FOR OFFICIAL USE

N5

National Qualifications 2019

Mark

X813/75/01

Chemistry
Section 1 — Answer grid and Section 2

FRIDAY, 10 MAY
1:00 PM – 3:30 PM

X8137501

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day		Month		Year	

Scottish candidate number

Total marks — 100

SECTION 1 — 25 marks

Attempt ALL questions.

Instructions for the completion of Section 1 are given on *page 02*.

SECTION 2 — 75 marks

Attempt ALL questions.

You may refer to the Chemistry Data Booklet for National 5.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

X8137501 01

SECTION 1 — 25 marks

The questions for Section 1 are contained in the question paper X813/75/02.

Read these and record your answers on the answer grid on *page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample question

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

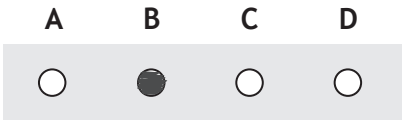
A fractional distillation

B chromatography

C fractional crystallisation

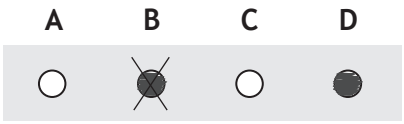
D filtration.

The correct answer is **B** — chromatography. The answer **B** bubble has been clearly filled in (see below).

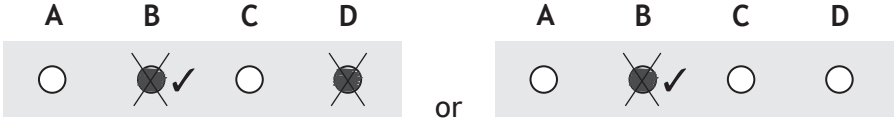


Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



or

* X 8 1 3 7 5 0 1 0 2 *

SECTION 1 — Answer grid

OBJ25AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○
21	○	○	○	○
22	○	○	○	○
23	○	○	○	○
24	○	○	○	○
25	○	○	○	○

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[Turn over for next question

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SECTION 2 — 75 marks

Attempt ALL questions

1. There are many different types of glass.

Glass is made from the chemical silica, SiO_2, which is obtained from sand.

(a) Silica has a melting point of 1713 °C.

State the term used to describe the structure of silica. **1**

(b) Borosilicate glass is a type of glass that also contains the element boron.

A sample of boron contains two different types of atom.

$^{10}_{5}B$ $^{11}_{5}B$

(i) State the term used to describe these different types of boron atom. **1**

(ii) Explain why the mass number of each type of boron atom is different. **1**

(iii) The relative atomic mass of boron is 10·8.

State the mass number of the most common type of atom in the sample. **1**

1. (continued)

(c) Glass that contains a minimum of 24% lead oxide is known as crystal glass.

Calculate the mass, in grams, of lead oxide in a sample of crystal glass weighing 500 g. **1**

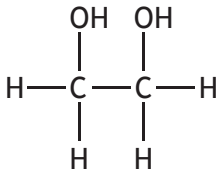
[Turn over

2. Read the passage below and answer the questions that follow.

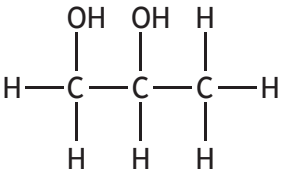
Antifreeze

Antifreeze lowers the freezing point of water. When diluted, antifreeze is used in car engines to prevent water-based liquids from freezing.

Different brands of antifreeze can contain either ethane-1,2-diol or propane-1,2-diol.

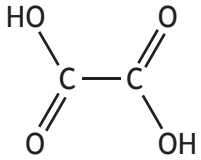


ethane-1,2-diol



propane-1,2-diol

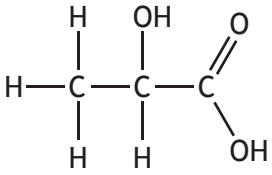
Ethane-1,2-diol is toxic if swallowed. In the liver, an enzyme converts ethane-1,2-diol into oxalic acid.



oxalic acid

The oxalic acid then reacts with calcium in the body to form calcium oxalate. Calcium oxalate is the main component of kidney stones, which can cause extreme pain.

