Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

Preliminary Examination

4NA **4NA**

SCIENCE (CHEMISTRY)

5105/04
5107/04

Paper 4

2 August 2023

Paper 3 & 4: 1 hour 15 minutes

Candidates answer on the Question Paper provided.
Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class at the top of this page.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B

Answer any **two** questions.
Candidates are reminded that all quantitative answers should include appropriate units.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is provided on page **12**.

For Examiner's Use	
Section A	
Section B	
TOTAL	

[Turn Over

Section A (14 marks)

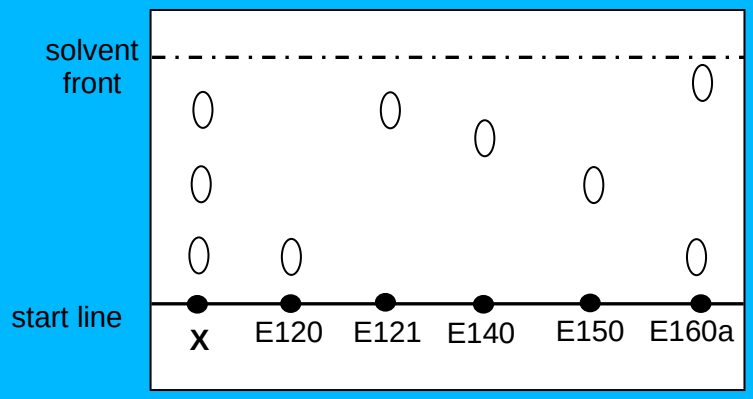
Answer **all** questions in the spaces provided.

1 A new food item, **X**, was tested for a banned food dye.

A sample of the food item was dissolved in a suitable solvent and the resulting solution was separated on a piece of chromatography paper, together with solutions of five known food dyes (E120, E121, E140, E150 and E160a).

Dye with the number code E121 is banned.

The diagram shows the chromatogram obtained.



(a) Identify all the food dyes present in the candy.

……. [1]

(b) Explain why E121 moves further up the chromatography paper than E120.

……. [1]

(c) Explain why the start line should be drawn with a pencil and not a pen.

……

……. [1]

2 The table shows some information about four particles **A**, **B**, **C** and **D**.

(The letters do not represent the chemical symbols of any element.)

particle	number of protons	number of neutrons	mass number	electronic configuration
A	6	6		2, 4
B	15		31	
C	6	8	14	2, 4
D		12	23	2, 8, 1

(a) Complete the table by filling in the missing information. [3]

(b) Which two particles are isotopes of the same element?

…… and …… [1]

(c) Deduce the identity of particle **C**.

…… [1]

3 The table gives details of two salts that are found in daily life.

salt	formula	relative formula mass, M_r
iron(II) nitrate	$Fe(NO_3)_2$	
calcium carbonate		100

[2]

(a) Complete the table by filling the missing details.

(b) Calculate the mass, in grams, of 0.2 mole of calcium carbonate.

[relative atomic masses, A_r : C, 12; Ca, 40; O, 16]

mass of calcium carbonate = …… g [1]

4 In the extraction of iron, limestone is placed into the blast furnace together with two other raw materials.

(a) Name the **two other** raw materials required for the extraction of iron.

……..…and …… [1]

(b) Explain why limestone is added to the blast furnace.

…… [1]

(c) Iron is produced from the reduction of its ore by carbon monoxide.

Balance the following equation.

……..Fe_2O_3 (s) + ..……CO (g) → …….Fe (s) + ..……CO_2 (g) [1]

Section B (16 marks)

Answer any **two** questions from this section in the spaces provided.

5 The observation for the reactions of four metals, **W**, **X**, **Y** and **Z** with steam and acid are shown in the table.

experiments	**metal**			
	S	**T**	**U**	**X**
reaction with steam	very bright flame observed	no visible reaction	metal burns in steam	metal glows faintly
reaction with acid	vigorous effervescence	no visible reaction	rapid bubbling observed	some bubbling observed

(a) **(i)** Arrange the four metals in order of their reactivity, starting with the most reactive metal.

most reactive ⟶ least reactive

[1]

(ii) Suggest how metal **S** can be extracted from its oxide.

……. [1]

(iii) Write a balanced equation for the reaction between zinc and steam.

……. [1]

(b) Part of the reactivity series for metals is shown below.

sodium	most reactive
calcium	
magnesium	
zinc	
iron	
lead	
copper	least reactive

The following list shows how long ago these metals were discovered.

calcium	206 years ago
copper	7000 years ago
iron	3000 years ago
lead	7000 years ago
magnesium	259 years ago
sodium	207 years ago
zinc	2000 years ago

Explain why some metals were discovered much earlier than others.

