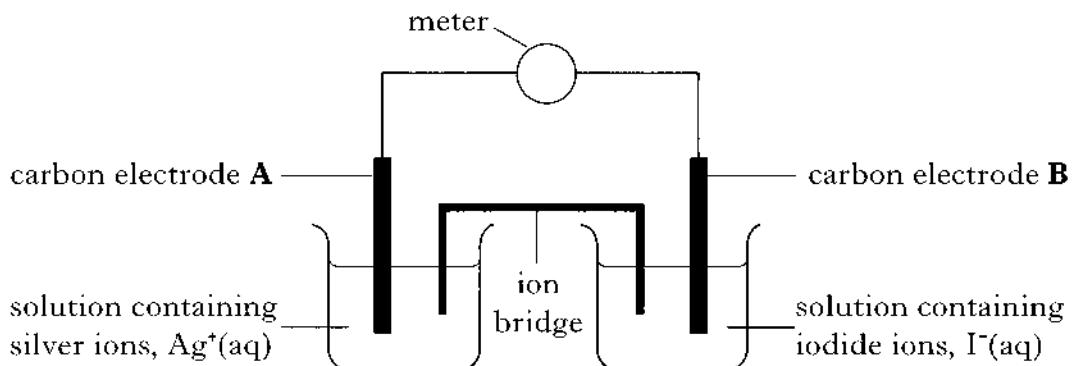


Why will the candle burn for longer in gas jar A?

1
(3)

[Turn over

3. A student set up the following cell.



Electrode	Reactions taking place
A	$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$
B	$2\text{I}^-(\text{aq}) \rightarrow \text{I}_2(\text{s}) + 2\text{e}^-$

(a) On the diagram, clearly mark the path and the direction of the electron flow.

(b) Combine the two ion-electron equations for the electrode reactions to produce a **balanced** redox equation.

1

1

(c) What is the purpose of the ion bridge?

1

(d) Describe the chemical test which could be used to show that iodine is formed at electrode B.

1

(4)

4. The table below shows the saturated and unsaturated fatty acid content of a fat and an oil.

Marks

Source	Fat/oil	% Fatty acid in substance	
		Saturated	Unsaturated
animal	chicken fat	68	32
marine	cod liver oil	25	75

(a) What do fats and oils provide in our diet?

1

(b) Name another source of fats and oils.

1

(c) Why do oils have a lower melting point than fats?

1

(d) How can oils be converted into hardened fats?

1

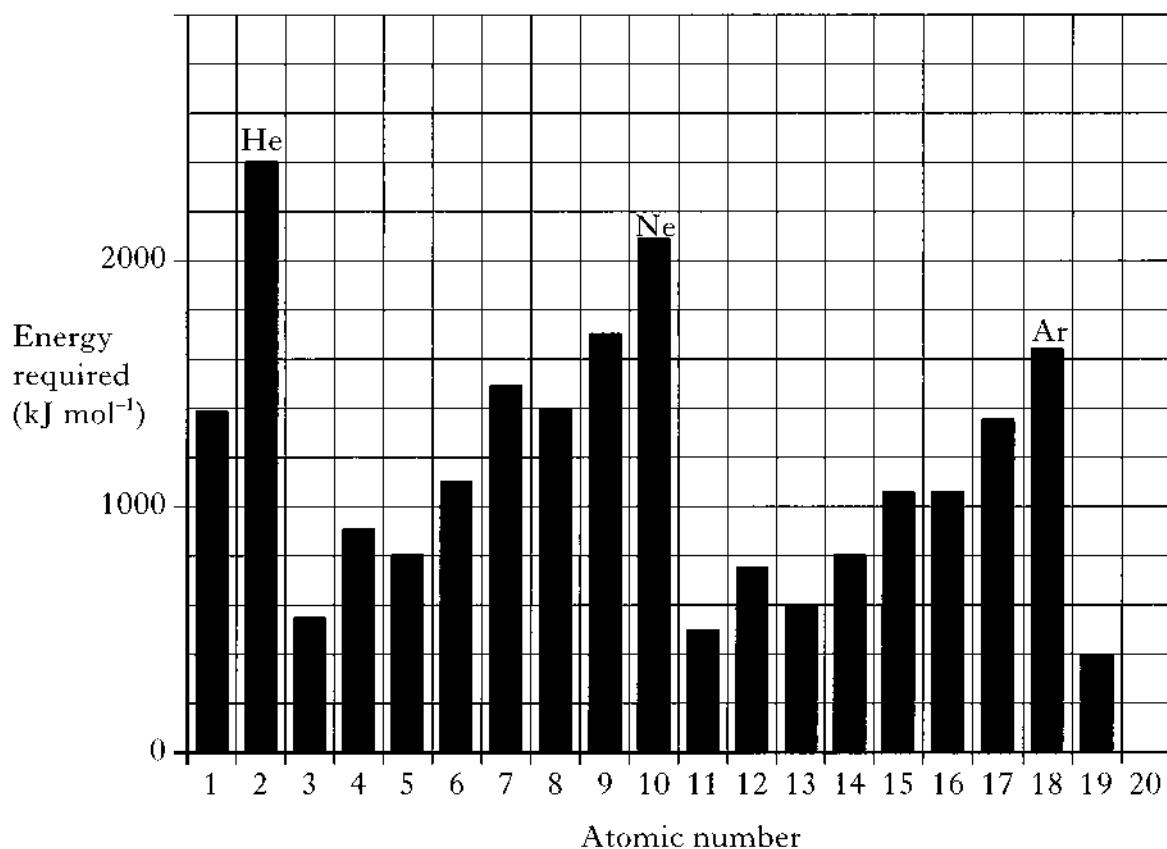
(4)