Propane-1,2-diol is not regarded as toxic because the body breaks down the molecule to harmless lactic acid, which is also produced naturally in the body during exercise.



lactic acid

Adapted from *Education in Chemistry, May 2008, Volume 45 Number 3*

2. (continued)

(a) Name the functional group found in both ethane-1,2-diol and propane-1,2-diol. **1**

(b) Name the type of substance used to convert ethane-1,2-diol into oxalic acid. **1**

(c) Name the salt mentioned in the passage. **1**

(d) Calculate the mass, in grams, of 1 mole of the harmless product formed, in the body, from propane-1,2-diol. **1**

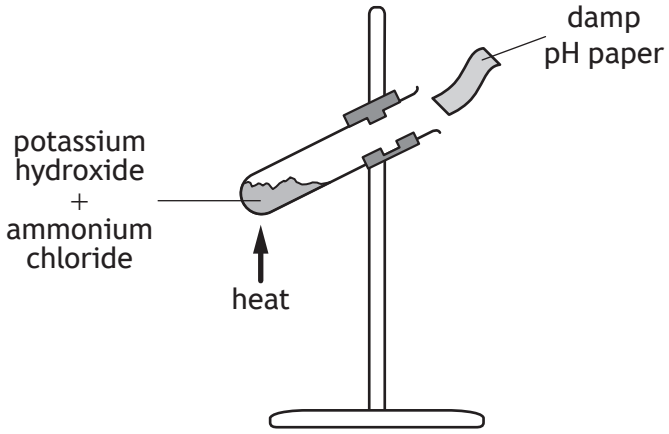
[Turn over

3. Nitrogen and hydrogen react together to form ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Draw a diagram, showing **all** outer electrons, to represent a molecule of nitrogen gas, N_2. **1**

(b) The following method can be used to prepare small quantities of ammonia in the laboratory.



Suggest what colour the damp pH paper would be after the mixture is heated. **1**

MARKS

DO NOT WRITE IN THIS MARGIN

(c) In industry, ammonia can be produced by the Haber process.

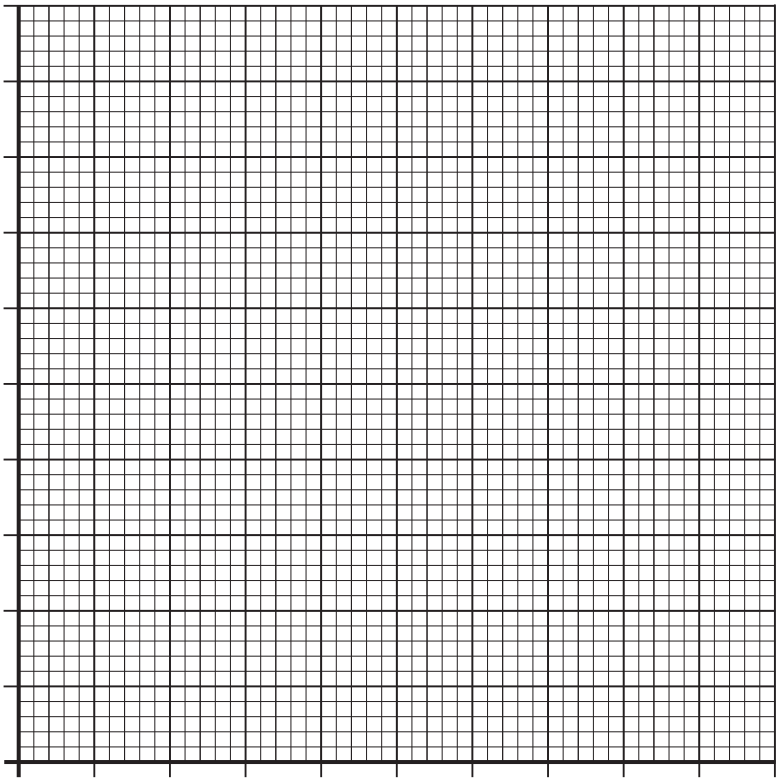
The table shows the yield of ammonia produced at different temperatures by this process.

Temperature (°C)	100	200	400	500	600	700
Percentage yield of ammonia (%)	97	87	46	28	17	10

(i) Describe the relationship between temperature and percentage yield of ammonia. **1**

(ii) Draw a graph of the percentage yield of ammonia against temperature. **4**

(Additional graph paper, if required, can be found on *page 33*.)



