FOR OFFICIAL USE

						Section B	Total Marks	

NATIONAL QUALIFICATIONS 2014

CHEMISTRY
INTERMEDIATE 2

MONDAY, 12 MAY
9.00 AM – 11.00 AM

X012/11/02

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

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

Section A – Questions 1–30 (30 marks)

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

For this section of the examination you must use an **HB pencil**.

Section B (50 marks)

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, should be written in this book, and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the Invigilator.

Additional space for answers 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 booklet.

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.

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

SQA ©

Read carefully

1 Check that the answer sheet provided is for **Chemistry Intermediate 2 (Section A)**.

2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.

3 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

4 If any of this information is wrong, tell the Invigilator immediately.

5 If this information is correct, **print** your name and seat number in the boxes provided.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).

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

8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.

9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

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

A chromatography

B fractional distillation

C fractional crystallisation

D filtration.

The correct answer is **A**—chromatography. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).

Changing an answer

If you decide to change your answer, carefully erase your first answer and, using your pencil, fill in the answer you want. The answer below has been changed to **D**.

SECTION A

1. Which of the following elements is an alkali metal?

A Aluminium

B Calcium

C Copper

D Sodium

2. Lemonade can be made by dissolving sugar, lemon juice and carbon dioxide in water.

In lemonade, the solvent is

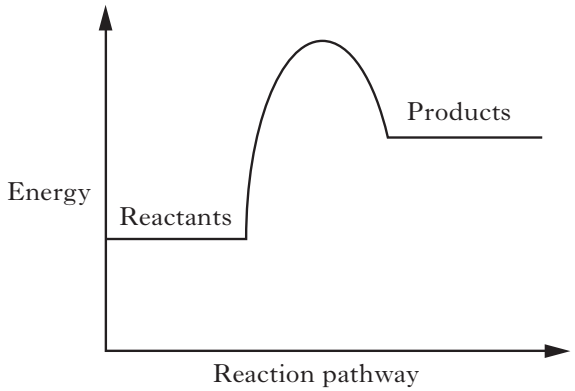
A water

B sugar

C lemon juice

D carbon dioxide.

3. The diagram shows the energy change during a chemical reaction.



Which of the following statements is true?

A The products have less energy than the reactants.

B The temperature of the reaction mixture will fall.

C Energy is given out to the surroundings.

D The reaction is exothermic.

4. Chemical reactions which take place in living cells can be catalysed by

A carbohydrates

B enzymes

C sugars

D fats.

5. Which of the following is the electron arrangements for a halogen atom?

A 2, 4

B 2, 5

C 2, 6

D 2, 7

6. What is the charge on the zinc ion in the compound zinc phosphate, $Zn_3(PO_4)_2$?

A 2+

B 3+

C 2–

D 3–

7. Which line in the table shows the properties of a covalent network compound?

			Conducts electricity	
	Melting point (°C)	**Boiling point (°C)**	**Solid**	**Liquid**
A	19	80	no	no
B	655	1425	no	no
C	1450	1740	no	yes
D	1495	2927	yes	yes

[Turn over

8. When a solution of hydrochloric acid is electrolysed, the reaction occurring at the negative electrode is

A $2H^+(aq) + 2e^- \longrightarrow H_2(g)$

B $H_2(g) \longrightarrow 2H^+(aq) + 2e^-$

C $2Cl^-(aq) \longrightarrow Cl_2(g) + 2e^-$

D $Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq)$.

9. $Fe_2O_3 + \boldsymbol{x}\ CO \longrightarrow \boldsymbol{y}\ Fe + 3CO_2$

This equation will be balanced when

A $x = 1$ and $y = 2$

B $x = 2$ and $y = 2$

C $x = 3$ and $y = 2$

D $x = 2$ and $y = 3$.

10. 0·5 mol of gas **X** has a mass of 23 g.

Gas **X** could be

A CH_4

B CO_2

C NO_2

D NH_3.

11. Catalytic converters speed up the conversion of harmful gases to less harmful gases. Which of the following reactions is most likely to occur in a catalytic converter?

A Carbon dioxide reacting to form carbon monoxide

B Carbon monoxide reacting to form carbon dioxide

C Nitrogen reacting to form nitrogen dioxide

D Oxygen reacting to form hydrogen oxide

12. A compound burns in air. The only products of the reaction are carbon dioxide, nitrogen dioxide and water vapour.

The compound **must** contain

A carbon and hydrogen only

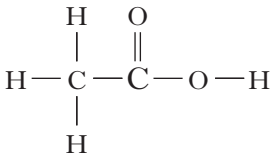
B carbon and nitrogen only

C carbon, hydrogen and nitrogen

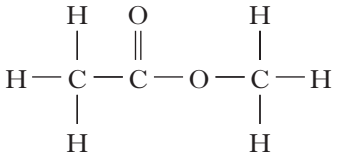
D carbon, hydrogen, nitrogen and oxygen.