[Turn over

5. Energy is required to remove an electron from an atom.

Marks

The graph shows the energy required to do this for the first 19 elements.



(a) Describe what happens to the energy required going down a group.

1

(b) Describe the general trend in the energy required going from sodium to argon.

1

(c) Draw a bar on the graph to show the energy you would expect to be required for the element with atomic number 20.

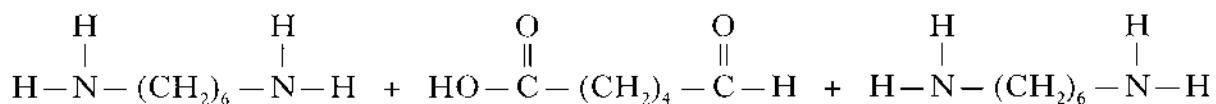
(3)

6. Nylon is a polymer.

Marks

The monomers shown below are used to produce a nylon.

(a) Draw a section of the polymer showing the three monomer units linked together.



1

(b) What feature of their structure makes these molecules suitable for use as monomers?

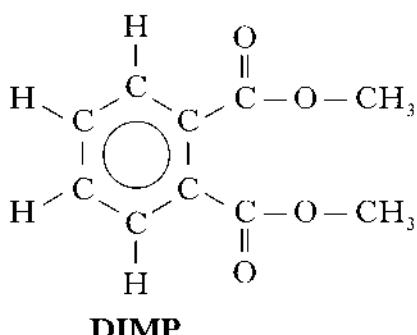
1
(2)

[Turn over

Marks

7. DIMP is a useful insect repellent.

DIMP contains two ester groups, as shown by the structure below.



