Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2024
Secondary 4 Normal Academic/ G2

CANDIDATE NAME		CLASS		CLASS INDEX NO	

CENTRE NUMBER	S					INDEX NO				

SCIENCE **5105 & 5107/04**

Paper 4 Chemistry **30 July 2024**

(Taken together with Paper 3) **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 the front cover.
Write in dark blue or black ink.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighter, glue or correction fluid.

Answer **all** questions in Section A and any **one** question 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.

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is given in Paper 3.

For Examiner's Use Only	
Paper Number	**Marks**
Paper 3	**/ 20**
Paper 4 Section A	**/ 22**
Paper 4 Section B ___	**/ 8**
Total	**/ 50**

This document consists of 11 printed pages.

Section A

Answer **all** questions.

1 The arrangement of electrons in the atoms of six different elements is shown in the table below.

The letters do not represent the chemical symbols of the elements.

element	**P**	**Q**	**R**	**S**	**T**	**U**
arrangement of electrons in the atoms	2.4	2.6	2.7	2.8.1	2.8.6	2.8.8

(a) Use the letters, **P**, **Q**, **R**, **S**, **T** and **U** to answer the following questions.

(i) Which element has a proton number of 8?

…… [1]

(ii) Which two elements are in the same group of the Periodic Table?

……and…… [1]

(b) **R** and **S** react to form a compound with a high melting point.

(i) Draw a ‘dot-and-cross’ diagram to show the arrangement of electrons in the compound formed between **R** and **S**.

[2]

(ii) In terms of structure and bonding, explain why the compound formed between **R** and **S** has a high melting point.

……

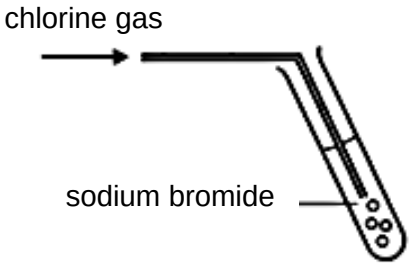
……

……

…… [2]

[Total: 6]

2 Chlorine gas is bubbled into colourless sodium bromide solution as shown below.



(a) The colourless sodium bromide solution turned reddish-brown. Explain why.

……

…… [1]

(b) Write the balanced chemical equation for the reaction in **(a)**. State symbols are not required.

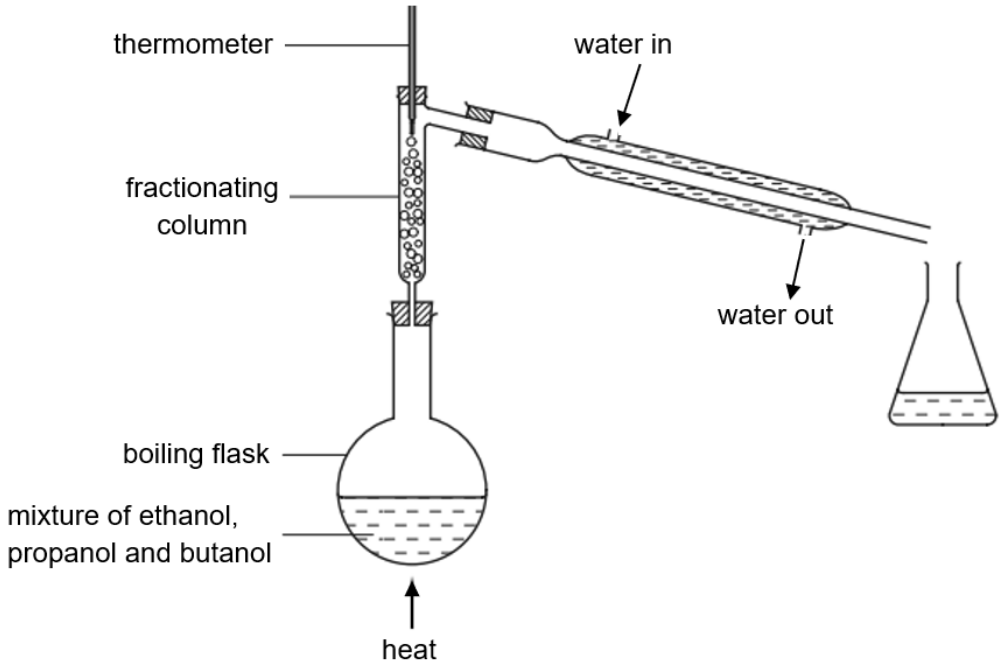
…… [1]

[Total: 2]

3 The table below shows the boiling points of three alcohols.

alcohol	boiling point/ ℃
ethanol	79
propanol	97
butanol	117

Fractional distillation can be used to separate a mixture of ethanol, propanol and butanol as shown in the set-up below.