13. Which structural formula represents an alkanoic acid (carboxylic acid)?

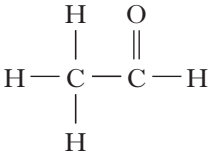
A



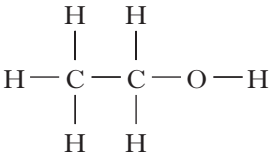
B



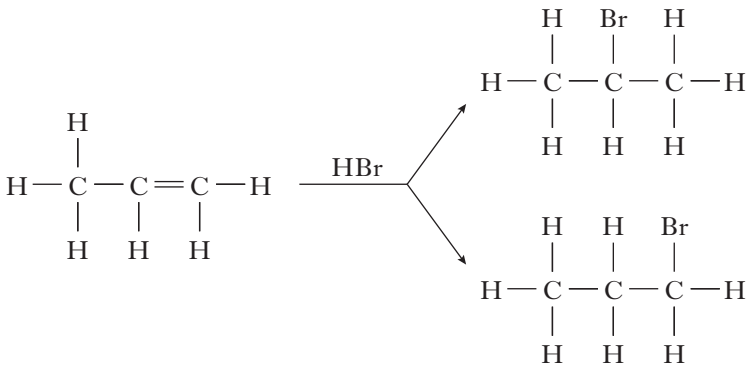
C



D



14. Propene reacts with hydrogen bromide to form two products.



Which of the following alkenes does **not** form two products on reaction with hydrogen bromide?

A But-1-ene

B But-2-ene

C Pent-1-ene

D Pent-2-ene

15. The method used to increase the ethanol concentration of fermentation products is

A addition

B cracking

C distillation

D hydrolysis.

16. A polythene bowl melted when placed in a hot oven.

It can be deduced that polythene is a

A natural thermoplastic polymer

B natural thermosetting polymer

C synthetic thermosetting polymer

D synthetic thermoplastic polymer.

17. Starch is made in plants from

A fructose by condensation polymerisation

B glucose by condensation polymerisation

C fructose by addition polymerisation

D glucose by addition polymerisation.

18. Which of the following carbohydrates does **not** react with either iodine solution or Benedict's solution?

A Glucose

B Maltose

C Sucrose

D Starch

19. Amino acids are monomers which are used to make

A esters

B fats

C proteins

D starch.

20. An acidic solution contains

A only hydrogen ions

B only hydroxide ions

C more hydrogen ions than hydroxide ions

D more hydroxide ions than hydrogen ions.

21. Which of the following solutions has the highest pH?

A $0{\cdot}1\ mol\ l^{-1}$ ammonia solution

B $0{\cdot}1\ mol\ l^{-1}$ sodium hydroxide

C $0{\cdot}1\ mol\ l^{-1}$ ethanoic acid

D $0{\cdot}1\ mol\ l^{-1}$ hydrochloric acid

22. Which of the following oxides, when shaken with water, would give an alkaline solution?

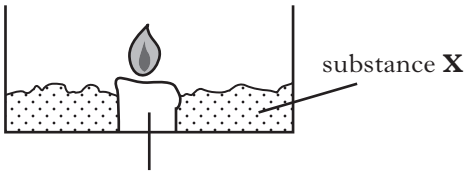
A Calcium oxide

B Nickel oxide

C Nitrogen dioxide

D Sulphur dioxide

23. 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 Magnesium hydroxide

B Magnesium carbonate

C Magnesium oxide

D Magnesium

24. Which of the following salts would **not** be suitable as a fertiliser?

A Sodium nitrate

B Ammonium nitrate

C Ammonium sulphate

D Sodium sulphate

25. Which of the following metals will **not** react with a dilute solution of hydrochloric acid?

A Copper

B Iron

C Magnesium

D Zinc

26. $Ba^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq)$

$\downarrow$

$Ba^{2+}SO_4^{2-}(s) + 2Na^+(aq) + 2NO_3^-(aq)$

The type of reaction represented by the equation above is

A addition

B displacement

C neutralisation

D precipitation.