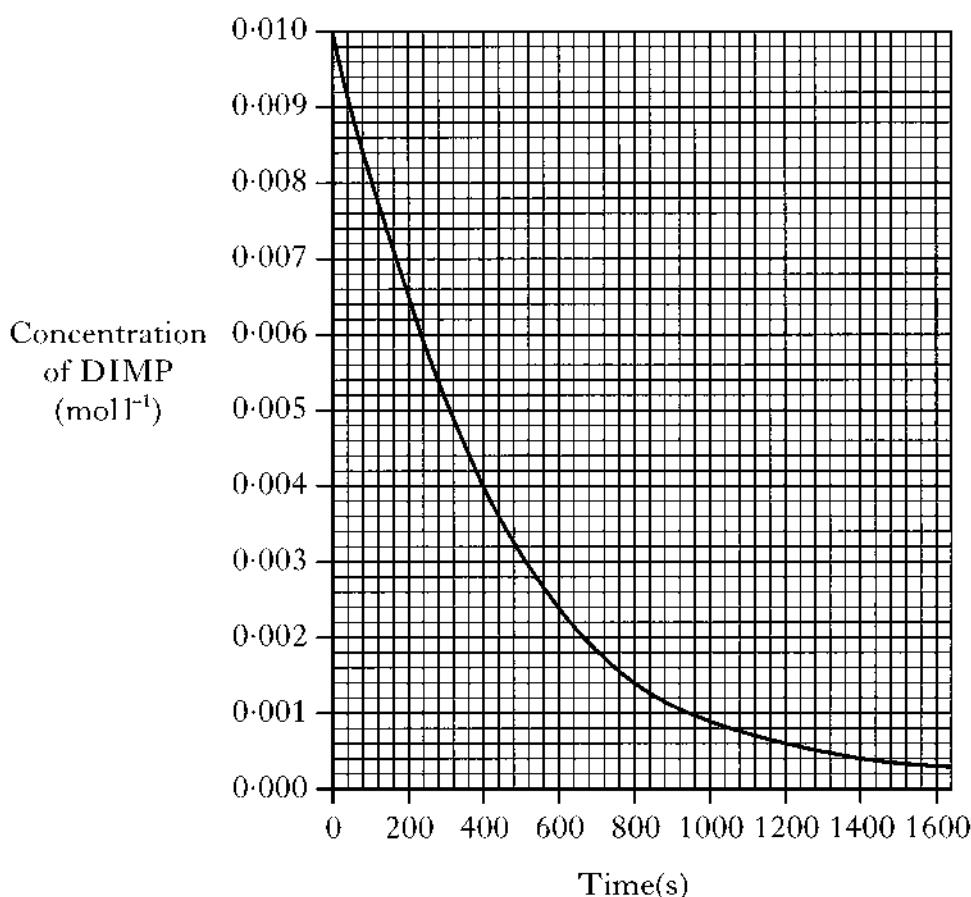
When DIMP is hydrolysed it forms a carboxylic acid and an alkanol.

(a) Name the alkanol produced when DIMP is hydrolysed.

1

(b) An experiment was set up to find out how quickly DIMP is hydrolysed.

The graph shows how the concentration of DIMP changed during hydrolysis.



7. (b) (continued)

Marks

(i) By how much does the concentration of DIMP fall in the first 400 s?

1

(ii) Calculate the average rate of reaction, in $\text{mol l}^{-1} \text{ s}^{-1}$, between 0 and 400 s.

Space for working

_____ $\text{mol l}^{-1} \text{ s}^{-1}$ 1
(3)

[Turn over

8. (a) In a solution of ethanoic acid not all the molecules break up to form ions.

What does this indicate about ethanoic acid?

1

(b) In a solution of hydrochloric acid all of the hydrogen chloride molecules have broken up to form ions.

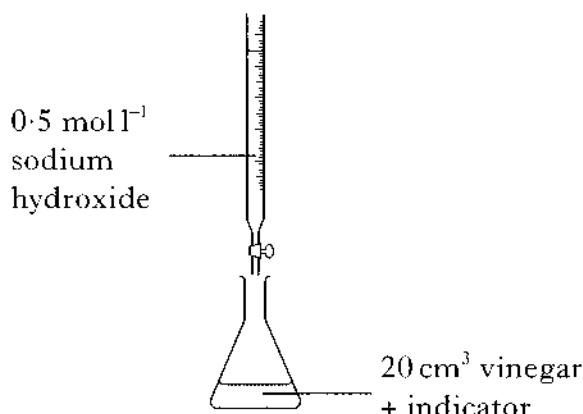
Two properties of solutions of ethanoic acid and hydrochloric acid were compared. The actual results for ethanoic acid are shown in the table.

Circle the appropriate words in the right-hand column of the table to show how the results for hydrochloric acid would compare with those for ethanoic acid.

	0.1 mol l^{-1} ethanoic acid	0.1 mol l^{-1} hydrochloric acid	
pH	4	lower	higher
Rate of reaction with magnesium	slow	slower	faster

2

(c) Vinegar is dilute ethanoic acid. The concentration of ethanoic acid in vinegar can be determined by neutralising a sample of vinegar with sodium hydroxide solution.

