Name	Class	Index Number

Anglo-Chinese School (Barker Road)

PRELIMINARY EXAMINATION 2024

SECONDARY FOUR NORMAL (ACADEMIC)

SCIENCE (CHEMISTRY) PAPER 4
5105/4

1 HOUR 15 MINUTES (FOR BOTH PAPERS)

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index Number in the space provided at the top of this page and on all the work you hand in. Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.

Section A
Answer **all** questions.
Write your answers in the spaces provided.

Section B
Answer **one** question.
Write your answers in the spaces provided.

For Examiner's Use Only	
Paper 3	/20
Paper 4 Section A	/22
Paper 4 Section B	/8
TOTAL	/50

A copy of the Periodic Table is printed on the last page.
The use of an approved scientific calculator is expected, where appropriate. In calculations, you should show all the steps in your working, giving your answer at each stage. You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **11** printed pages.

Section A

Answer **all** the questions in this section.

1 One of the isotopes of bromine has the symbol shown.

$$^{79}_{35}Br$$

(a) Complete the table to show the relative mass and relative charge of the particles found in this isotope.

particle	relative mass	relative charge
electron		
proton		1+
neutron	1	

[2]

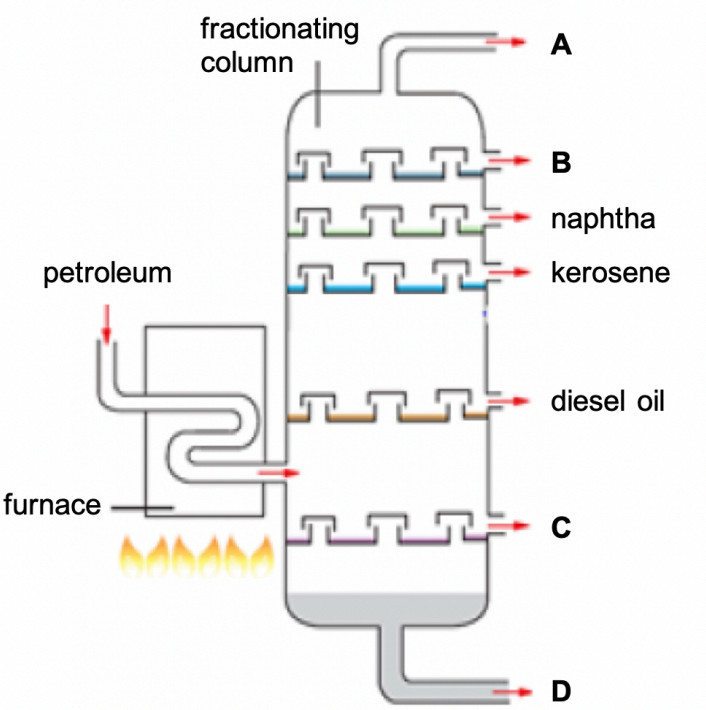
(b) Determine the number of each of these particles in one atom of the isotope of bromine, $^{79}_{35}Br$.

number of electrons = ……

number of neutrons = ……

number of protons = …… [2]

2 The diagram shows how the components in petroleum (crude oil) can be separated into different fractions using fractional distillation.



(a) Which of the fractions, **A**, **B**, **C** or **D** has the highest boiling point?

……..…… [1]

(b) Suggest one compound likely to be present in fraction **A**.

……..…… [1]

(c) Some fractions like diesel oil, which contain larger molecules, can be broken up into smaller molecules by a chemical reaction.

$$C_{16}H_{34} \longrightarrow \text{substance } \mathbf{E} + C_2H_4 + C_3H_6$$

(i) Name the chemical reaction.

……..…….. [1]

(ii) Deduce the chemical formula of substance **E**.

……..…….. [1]

(iii) Name and draw the structural formula of C_3H_6.

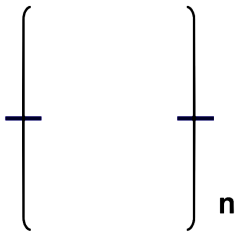
name …….

structural formula

[2]

(iv) C_2H_4 can act as monomers to undergo polymerisation to form polyethene.

Complete the structure of polyethene.



[1]

(d) Bioethanol is produced from sugarcanes and is considered an alternative renewable energy source to fossil fuels like petroleum.

The following description for the use of bioethanol is in a student's notebook. Some words have been left out.

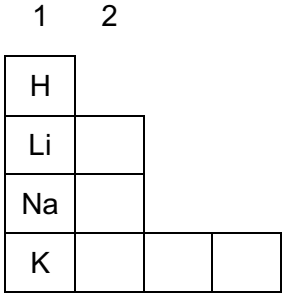
Complete the description by writing in the missing words.