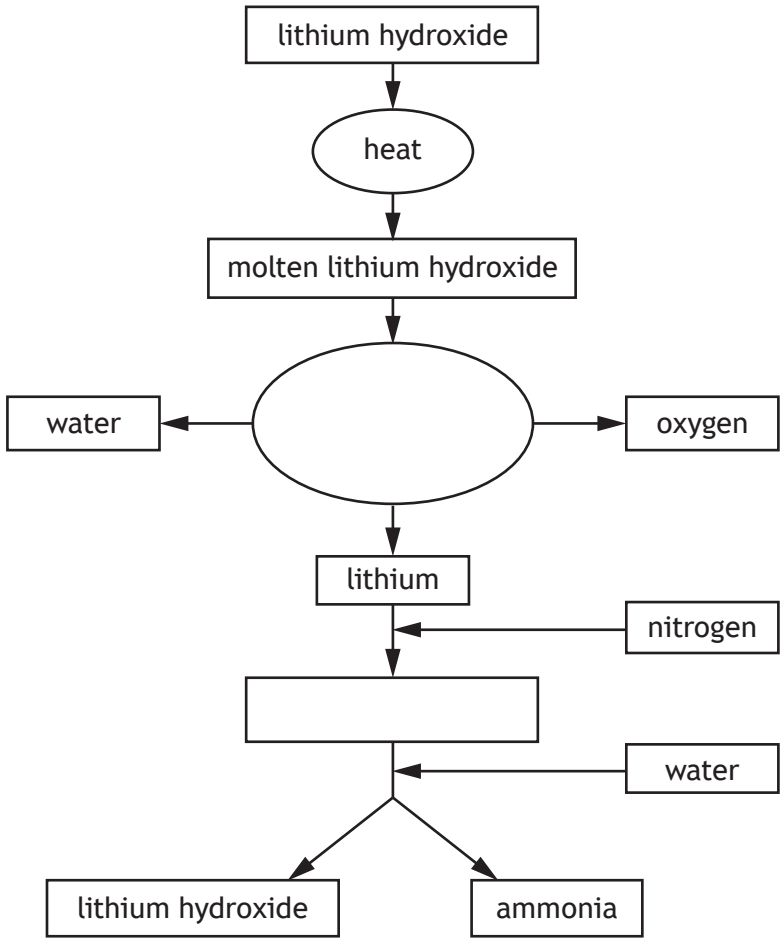
3. (continued)

(d) Scientists are developing an alternative industrial process to produce ammonia, which is more efficient than the Haber process.

This involves the electrolysis of molten lithium hydroxide to produce lithium, water and oxygen. Lithium is then reacted with nitrogen gas, which is obtained from air, to produce lithium nitride. Ammonia and lithium hydroxide are produced when lithium nitride reacts with water.

(i) Complete the flow diagram using the information above. **1**

(An additional diagram, if required, can be found on *page 34*.)



(ii) **On the flow diagram**, draw an arrow to show how the process can be made more economical. **1**

4. Radioisotopes emit radiation to become more stable.

(a) State where the radioactive decay occurs in an atom. **1**

(b) Iodine-131 is a radioisotope with a half-life of 8 days and can be used in the treatment of thyroid cancer.

(i) State what is meant by the term half-life. **1**

(ii) Calculate the percentage of iodine-131 that would have **decayed** after 24 days. **3**

(iii) Different concentrations of iodine-131 are used to treat different types of cancer.

