LOYANG VIEW SECONDARY SCHOOL

Preliminary Examination 2023
Secondary Four Normal (Academic)

CANDIDATE NAME : ……

CLASS : …… **INDEX NUMBER** : ……

SCIENCE (CHEMISTRY) 5105/04

Paper 4 **3 Aug 2023**

Papers 3 and 4: 1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions in Section B.
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 more than **30 minutes** on **Paper 3**.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on page **11**.

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.

For Examiner's Use	
Section A	/ 14
Section B	/ 16
Total	/ 30

Setter: Mdm Elvina Abu Hasan

Section A

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

1 The positions of 8 elements in the Periodic Table are shown in Fig. 1.1.

The letters **A** to **H** do not represent the chemical symbols of the elements.

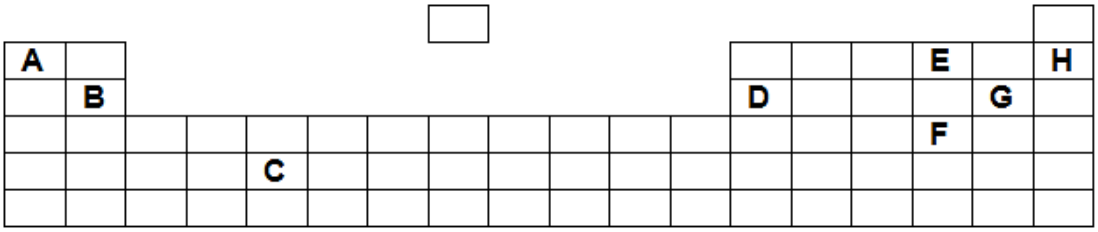


Fig. 1.1

(a) Which element, **A** to **H**, forms an ion with a charge of +2?

……[1]

(b) Explain why element **H** is unreactive?

……[1]

(c) An atom of element **X** has an electronic structure of 2,7.

Which element, **A** to **H**, will have properties most similar to **X**?

…….. [1]

[Total: 3]

2 Reacting an acid with a base is a common method of preparing salts. This is known as an *acid-base* reaction.

Table 2.1 gives details of three salts that can be prepared by acid-base reactions.

Table 2.1

salt	formula	relative formula mass, M_r
copper(II) sulfate	$CuSO_4$	160
magnesium nitrate	$Mg(NO_3)_2$	
sodium sulfate	Na_2SO_4	

(a) Use data from the Periodic Table to complete Table 2.1 by calculating the relative formula mass, M_r, of magnesium nitrate and sodium sulfate.

[2]

(b) Calculate the mass of 0.5 mol of magnesium nitrate, $Mg(NO_3)_2$.

mass of magnesium nitrate = …….. g [1]

(c) **(i)** Identify the acid and base required to produce sodium sulfate.

acid ……..

base …… [1]

(ii) At the end of the reaction between the acid and base from **(c)(i)**, a solution of sodium sulfate is produced.

Describe how pure and dry crystals of sodium sulfate can be obtained from its solution.

…….

…….

…….

……... [2]

(iii) State the pH of a pure solution of sodium sulfate.

..…… [1]

[Total: 7]

3 Some of the substances found in the exhaust fumes of a motorcar are shown in Fig. 3.1.

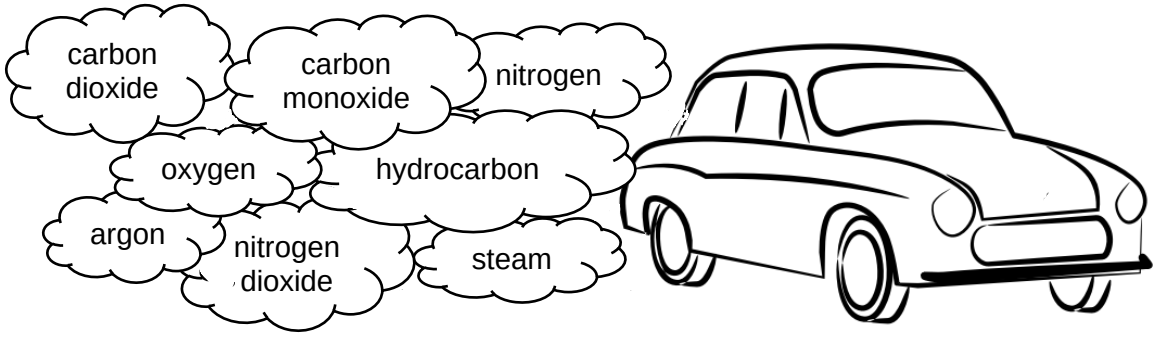


Fig. 3.1

(a) Complete Table 3.1 using the names of the substances shown.