"The use of bioethanol is often described to be environmentally sustainable or 'carbon neutral', as it does not ……..…… the levels of carbon dioxide in our atmosphere.

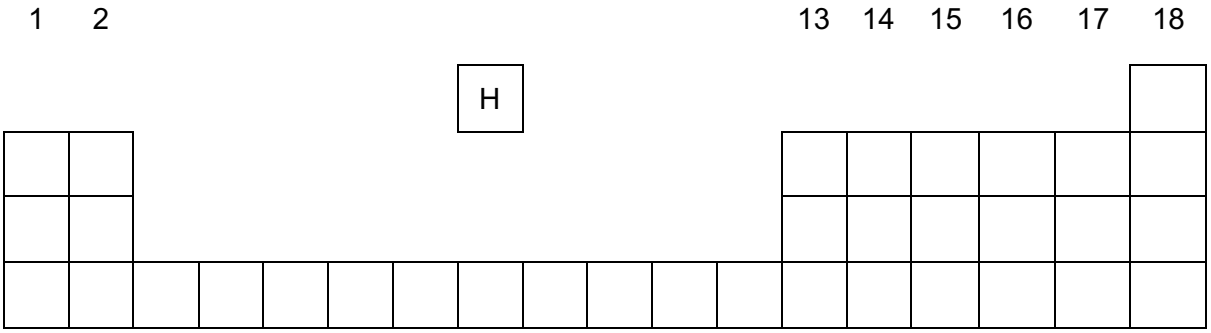
Bioethanol fuel is obtained through the fermentation of ……..……, which is obtained during photosynthesis in sugarcane which absorbs atmospheric carbon dioxide. This volume of carbon dioxide absorbed in the production of bioethanol offsets the volume of carbon dioxide produced in the ……..…… of bioethanol." [3]

3 The diagram shows two versions of the Periodic Table, where hydrogen is either placed in Group 1 or not with any group.

version 1



version 2



(a) With reference to **version 1** of the Periodic Table, give a reason why hydrogen can be placed in the same group as the other elements in Group 1.

……

…… [1]

(b) With reference to **version 2** of the Periodic Table, state **one** difference between the physical properties of hydrogen and the other elements in Group 1.

……

…… [1]

(c) Margarine is manufactured by passing hydrogen through polyunsaturated vegetable oils to form a solid product.

(i) State the type of reaction involved in this process.

…….. [1]

(ii) State what is meant by the term *polyunsaturated*.

……..

…….. [1]

(d) Hydrogen was reacted with oxygen to form water.

(i) Calculate the number of moles of 225 g of water.

[A_r: H, 1; O, 16]

Show your working.

number of moles of water = ……. [2]

(ii) Sodium from Group 1 can react with water to form sodium hydroxide and hydrogen gas.

Complete the equation for this reaction.

2Na + [2]

Section B

Answer **one** question from this section.

4 Pentadecane, $C_{15}H_{32}$, can under combustion under different conditions to give different products.

condition	supply of oxygen	products
1	excess	gas **P** and water vapour
2	limited	gas **P**, gas **Q** and gas **R**

(a) **(i)** Identify gas **P** and state the observation when gas **P** is bubbled through limewater.

gas **P** ……

observation ……

…… [2]

(ii) Methane and gas **P** have similar effects on the environment.

Describe the effect of an increased level of methane on the environment.

……

……

…… [1]

(iii) Given that gas **P** is an acidic gas, state the colour change when gas **P** is bubbled into Universal indicator solution.

colour changes from …… to …… [1]

(b) Gas **Q** is a toxic gas and can be formed by the incomplete combustion of pentadecane.

(i) Identify gas **Q**. ..... [1]

(ii) 210 cm^3 of oxygen is required to completely combust a certain volume of pentadecane.

Calculate the minimum volume of **air** needed at room temperature and pressure.

volume of air = ... cm^3 [1]

(c) Given that **R** has a boiling point of 100 °C, draw a 'dot and cross' diagram of the molecule of **R**.

Show only the outer shell electrons.

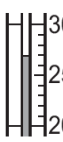
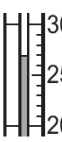
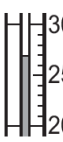
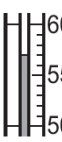
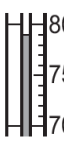
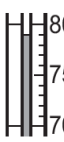
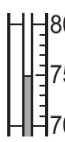
[2]

5 In experiment 1, a student investigated the temperature changes when zinc reacts with copper(II) sulfate.

5 g of zinc powder was added to 30 cm^3 of aqueous copper(II) sulfate in a Styrofoam cup.