27. Which of the following reactions takes place during the rusting of iron?

A $Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$

B $Fe^{2+}(aq) + 2e^- \longrightarrow Fe(s)$

C $Fe^{2+}(aq) \longrightarrow Fe^{3+}(aq) + e^-$

D $Fe^{3+}(aq) + 3e^- \longrightarrow Fe(s)$

28. Which of the following compounds could be used as an electrolyte in an electrochemical cell?

A Hexane

B Copper(II) oxide

C Calcium chloride

D Carbon chloride

29. The ion-electron equations for the oxidation and reduction steps in the reaction between **sulphite ions** and **iron(III) ions** are given below.

oxidation $H_2O(\ell) + SO_3^{2-}(aq) \longrightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$

reduction $Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$

The redox equation for the overall reaction is

A $H_2O(\ell) + SO_3^{2-}(aq) + Fe^{3+}(aq) \longrightarrow SO_4^{2-}(aq) + 2H^+(aq) + Fe^{2+}(aq) + e^-$

B $H_2O(\ell) + SO_3^{2-}(aq) + 2Fe^{3+}(aq) \longrightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2Fe^{2+}(aq)$

C $SO_4^{2-}(aq) + 2H^+(aq) + Fe^{2+}(aq) + e^- \longrightarrow H_2O(\ell) + SO_3^{2-}(aq) + Fe^{3+}(aq)$

D $SO_4^{2-}(aq) + 2H^+(aq) + 2Fe^{2+}(aq) \longrightarrow H_2O(\ell) + SO_3^{2-}(aq) + 2Fe^{3+}(aq)$.

30. Which metal can be extracted from its oxide by heat alone?

A Lead

B Silver

C Tin

D Zinc

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

[Turn over

DO NOT WRITE IN THIS MARGIN

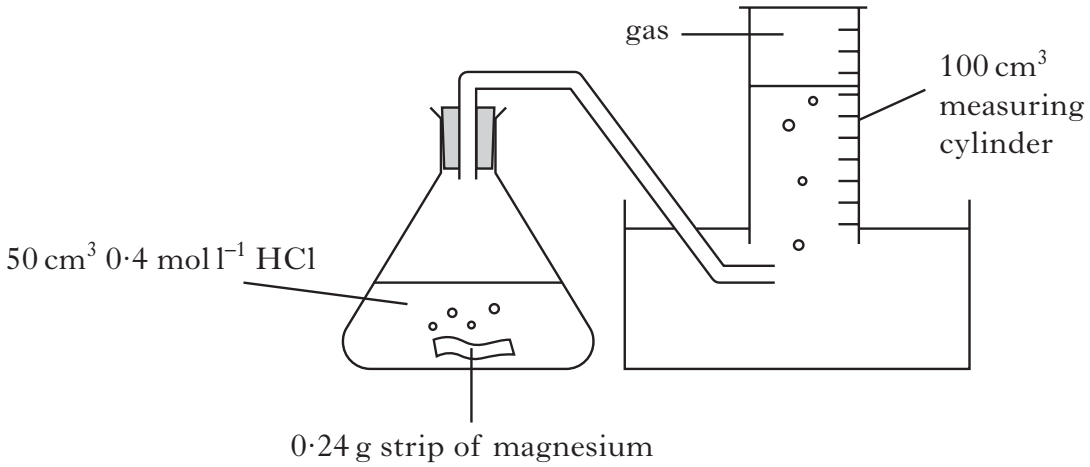
SECTION B

Marks

50 marks are available in this section of the paper.

All answers must be written clearly and legibly in ink.

1. A student monitored the rate of reaction between magnesium and dilute hydrochloric acid using a measuring cylinder to collect the gas produced.



(*a*) Name the gas produced in this experiment.

_____ **1**

(*b*) The experiment produced more gas than could be measured using the 100 cm^3 measuring cylinder.

The student changed the experiment to allow the total volume of gas to be measured, using a lower concentration of hydrochloric acid.

(i) Describe another change which would allow the total volume of gas to be measured.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

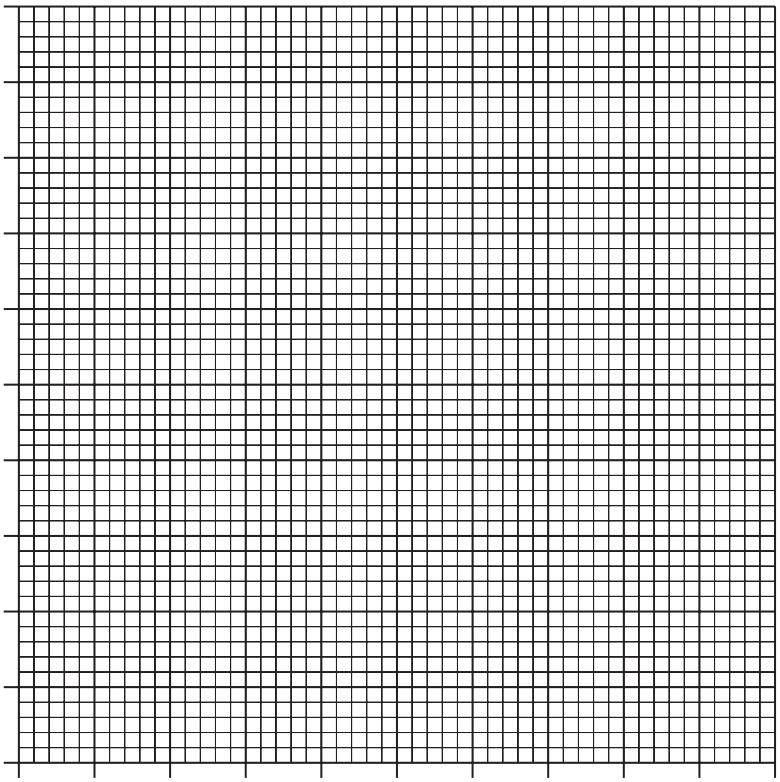
1. (*b*) (continued)