Circle the correct words to complete the sentence. **1**

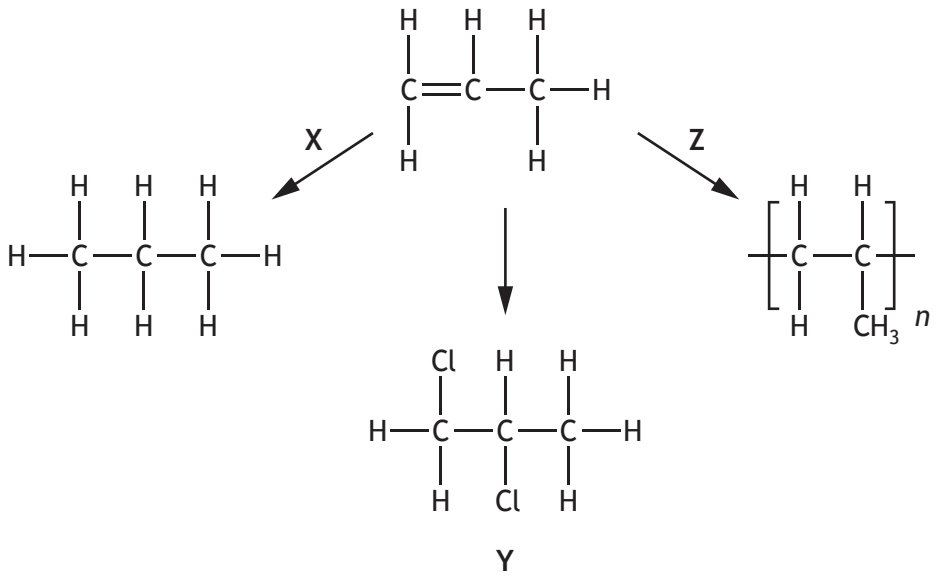
When an iodine-131 solution is diluted,

the half-life { gets longer / stays the same / gets shorter }.

5. The alkenes are a family of unsaturated hydrocarbons.

(a) Describe the chemical test, including the result, to show that a hydrocarbon is unsaturated. **1**

(b) Propene is an alkene that can take part in a range of addition reactions.



Y

(i) Name the type of addition reaction taking place in reaction **X**. **1**

(ii) Name the chemical that reacts with propene to form compound **Y**. **1**

(iii) Name the polymer formed in reaction **Z**. **1**

5. (continued)

(c) The cycloalkenes are another family of unsaturated hydrocarbons.

(i) Cyclohexene can be made by reacting ethene with butadiene in a reaction called the Diels-Alder reaction as shown.

$$\underset{\text{ethene}}{C_2H_4} + \underset{\text{butadiene}}{C_4H_6} \rightarrow \underset{\text{cyclohexene}}{C_6H_{10}}$$

Calculate the mass, in grams, of ethene required to make 410 g of cyclohexene. **3**

Show your working clearly.

(ii) The table gives information about cyclopentene and cyclohexene.

Cycloalkene	Boiling point (°C)
cyclopentene	45
cyclohexene	83

Explain why cyclopentene has a lower boiling point than cyclohexene. **2**

6. An oxide is a compound that contains at least one oxygen atom and **only one** other element in its chemical formula.

Using your knowledge of chemistry, comment on the chemistry of oxides. **3**

[Turn over for next question

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X8137501 17

7. Paraffin wax is a mixture of hydrocarbon molecules that belong to the same homologous series.

(a) State what is meant by the term homologous series. **1**

(b) An example of one hydrocarbon contained in paraffin wax is $C_{25}H_{52}$.

(i) Name the homologous series to which this hydrocarbon belongs. **1**

(ii) Write the molecular formula for the molecule, containing 72 hydrogen atoms, that belongs to the same homologous series. **1**

7. (continued)

(c) The table contains information about some hydrocarbon molecules.

Number of carbon atoms	Boiling point (°C)
20	343
21	356
22	369
23	381

Predict the boiling point, in °C, of the hydrocarbon with 24 carbon atoms. **1**

[Turn over

8. Read the passage below and answer the questions that follow.

Beryllium

Beryllium is a rare element in the universe. Unlike most elements it was not formed during the Big Bang or by stars. In fact, beryllium is only formed in supernova explosions.

Beryllium is found in the mineral Beryl, which has the chemical name beryllium aluminium silicate. Beryl makes up a range of glittering gemstones such as emerald and aquamarine.

In 1828 the metal beryllium was extracted from beryllium chloride ($BeCl_2$) by reacting this compound with potassium. Potassium chloride was also produced in this reaction.

In 1932 James Chadwick discovered when a sample of beryllium was bombarded with X-rays from radium, it emitted a new kind of sub-atomic particle that had mass but no charge. He called this new particle a neutron and was awarded the Nobel Prize for his work in 1935.

Adapted from *Education in Chemistry, November 2015, Volume 52, Issue 6*

(a) State where beryllium is formed. **1**

(b) Name the elements found in the mineral Beryl. **1**

8. (continued)

(c) Write an equation, using symbols and formulae, to show the reaction taking place when beryllium is extracted from beryllium chloride.