Each substance can be used only once.

Table 3.1

description	name of substance
a greenhouse gas	
causes acid rain	
a noble gas	

[2]

(b) **(i)** Carbon monoxide is a toxic gas.

Explain why carbon monoxide is harmful to human beings.

……

…..…… [1]

(ii) Fig. 3.2 shows a water heater.

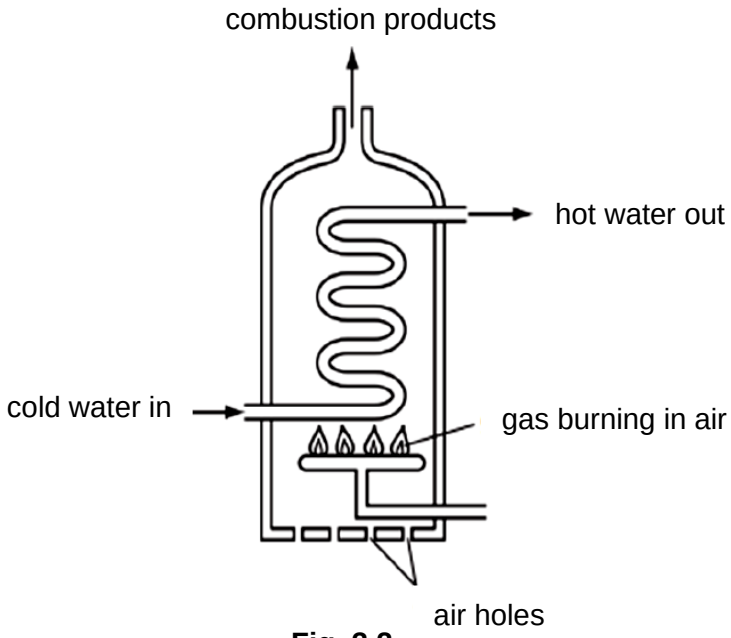


Fig. 3.2

Carbon monoxide can be formed when some of the air holes in a water heater get blocked.

Explain why this is so.

……

…..……..……...……. [1]

[Total: 4]

Section B (16 marks)

Answer any **two** question in the spaces provided.
Write your answers in the spaces provided.

4 Fig. 4.1 shows how iron is extracted in a blast furnace with coke and limestone.

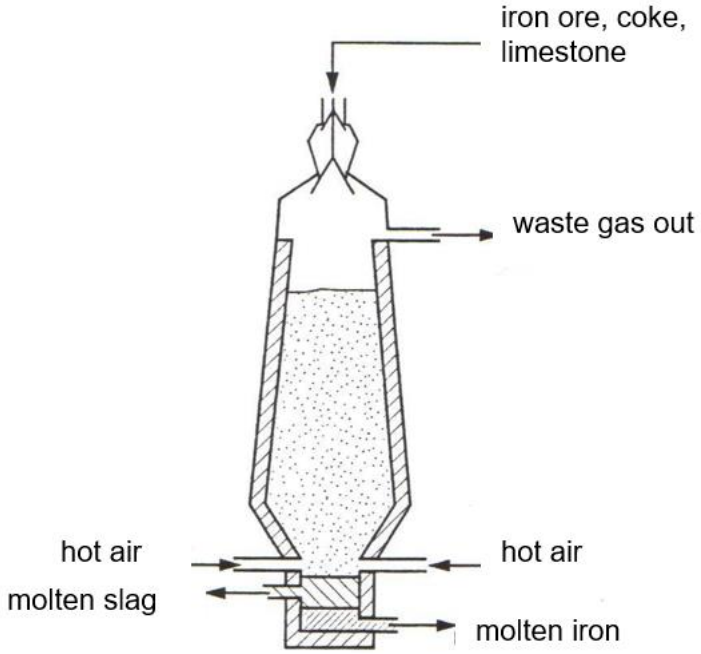


Fig. 4.1

(a) **(i)** State the purpose of adding limestone to the blast furnace.