(ii) The student obtained the results shown.

Time (min)	0	1	2	4	6	8	10
Volume of gas (cm^3)	0	27	46	71	86	94	94

Draw a line graph of the results.

(Additional graph paper, if required, can be found on *Page twenty-seven*.)



2

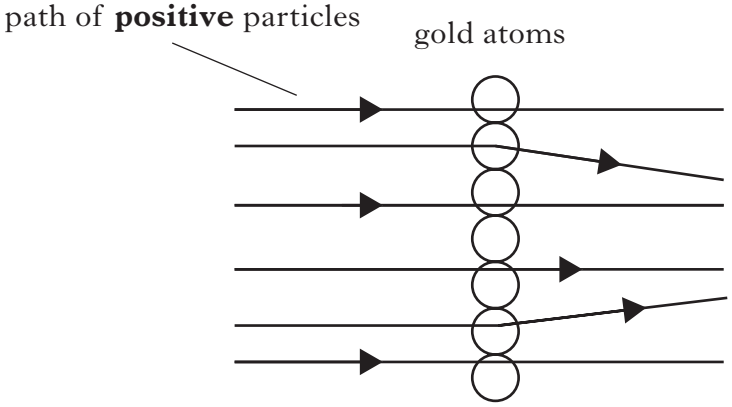
(iii) Calculate the average rate of reaction between 2 and 6 minutes.

_____ $cm^3\ min^{-1}$ **1**

(5)

Marks

2. In 1911, Ernest Rutherford carried out an experiment to confirm the structure of the atom. In this experiment, he fired positive particles at a very thin layer of gold foil. Most of the particles passed straight through but a small number of the positively charged particles were deflected.



(*a*) What caused some of the positive particles to be deflected in this experiment?

_____

_____ **1**

(*b*) Gold is the heaviest element to have only one naturally occurring isotope.

The isotope has a mass number of 197.

(i) Complete the table to show the number of each type of particle in this gold atom.

(You may wish to use page 8 of the data booklet to help you.)

Particle	Number
Proton	
Electron	
Neutron	

1

(ii) Most elements have more than one isotope.

What is meant by isotope?

_____ **1**

(3)

Marks

3. Part of a process to separate the gases in air is to cool air down to very low temperatures.

(*a*) The three main gases in air are nitrogen, oxygen and argon.

Gas	Approximate percentage (%)	Boiling point (°C)
Nitrogen	78	–196
Oxygen	21	–183
Argon	0·9	–186

Place the gases in the order in which they would become liquids on cooling.

First _____

Second _____

Third _____ **1**

(*b*) What is the name given to the process used to separate the gases in the air?

_____ **1**

(*c*) The test for oxygen is that it relights a glowing splint.

Why do glowing splints **not** relight in air?

_____ **1**

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

4. Ammonia is a compound of nitrogen and hydrogen.

(*a*) Draw a diagram to show how the outer electrons are arranged in a molecule of ammonia, NH_3.

1

(*b*) Ammonia is a gas at room temperature.

What does this indicate about the strength of the bonds between the ammonia molecules?

_____

_____ **1**

(*c*) Ammonia, a weak base, can be used to make the fertiliser ammonium phosphate.

$$3NH_3 + H_3PO_4 \longrightarrow (NH_4)_3PO_4$$

(i) What is meant by a weak base?

_____

_____ **1**

(ii) Calculate the mass of ammonium phosphate that would be produced from 510 g of ammonia.

_____ grams **2**

(5)

Marks

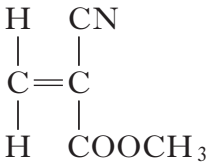
5. Superglue is used widely. Care must be taken when using superglue.