(a) State the order in which the three alcohols, ethanol, propanol and butanol will be distilled.

……, ……, …… [1]
distilled first *distilled last*

(b) Explain the role of the glass beads in the fractionating column.

……

…… [1]

(c) Identify one mistake in the set-up above.

…… [1]

[Total: 3]

4 **(a)** 265g of sodium carbonate reacts with dilute hydrochloric acid.
The chemical equation for this reaction is given below.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$$

Calculate the number of moles in 265g of sodium carbonate.
Show your working.
[relative atomic masses, *A*r: C, 12; O, 16; Na, 23; C*l*, 35.5]

number of moles of Na_2CO_3 = …… mol [2]

(b) 2.50 moles of water were produced in the reaction.
Calculate the mass of water produced.
[relative atomic masses, *A*r: H, 1; O, 16]

mass of water = …… g [1]

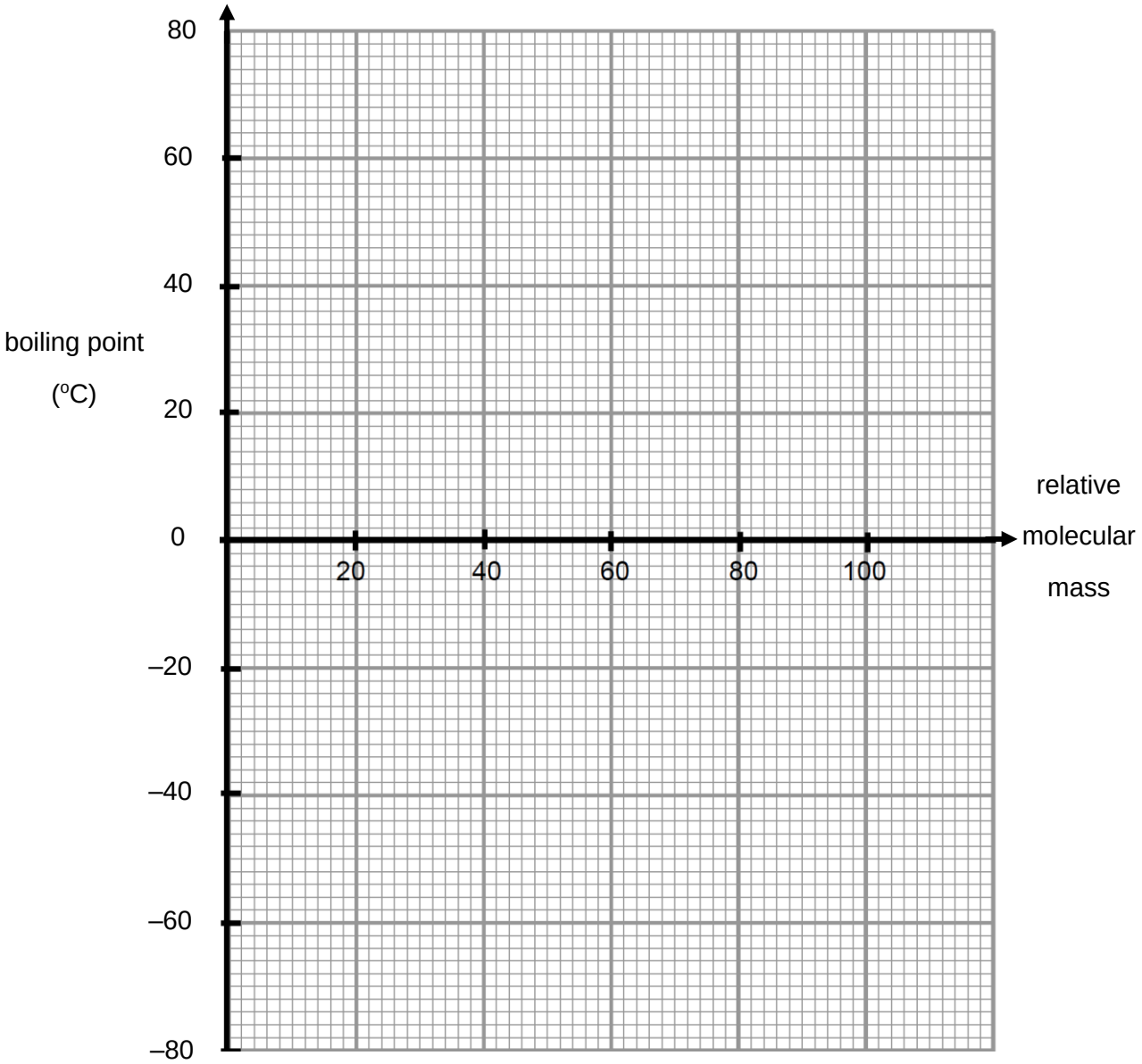
[Total: 3]

5 The table below shows some of the properties of hydrocarbons that are in the same homologous series.

hydrocarbon	relative molecular mass (M_r)	boiling point (°C)
A	30	– 62
B	58	0
C	72	32
D	88	69

(a) On the graph below, plot a graph of boiling point against relative molecular mass of the four hydrocarbons shown, marking each point with a cross (×).