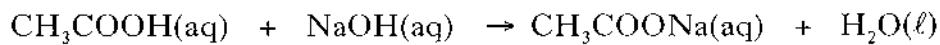


Volume of 0.5 mol l^{-1} sodium hydroxide solution required = 33.4 cm^3

8. (c) (continued)

Marks

The equation for the reaction is



Calculate the concentration, in mol l^{-1} , of the ethanoic acid in vinegar.

_____ mol l^{-1} 2
(5)

[Turn over

9. Part of a student's PPA instruction sheet is shown below.

Intermediate 2 Chemistry	Preparation of a Salt	Unit 3 PPA 1
-----------------------------	-----------------------	-----------------

Aim

The aim of this experiment is to make a magnesium salt by the reaction of magnesium/magnesium carbonate with sulphuric acid.

Procedure

1. Using a measuring cylinder add 20 cm³ of dilute acid to the beaker.
2. Add a spatulaful of magnesium or magnesium carbonate to the acid and stir the reaction mixture with a glass rod.
3. If all the solid reacts add another spatulaful of magnesium or magnesium carbonate and stir the mixture.
4. Continue adding the magnesium or magnesium carbonate until . . .



(a) Complete instruction 4 of the procedure. 1

(b) Why is an excess of magnesium or magnesium carbonate added to the acid? 1

(c) There are three steps in the preparation of magnesium sulphate from magnesium or magnesium carbonate.

Instructions 1 to 4, shown above, describe the "reaction step".

Name the next two steps.

Step 2 _____

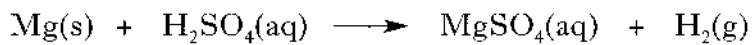
Step 3 _____

1

9. (continued)

Marks

(d) The equation for the preparation of magnesium sulphate from magnesium is shown below.



Calculate the mass of magnesium sulphate produced when 4.9 g of magnesium reacts completely with dilute sulphuric acid.

_____ g 2
(5)

[Turn over

Marks

10. Biogas is a renewable fuel which consists of 70% methane and 30% carbon dioxide.

(a) Name the **two** products which would be formed when biogas is burned in a good supply of air.

1

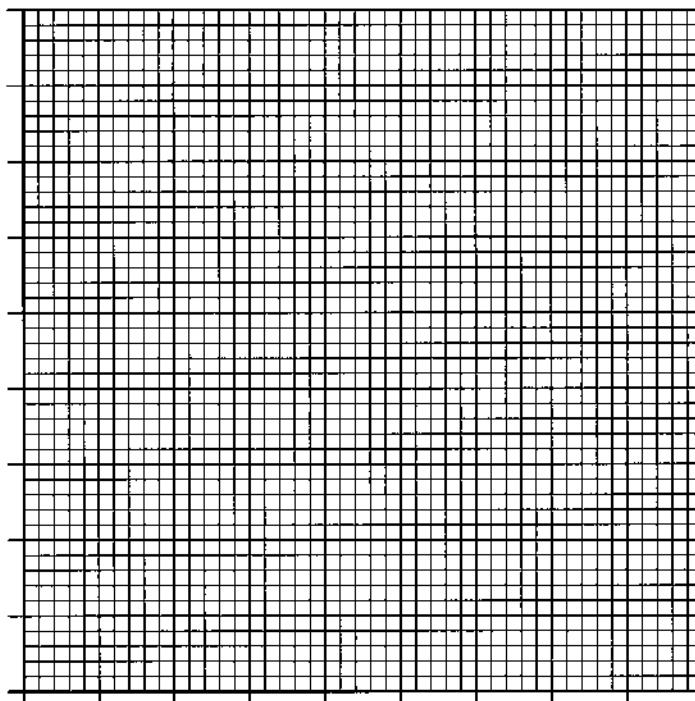
(b) Carbohydrates in plant waste can be digested by bacteria in the soil to produce biogas.

The table shows how the number of bacteria in soil is affected by the pH of the soil.

pH of soil	4.0	4.5	5.5	6.0	6.5
Number of bacteria (millions per gram of soil)	2.0	3.0	8.0	5.0	4.0

(i) Draw a line graph of these results.