(*a*) Heat is given out when superglue comes into contact with cotton or wool.

What term is used to describe chemical reactions which give out heat?

_____ **1**

(*b*) Superglue contains the compound methyl-2-cyanopropenoate. Its structure is shown.



On exposure to air the polymer poly(methyl-2-cyanopropenoate) is formed.

Draw a section of the polymer showing 3 repeating units.

1

(*c*) Name a toxic gas which could be produced when the polymer burns.

_____ **1**

(3)

DO NOT WRITE IN THIS MARGIN

Marks

6. In the manufacture of some low-calorie foods, fructose is used in preference to glucose.

(*a*) Information about glucose and fructose is given.

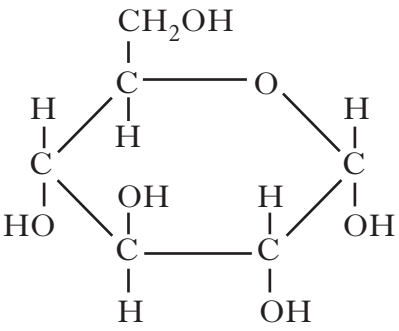
	Glucose	**Fructose**
Appearance	white solid	white solid
Solubility	soluble	soluble
Sweetness (compared with sucrose)	0·74	1·75
Calories/100 g	364	370

Suggest why fructose is used instead of glucose in low calorie foods.

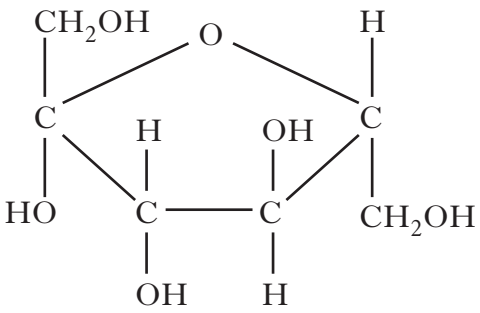
_____

_____ **1**

(*b*) The structures of the monosaccharides glucose and fructose are shown.



glucose
$C_6H_{12}O_6$



fructose
$C_6H_{12}O_6$

(i) What name is given to carbohydrates like glucose and fructose that have different structural formulae?

_____ **1**

(ii) Name the functional group present in both glucose and fructose.

_____ **1**

(3)

[Turn over for Question 7 on *Page sixteen*

DO NOT WRITE ON THIS PAGE

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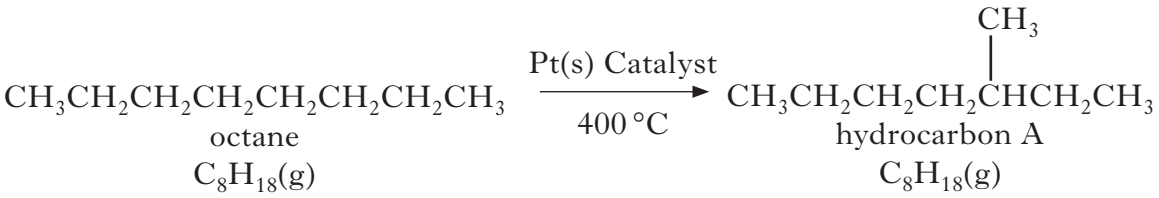
7. Octane is a hydrocarbon found in petrol. *Marks*

(*a*) The quality of the petrol can be improved by reforming octane.

During reforming the following reaction occurs.



octane
$C_8H_{18}(g)$

hydrocarbon A
$C_8H_{18}(g)$

(i) What type of catalyst is the platinum?

_____ **1**

(ii) Name hydrocarbon A.

_____ **1**

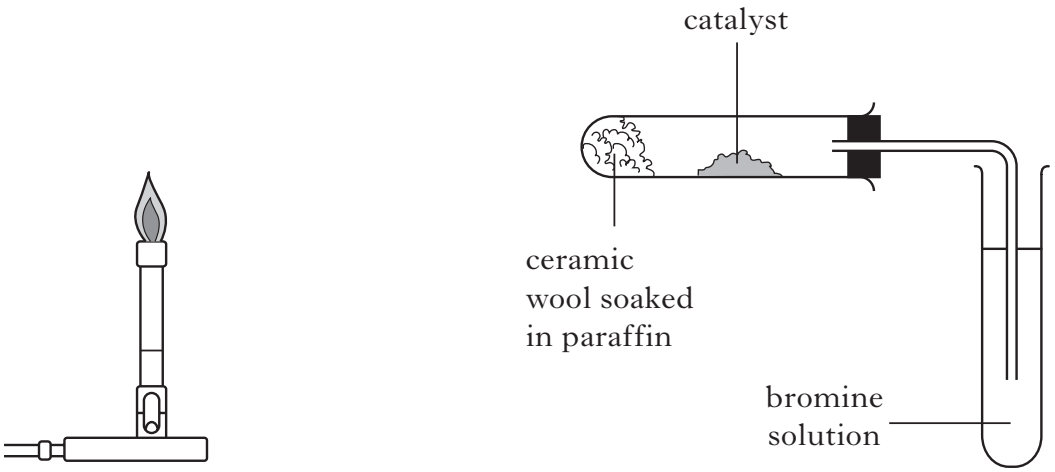
(iii) Draw another possible structure for C_8H_{18}.