…… [1]

(ii) The chemical equation below shows the reaction between iron(III) oxide and carbon monoxide that occurs in the blast furnace.

Balance the chemical equation by writing the correct numerals in the blanks provided.

…..… Fe_2O_3 + …….. CO → …..… Fe + …..… CO_2 [1]

(b) An experiment was set up to investigate the rusting of iron.

Five identical iron nails, each weighing 5 g, were used. Each nail was given a different treatment. The nails were left outside in the air for ten weeks, and then reweighed. The results are shown in Table 4.1.

Table 4.1

nail	treatment	mass at start / g	mass after ten weeks / g
P	covered in grease	5.0	5.2
Q	coated with zinc	5.0	5.1
R	painted	5.0	5.3
S	plastic coated	5.0	5.0
T	untreated	5.0	6.3

(i) State the conditions required for iron to rust.

…….. [1]

(ii) Bicycle frames are made from steel which is an iron alloy.

Based on the results in Table 4.1, suggest which treatment gives the best protection against rusting for the frames and explain why.

…….

…….

…….. [2]

(iii) Steel is an alloy which contains some carbon atoms mixed with iron atoms.

The diagram below shows the arrangement of atoms in steel.

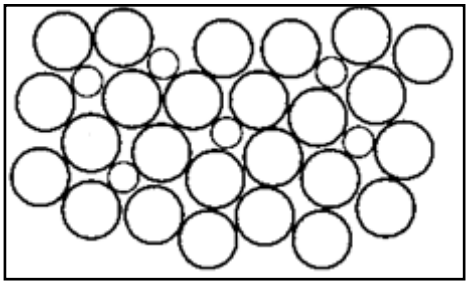


Fig. 4.2

Using the diagram shown, explain why steel is harder than pure iron.

…….

…….

…….. [2]

(c) Aluminium is a metal which does not rust. It can be recycled many times without losing its properties.

State another advantage of recycling aluminium metal.

…….. [1]

[Total: 8]

5 Fluorine, chlorine and bromine are Group VII elements found in the Periodic Table. They are also commonly known as halogens. Halogens exist as *diatomic* molecules.

(a) State the meaning of 'diatomic'.

…….. [1]

(b) The arrangement of electrons in bromine is 2,8,18,7.

Explain why bromine is found in Group VII and Period 4 of the Periodic Table.

Group VII ……..……

……..…

Period 4 ……...

……..…… [2]

(c) Draw a 'dot and cross' diagram to show the arrangement of **all** the electrons in a molecule of fluorine.

[2]

(d) **(i)** Halogens can undergo displacement reaction.

Put a tick (✓) if there is a reaction between chlorine and aqueous solutions of sodium chloride, sodium bromide and sodium iodide.

halogen	reaction with sodium chloride	reaction with sodium bromide	reaction with sodium iodide
chlorine			

[1]

(ii) Write a balanced chemical equation for any of the reactions that occur in **(d)(i)**.

..……..…… [2]

[Total: 8]