There is no need to balance the equation. **1**

(d) During the extraction of beryllium, the beryllium ions are changed to beryllium atoms.

Name this type of chemical reaction. **1**

(e) Write the nuclide notation for the sub-atomic particle discovered by James Chadwick in 1932. **1**

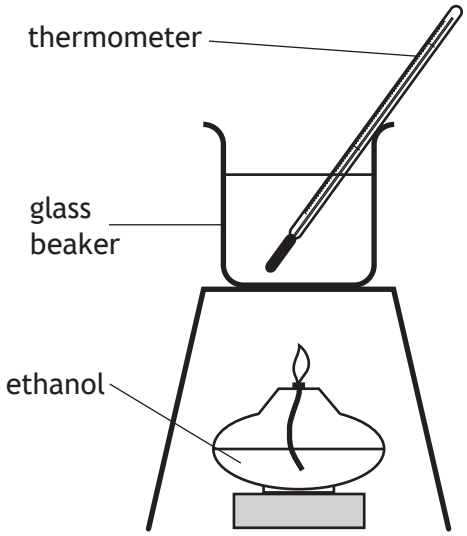
[Turn over

9. Alcohols can take part in different types of chemical reaction.

(a) When alcohols are burned, heat energy is released.

State the term used to describe all chemical reactions that release heat energy. **1**

(b) A student carried out the following experiment.



(i) When 0·8 g of ethanol was burned, 8·36 kJ of energy was absorbed by the water.

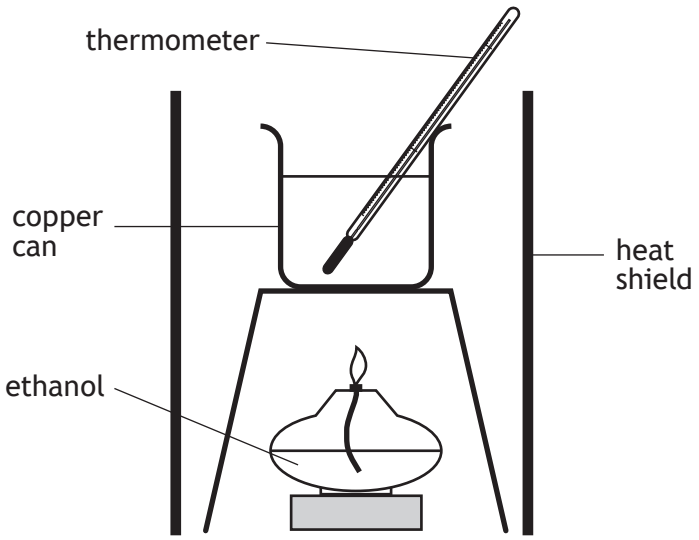
If the temperature of the water increased by 40 °C, calculate the mass, in kg, of water used by the student in this experiment. **3**

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

Show your working clearly.

9. (b) (continued)

(ii) The experiment was repeated, replacing the glass beaker with a copper can and using a heat shield.



Explain why these changes resulted in more heat energy being absorbed by the water. **2**

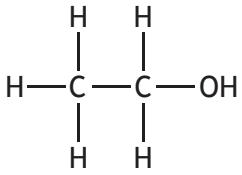
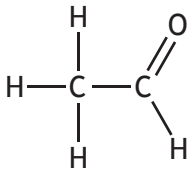
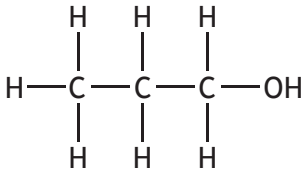
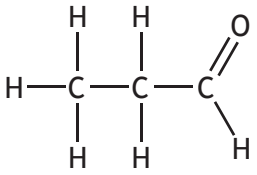
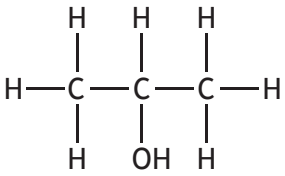
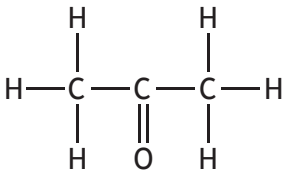
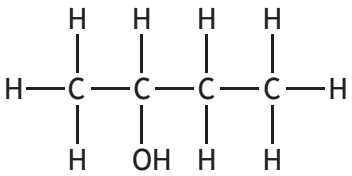
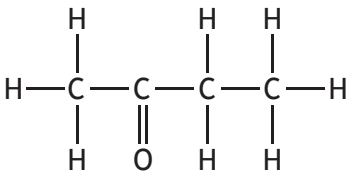
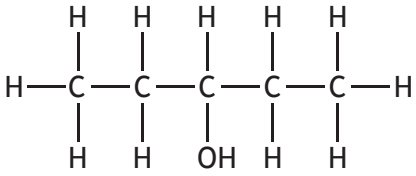
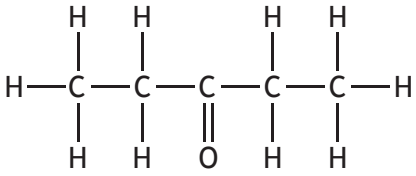
Improvement	Explanation
Use of a copper can	
Use of a heat shield	