1

Marks

7. (continued)

(*b*) Octane can also be cracked to produce smaller molecules. Students set up the apparatus below to carry out the PPA "Cracking".



(i) The PPA gives special instructions as to how the test tube should be heated.

Describe how the test tube should be heated.

_____

_____ **1**

(ii) What would be seen in the test tube with the bromine solution, that would indicate that cracking had occurred?

_____

_____ **1**

(iii) In the experiment there is a danger that bromine solution can be sucked back into the reaction tube.

How is suck back avoided?

_____

_____ **1**

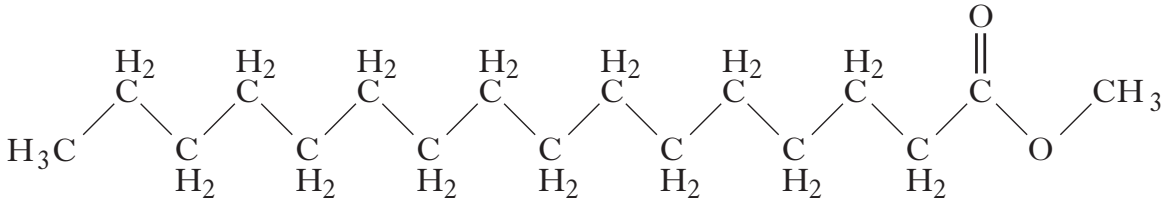
(6)

[Turn over

Marks

8. Biodiesel is a renewable source of energy which is being used as a fuel for cars.

The structure of a molecule of biodiesel is shown.



Biodiesel

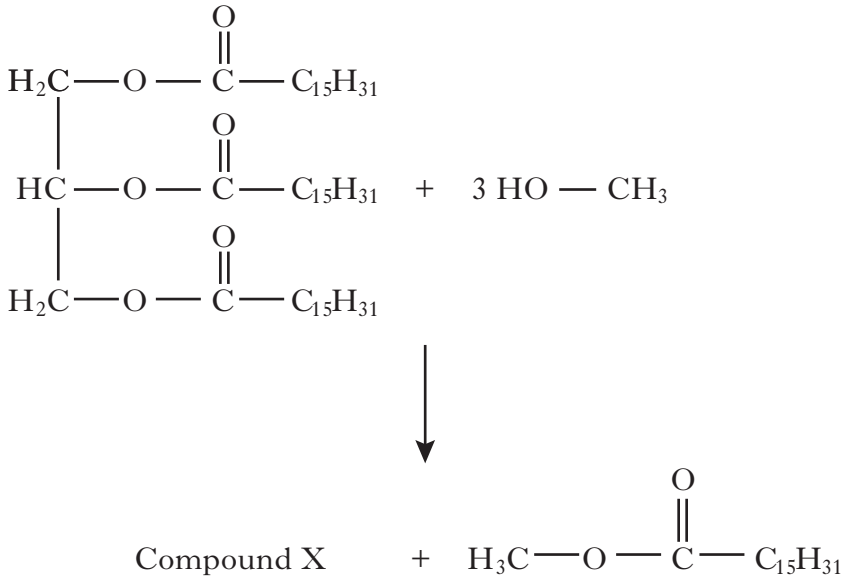
(a) (i) Which family of compounds does this molecule belong to?

_____ **1**

(ii) Why can this molecule be described as saturated?

_____ **1**

(*b*) Biodiesel can be formed by reacting fats and oils with methanol.



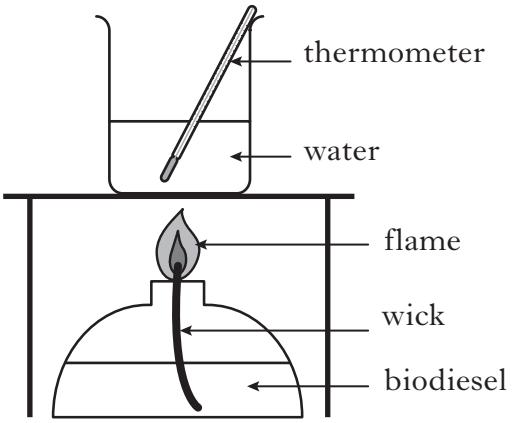
Name compound X.