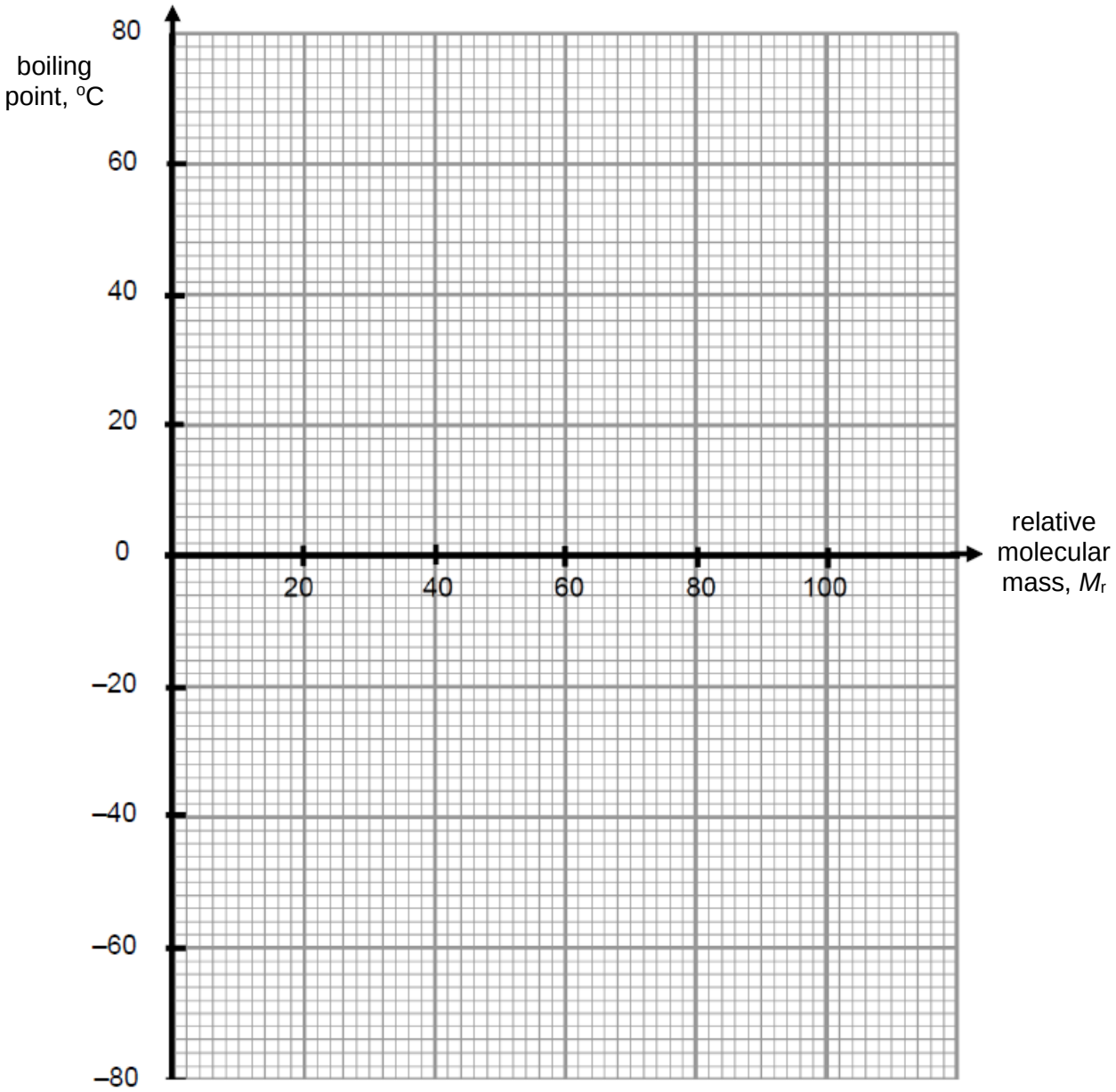
6 **(a)** Table 6.1 shows the relative molecular masses and boiling points of substances **A** to **D** which are members of the same homologous series.

Table 6.1

substance	relative molecular mass, M_r	boiling point, °C
A	30	-62
B	58	0
C	72	32
D	88	69

Using the data from Table 6.1, plot the boiling points against relative molecular masses of the substances on Graph 6.1, marking each point with a cross (×).

Draw a line through your plotted points.



Graph 6.1

[2]

(b) Substance **E**, a member of the same homologous series, has a relative molecular mass of 44.

Use the graph to predict the boiling point of substance **E**.

…….. [1]

(c) State one property that members in the same homologous series have.

…….. [1]

(d) Propane is a gas at room temperature and pressure.
It is formed when substance **X** undergoes an addition reaction with hydrogen.

(i) State the catalyst and temperature needed for the addition reaction.

catalyst ……

temperature …….. [1]

(ii) Describe a test to differentiate between propane and substance **X**.

test …….

…….

observation with propane ……...

…….

observation with propene ……...

…… [2]

(e) Name the products formed when propane undergoes complete combustion.

…… [1]

[Total: 8]

END OF PAPER

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											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 –		

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.).

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