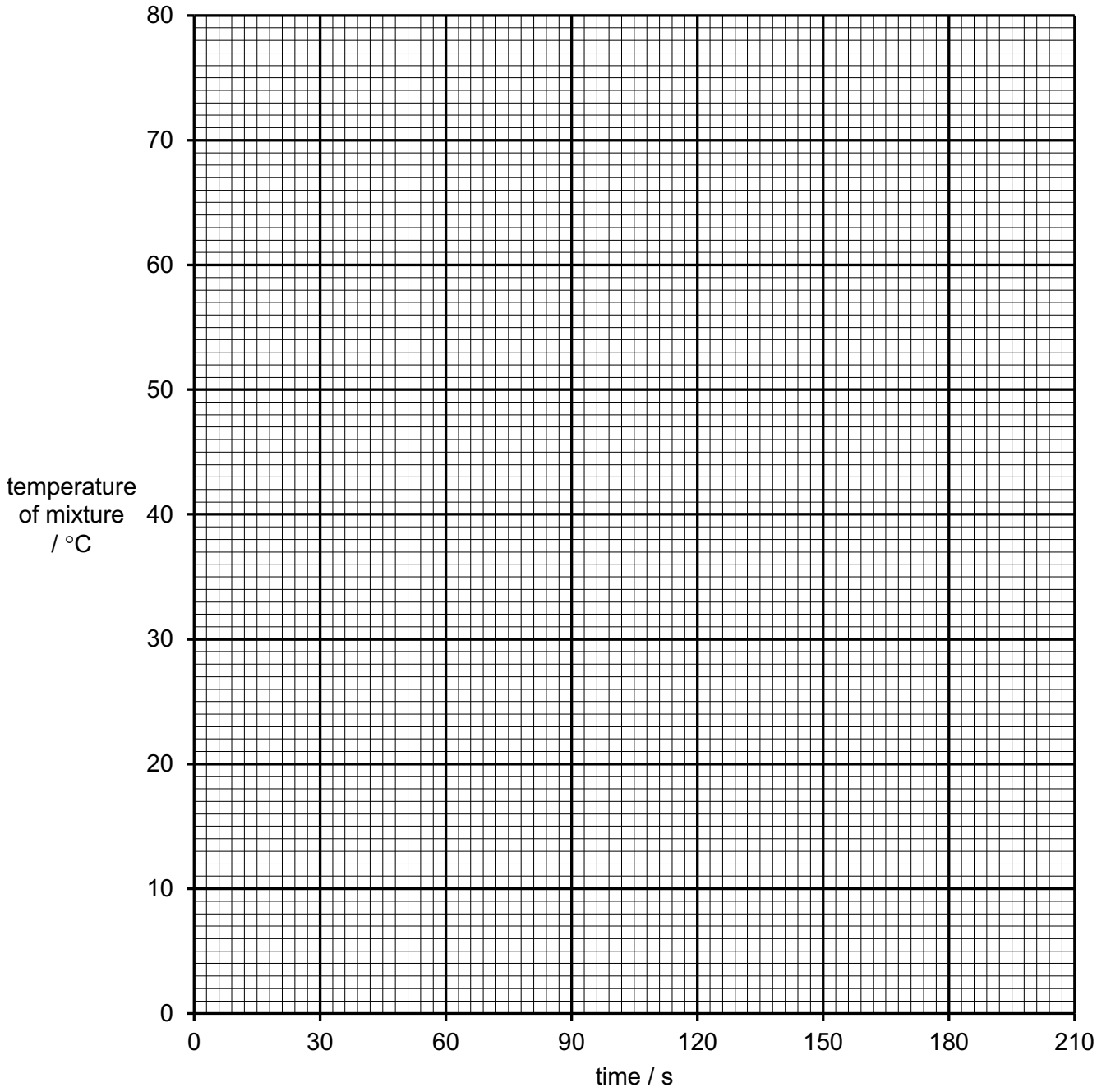
The temperature of the mixture was measured every 30 seconds.

(a) Use the thermometer diagrams to record the temperatures in the table below.

time / s	0	30	60	90	120	150	180	210
thermometer diagram								
temperature of mixture / °C								

[2]

(b) Plot the results on the grid below. Join each point to the next point with a straight line.



[3]

(c) From your graph, deduce the temperature of the mixture after 75 seconds.

Show clearly **on the graph** (with dotted lines) how you obtained your answer.

…….°C [1]

(d) In experiment 2, the student repeated the experiment, but used a **metal** cup instead of a Styrofoam cup.

Describe how the temperature readings will differ in experiment 2 as compared to experiment 1.

Explain your answer.

……..…….

……..…….

……..…….

……..……. [2]

END OF PAPER

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).
The Avogadro constant, L = 6.02 x 10^{23} mol^{-1}