Draw a line through your plotted points. [2]



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

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

…… [1]

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

…… [1]

(d) Hydrocarbon **A** is formed when ethene undergoes an addition reaction with hydrogen.

(i) Draw the full structural formula of ethene.

[1]

(ii) Describe a test to differentiate between hydrocarbon **A** and ethene.

test ……

……

observation with hydrocarbon **A** ……

……

observation with ethene ……

…… [2]

(e) Name the products formed during the complete combustion of ethene.

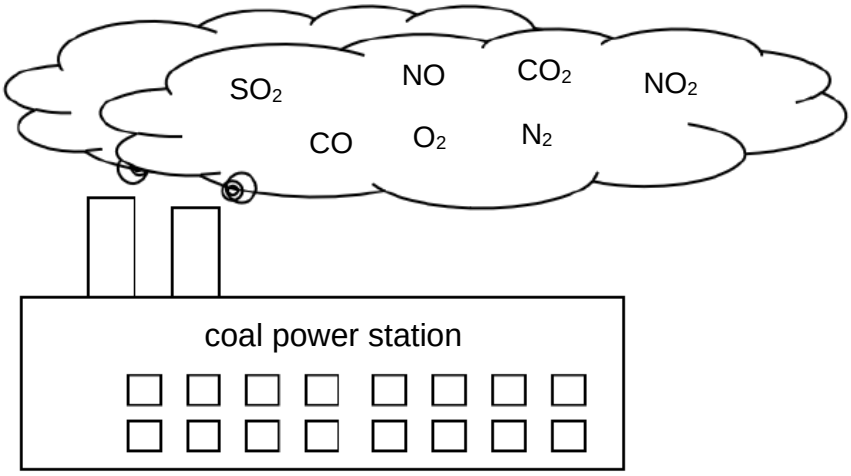
…… [1]

[Total: 8]

Section B

Answer any **one** question from this section.

6 The diagram below shows the formulae of some gases emitted by a coal power station.



(a) **(i)** State the formula of two gases from the diagram that produces acid rain.

……and…… [1]

(ii) Describe how acid rain is formed in the area near the coal power station.

……

…… [1]

(iii) Describe one harmful effect of acid rain.

……

…… [1]

(b) **(i)** From the diagram, state the formula and name a poisonous gas that is produced by incomplete combustion of coal.

chemical formula ……

name …… [1]

(ii) Explain why the gas in **(b)(i)** is toxic to humans when inhaled.

……

…… [1]

(c) Describe a positive test to identify oxygen gas.

test……

observation…… [2]

(d) Classify the seven gases produced by the coal power station as element or compound in the table provided below.

element	compound

[1]

[Total: 8]

7 **(a)** The method of extraction of metals from their ores depends on the reactivity of the metals. The more reactive the metal, the more stable its ore.

The table shows the methods with which four metals are extracted from their ores.

metal	method of extraction
lead	reduced by carbon
magnesium	electrolysis
silver	reduced by heating without carbon
zinc	reduced by carbon

(i) State the most reactive metal in the table.

…… [1]

(ii) Lead is extracted from its ore, lead(II) oxide.
The reaction is shown below.

lead(II) oxide + carbon → lead + carbon dioxide

Write a balanced chemical reaction for the above equation.

…… [1]

(iii) Using your knowledge of the metal reactivity series and the information above, suggest the method used to extract iron from its ore.
Explain your answer.

……

……

…… [2]

(b) A student carried out experiments to determine the order of reactivity of four metals, **A**, lead, **B** and zinc. He placed a sample of each metal in the four solutions shown in the table.

He recorded the results in the table below.

metal / solution	**A**	lead	**B**	zinc
metal **A** nitrate	×	✓	✓	✓
iron (II) nitrate	×	×	✓	✓
copper (II) nitrate	✓	✓	✓	✓
zinc nitrate	×	×	✓	×

key	
✓	reaction
×	no reaction

(i) Arrange the four metals, **A**, lead, **B** and zinc, in order of decreasing reactivity, starting with the **most** reactive metal.

……, ……, ……, …… [1]

(ii) Suggest a possible identity of metal **B**.

…… [1]

(c) Iron can undergo rusting.

(i) State the two conditions required for rusting to occur.

……and…… [1]

(ii) There are various methods to prevent rusting.

Food cans made of iron are commonly plated with tin.
Suggest a disadvantage of this method to prevent rusting.

……

…… [1]

[Total: 8]

End of Paper 4