[Turn over

9. (continued)

(c) Alcohols can react with hot copper(II) oxide.

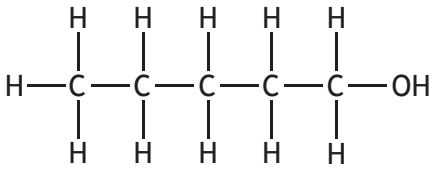
Depending on the structure of the alcohol used, the product will be either an aldehyde or a ketone.

Structural formula of alcohol	Type of product	Structural formula of product
	aldehyde	
	aldehyde	
	ketone	
	ketone	
	ketone	

(i) Write a general statement linking the position of the functional group in an alcohol to the **type** of product formed. **1**

9. (c) (continued)

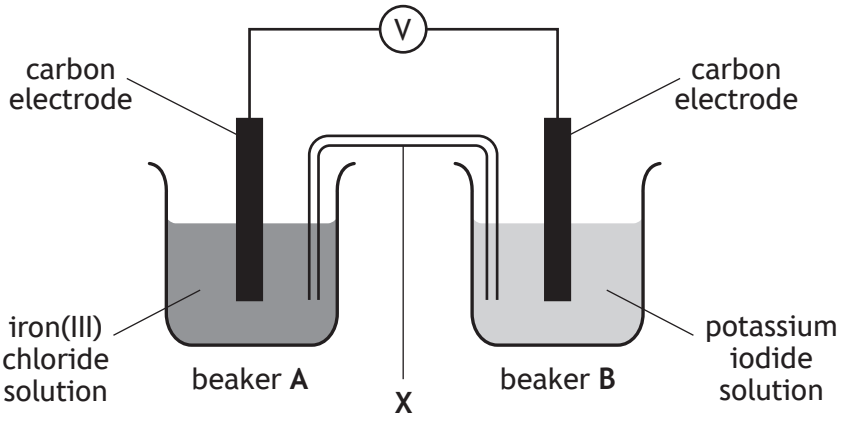
(ii) The following alcohol reacts with hot copper(II) oxide to produce an aldehyde.



Draw the full structural formula for the aldehyde produced when this alcohol reacts with hot copper(II) oxide. **1**

[Turn over

10. A student set up an electrochemical cell using solutions of iron(III) chloride and potassium iodide.



The reactions taking place are

beaker **A** $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$

beaker **B** $2I^-(aq) \rightarrow I_2(\ell) + 2e^-$

(a) Name the piece of apparatus labelled **X**. **1**

(b) (i) **On the diagram**, draw an arrow to show the path and direction of electron flow. **1**

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

(ii) Name the type of chemical reaction taking place in beaker **B**. **1**

10. (b) (continued)

(iii) Write the redox equation for the overall reaction. **1**

(c) Carbon in the form of graphite is a suitable material for use as an electrode as it does not react with the solutions.

Suggest another reason why it is a suitable material. **1**

[Turn over

11. A student was asked to prepare the soluble compound, calcium propanoate.

A section of the procedure used by the student is shown.

Preparation of calcium propanoate

Procedure

1. Using a measuring cylinder add 20 cm^3 of dilute acid to a beaker.
2. Add a spatulaful of calcium carbonate to the acid and stir the reaction mixture with a glass rod.
3. Continue adding the calcium carbonate until . . .

(a) Write the formula, showing the charge on each ion, for calcium carbonate. **1**

(b) Name the acid used to prepare calcium propanoate. **1**

(c) Complete the instruction for step 3 of the procedure. **1**

Continue adding the calcium carbonate until . . .