_____ **1**

Marks

8. (continued)

(*c*) The energy produced from biodiesel can be measured using the following arrangement.



The energy absorbed by the water can be calculated using the equation.

$$\text{energy (kJ)} = 4{\cdot}18 \times m \times \Delta T$$

m = mass of water heated in (kg)

ΔT = increase in temperature (°C)

Calculate the energy absorbed by the water when 0·1 kg of water is heated from 18 °C to 26 °C.

_____ kJ **1**

(4)

DO NOT WRITE IN THIS MARGIN

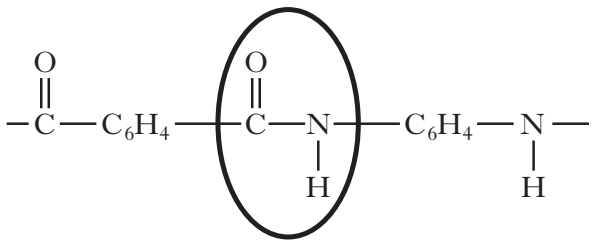
Marks

9. For many years, the frames of racing bikes were made from steel. Professional road racing bikes are now made from a carbon fibre containing Kevlar.

(*a*) What property of Kevlar makes it suitable for manufacturing professional road racing bikes?

_____ **1**

(*b*) Part of the Kevlar structure is shown.



(i) What name is given to the functional group circled?

_____ **1**

(ii) Draw the structural formula for **one** of the monomers from which Kevlar is made.

1

(3)

DO NOT WRITE IN THIS MARGIN

Marks

10. Vinegar is an aqueous solution of ethanoic acid.

(*a*) A vinegar contains 6 g of ethanoic acid, CH_3COOH, in 100 cm^3 of solution.

Calculate the concentration in mol l^{-1} of this solution?

_____ mol l^{-1} **2**

(*b*) A student compared ethanoic acid with hydrochloric acid.

Complete the table by circling the correct words to show how the properties of ethanoic acid compare with hydrochloric acid.

	0·1 mol l^{-1} hydrochloric acid solution	**0·1 mol l^{-1} ethanoic acid solution**
Reaction with magnesium	fast	slower the same faster
Current in a conductivity cell (microamps)	60	lower the same higher

1

(3)

[Turn over

Marks

11. A student carried out a PPA to prepare the salt, magnesium sulphate.

(*a*) Name the acid used to make this salt. **1**

_____

(*b*) Part of the student's PPA assessment sheet is shown.

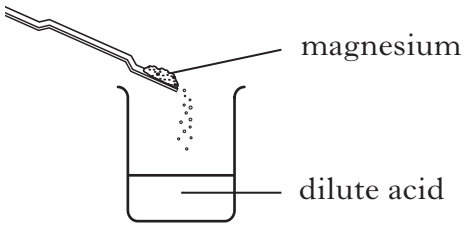
Intermediate 2 Chemistry	**Preparation of a Salt**	**Unit 3 PPA1**

Assessment Sheet

Aim To prepare magnesium sulphate crystals by reacting excess magnesium with dilute acid.

Procedure

Step 1 reaction



Step 2

_____

Step 3

_____

Step 4

DO NOT WRITE IN THIS MARGIN

Marks

11. (*b*) (continued)

Name steps 2 and 3 in the preparation of magnesium sulphate.

Step 2 _____

Step 3 _____ **2**

(3)

[Turn over

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Marks

12. A gold pendant was hung on a nickel chain. After a short time, the nickel chain corroded.

(*a*) Why did the contact between the nickel and gold speed up the corrosion of the nickel?

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

_____

_____ **1**

(*b*) During corrosion, the nickel atoms are oxidised to nickel(II) ions.

Write an ion-electron equation for the oxidation of nickel.

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

_____ **1**

(*c*) To prevent corrosion of the nickel it can be electroplated with gold.

How does this prevent corrosion?