……..……..

……..……..

……..……..

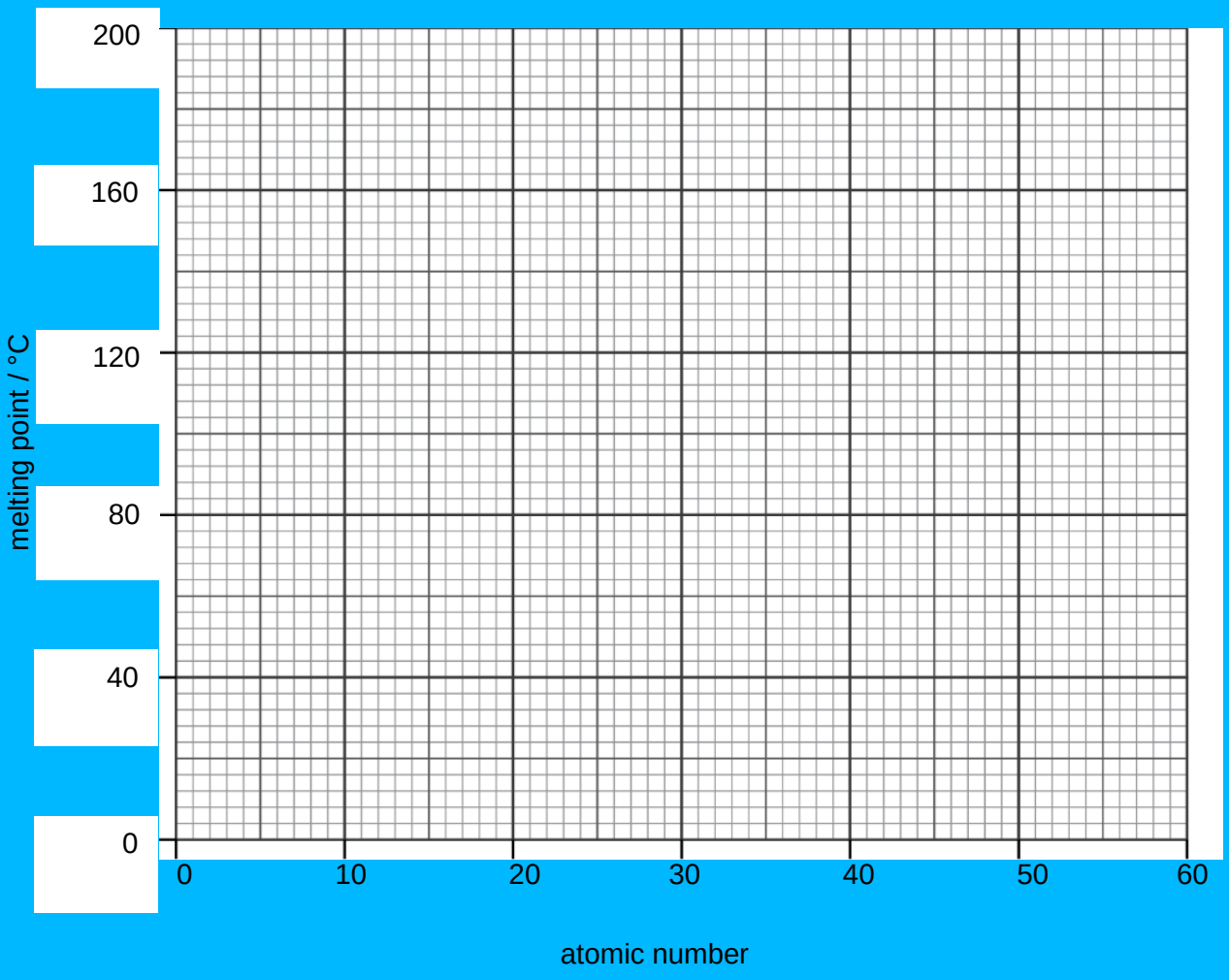
……..…….. [2]

(c) The table shows the atomic number and melting points of some metals.

atomic number	melting point / ºC
3	180
11	96
19	?
37	36
55	28

(i) Plot a graph of melting point against the atomic number.

Mark each point with a cross (×).



[2]

(ii) From your graph determine the melting point of the metal with an atomic number of 19.

melting point = ... ºC [1]

6 A section of the Periodic Table with seven labelled elements is given. The letter labels, **P**, **Q**, **R**, **W**, **U**, **Y** and **Z**, are not the chemical symbol of the elements.