(d) After step 3 has been completed a further two techniques are carried out to prepare a dry sample of calcium propanoate.

Name the two techniques, in the correct order, that must be carried out. **1**

1st technique _____

2nd technique _____

12. A student carried out a titration experiment to calculate the concentration of a solution of hydrochloric acid.

(a) Before the titration was carried out the student prepared a 200 cm^3 solution of sodium carbonate.

This solution had an accurate concentration of 1·0 mol l^{-1}.

(i) State the term given to a solution of accurately known concentration. **1**

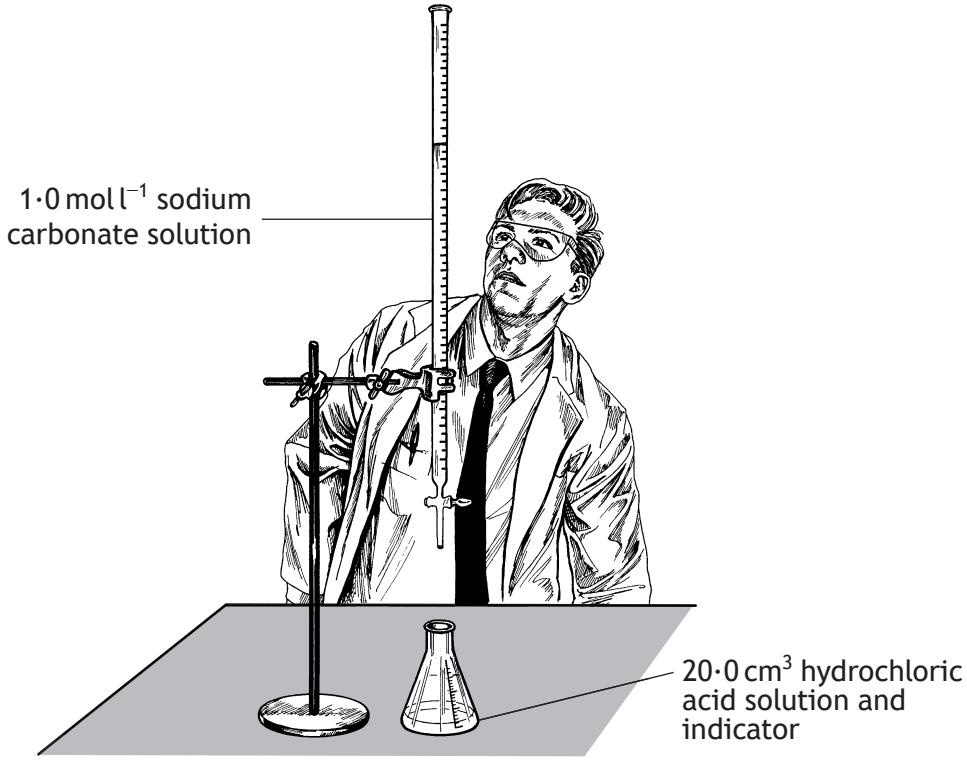
(ii) Calculate the mass, in grams, of sodium carbonate, Na_2CO_3, required to prepare 200 cm^3 of 1·0 mol l^{-1} solution. **3**

Show your working clearly.

[Turn over

12. (continued)

(b) The student performed the titration as shown.



(i) Suggest one improvement to the student's experimental technique. **1**

(ii) State why an indicator is used. **1**

12. (continued)

(iii) The average volume of sodium carbonate used was 15·0 cm^3.

To calculate the average volume of sodium carbonate used, the student only used titre volumes within 0·2 cm^3 of each other.

State the term used to describe these titre volumes. **1**

(iv) The equation for the reaction is

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(\ell) + CO_2(g)$$

Calculate the concentration, in mol l^{-1}, of the hydrochloric acid solution. **3**

Show your working clearly.