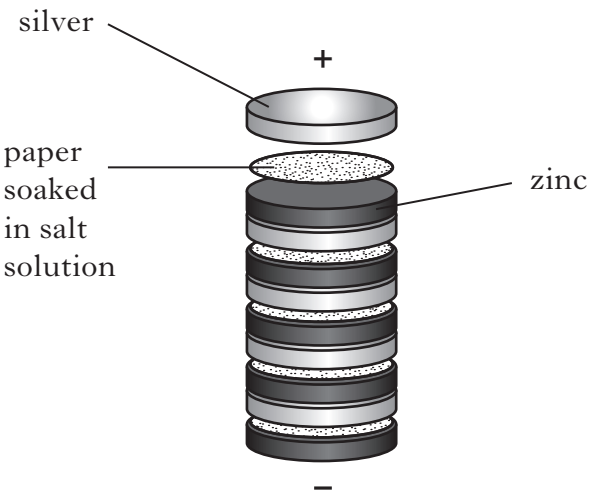
_____

_____ **1**

(3)

Marks

13. Early batteries were made from silver and zinc discs. Paper soaked in salt solution was inserted between the metal discs.



(*a*) What is the purpose of the paper soaked in salt solution?

_____ **1**

(*b*) The number of pairs of discs was increased and the voltage measured.

Number of pairs of discs	1	2	3	4	5	6
Voltage (V)	1·56	3·12	4·68	6·24	7·80	9·36

(i) Predict the voltage produced when seven pairs of discs were used.

_____ V **1**

(ii) What will be the effect on the voltage if the zinc discs are replaced with copper discs?

_____ **1**

(3)

[Turn over

14. Aluminium has been produced industrially in Scotland since 1926.

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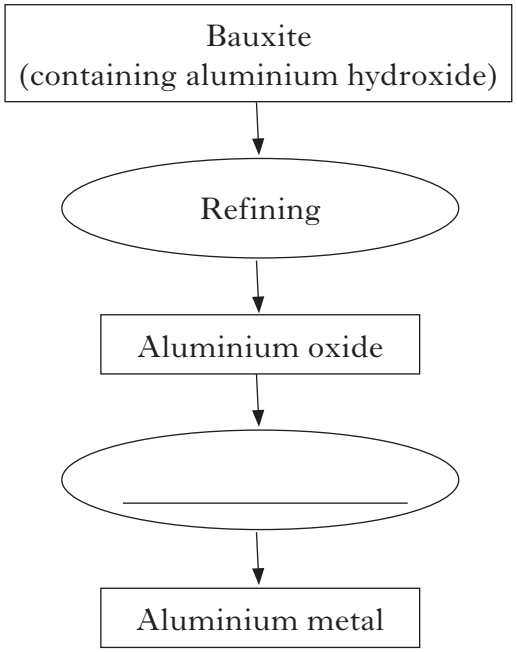
Marks

The process is shown in the flow chart.



(*a*) What is the name given to naturally occurring compounds of metals such as bauxite?

_____ **1**

(*b*) Write the formula for aluminium hydroxide?

_____ **1**

(*c*) Complete the flowchart to show the name of the reaction which converts aluminium oxide to aluminium metal. **1**

(3)

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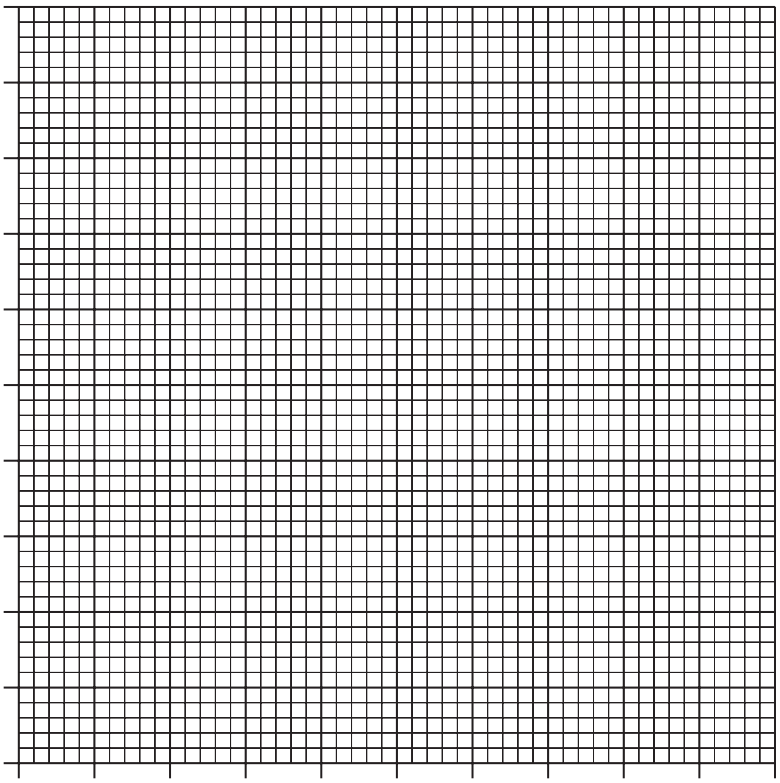
ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 1(*b*)(ii)



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