P																**Z**	
	W																**Y**
U																**Q**	
																R	

Use the letters **P**, **Q**, **R**, **U**, **W, Y** and **Z** in the diagram to answer the following questions.

(a) Which is the least reactive element?

……. [1]

(b) Write the chemical formula of the compound formed when **W** and **Z** react.

……. [1]

(c) **Q**, **R** and **Z** belong to Group VII. They are also known as halogens and exist as diatomic molecules.

(i) The arrangement of electrons in **Q** is 2,8,18,7.
Explain why **Q** is found in Group VII and Period 4 of the Periodic Table.

Group VII

……

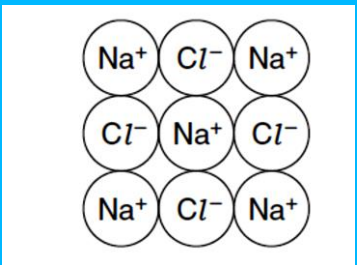
Period 4

……. [2]

(ii) Draw a 'dot and cross' diagram to show the arrangement of all the electrons in a molecule of **Q**. Show only the outermost electrons.

[1]

(d) The simplified lattice structure of a halogen compound, sodium chloride is shown.



(i) Describe how the ions present in sodium chloride are formed from atoms of sodium and chlorine.

.....

.....

..... [2]

(ii) Explain why sodium chloride has to be dissolved in water, or melted, before it will conduct electricity.

.....

..... [1]

7 Crude oil is a mixture of compounds called hydrocarbons. Many useful materials can be obtained from crude oil. Crude oil is separated into fractions by a common separation technique.
The table shows some fractions obtained from crude oil and their approximate range of boiling points.

fraction	approximate range of boiling points / °C
W	40 - 75
X	below 40
Y	350 - 650
Z	220 - 250

(a) Name the separation technique used to separate the fractions in crude oil.

……. [1]

(b) Arrange the four fractions **W**, **X**, **Y** and **Z** in order of increasing length of the molecules.

…… [1]

(c) Fraction **Z** is a fraction that is used as fuels for large vehicles such as buses and lorries.

Suggest the identity of fraction **Z**.

…… [1]

(d) Many transport vehicles produce carbon monoxide.

(i) Explain how carbon monoxide is formed.

……..

…….. [1]

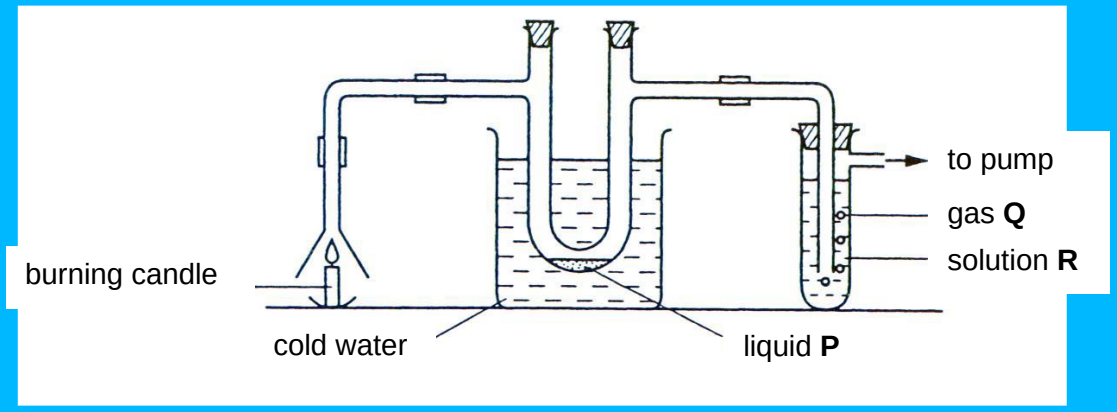
(ii) Explain the harmful effect of carbon monoxide on human health.

……..

…….. [1]

(e) Candles are made from solid hydrocarbons.

An experiment was carried out to study the substances produced when candles are burnt. When gas **Q** bubbles into solution **R**, the identity of the gas is confirmed.



(i) Identify **P**, **Q** and **R**.

P…… **Q**…… **R**…… [2]

(ii) Apart from gas **Q** which is produced, state one other observation for solution **R** during the experiment.

…….. [1]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									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											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 –		114 Fl flerovium –		116 Lv livermorium –		

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 –