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

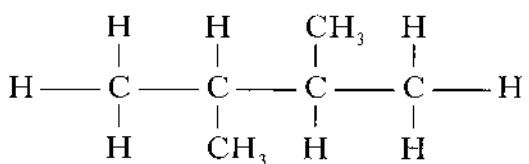


2

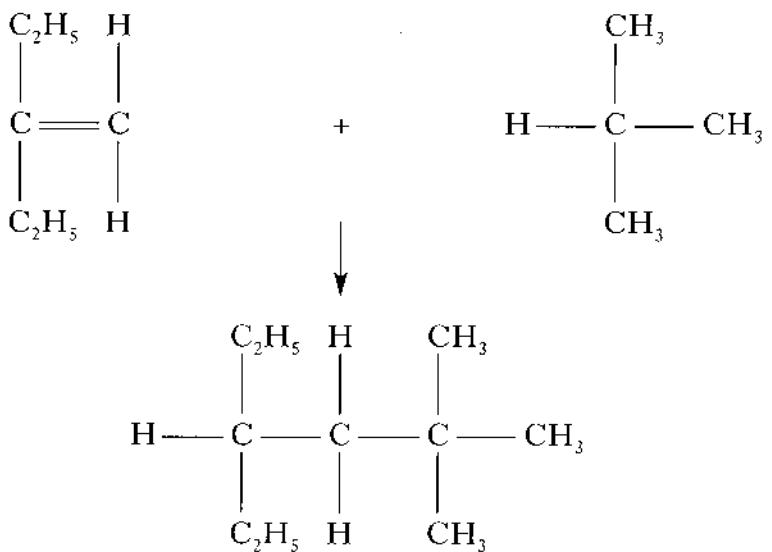
(ii) At which pH would the rate of biogas production be fastest?

1

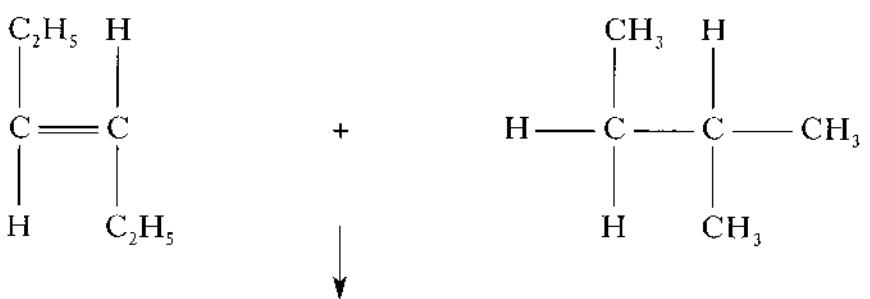
(4)

11. (a) Name the alkane shown below.

1

(b) Alkanes can be reacted with alkenes to produce longer chain alkanes.

Draw the structural formula of the alkane formed in the following reaction.

1
(2)

Marks

12. (a) Why does copper metal conduct electricity?

1

(b) Copper reacts with chlorine to form copper(II) chloride.

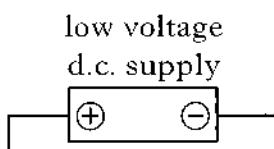
The chloride ions in copper(II) chloride have a stable electron arrangement.
How do they achieve this arrangement?

1

(c) Copper(II) chloride solution can be electrolysed to produce copper and chlorine.

Complete the diagram below to show this electrolysis.

Show clearly where copper and chlorine are formed.

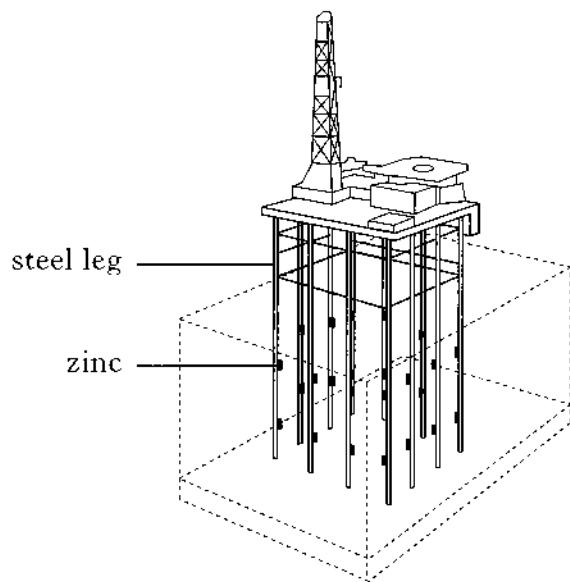


2
(4)

Marks

13. Oil rigs are made from steel.

The oil rigs have zinc blocks attached to them to help prevent rusting. The zinc is oxidised, protecting the steel.