[Turn over for next question

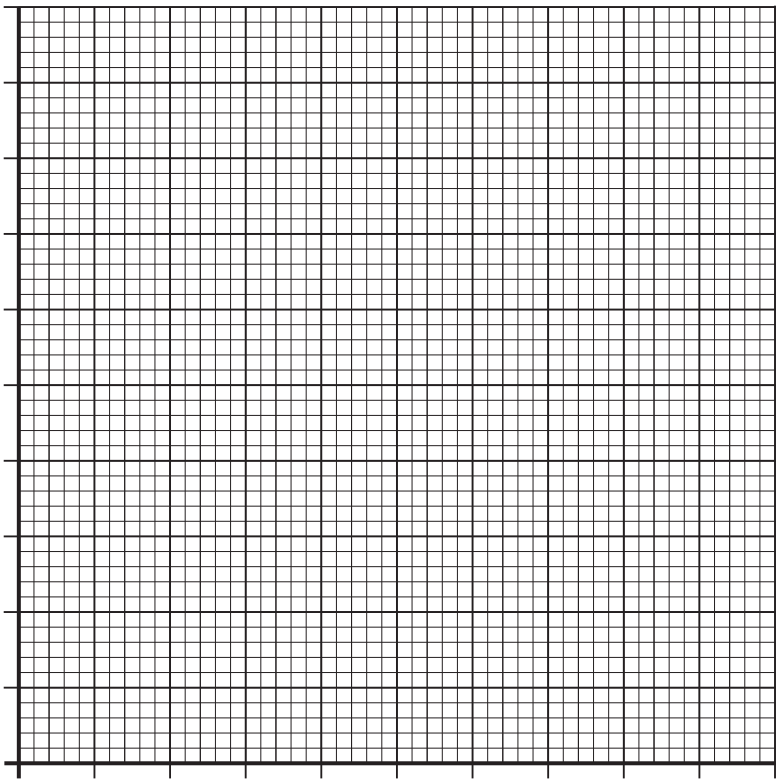
13. The force of attraction between oppositely charged particles is important in chemistry.

Using your knowledge of chemistry, explain why this force of attraction is important. **3**

[END OF QUESTION PAPER]

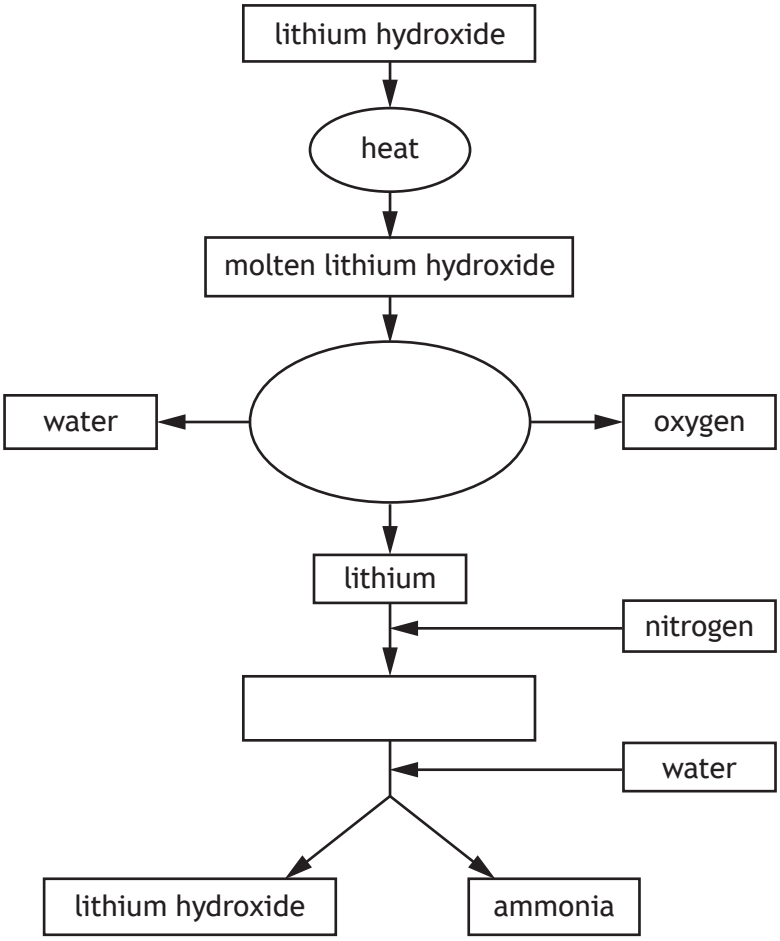
ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph for use with question 3 (c) (ii)



ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional diagram for question 3 (d) (i)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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