(a) Write the ion-electron equation for the oxidation of zinc.

1

(b) Why would tin blocks not prevent rusting?

1

(c) Stainless steel is a type of steel which does not need protection. It contains chromium which forms an outer layer of chromium(III) oxide.

Write the formula for chromium(III) oxide.

1

(3)

[Turn over

14. A student's results are shown below for the PPA "Testing for Unsaturation".

Marks

Hydrocarbon	Molecular formula	Observation with bromine solution	Saturated or Unsaturated
A	C_6H_{14}	No change	Saturated
B	C_6H_{12}	Bromine decolourises	Unsaturated
C	C_6H_{12}	No change	Saturated
D	C_6H_{10}	Bromine decolourises	Unsaturated

(a) Draw a possible structural formula for hydrocarbon D.

1

(b) Sodium thiosulphate solution is made available as a safety measure, because one of the chemicals used in the experiment is corrosive.

Which chemical is corrosive?

1

(2)

15. Ethers are useful chemicals.

Some ethers are listed in the table below.

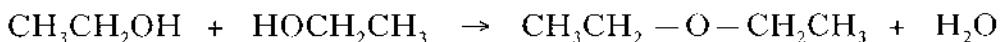
Marks

Structural formula	Name of ether
$\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_2\text{CH}_3$	ethoxyethane
$\text{CH}_3 - \text{O} - \text{CH}_2\text{CH}_2\text{CH}_3$	methoxypropane
$\text{CH}_3 - \text{O} - \text{CH}_2\text{CH}_3$	methoxyethane
$\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_2\text{CH}_2\text{CH}_3$	X

(a) Suggest a name for ether X.

1

(b) An ethoxyethane molecule can be formed when **two** ethanol molecules join together **with the loss of water**.



Name the type of reaction taking place.

1

(c) The boiling points of ethers and alkanes are approximately the same when they have a **similar** relative formula mass.

Suggest the boiling point of ethoxyethane (relative formula mass 74).

(You may wish to use page 6 of the data booklet to help you.)

$$\text{_____ } ^\circ\text{C}$$

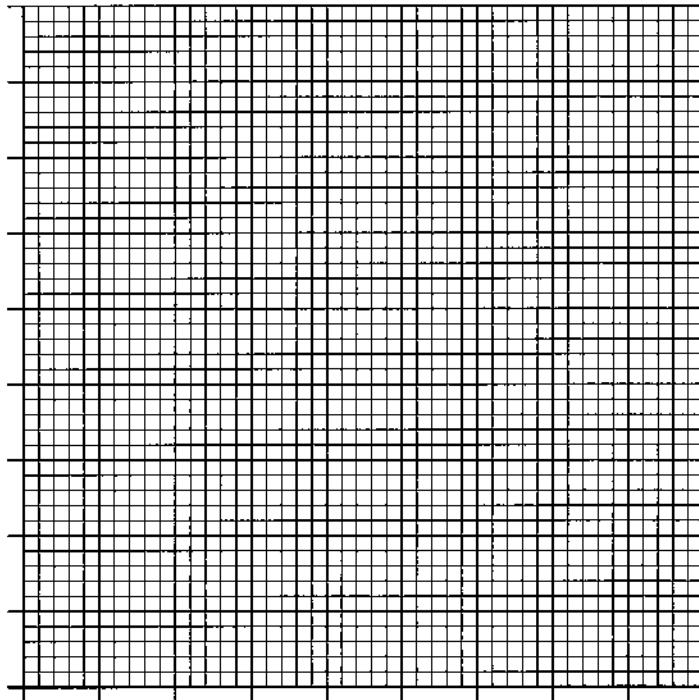
1

(3)

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 10(b)(i)



ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS