Name and Index Number:	Class:
( )	

SENG KANG SECONDARY SCHOOL
2024 PRELIMINARY EXAMINATION

SCIENCE (CHEMISTRY) 5105/04 Secondary 4 Normal (Academic) 6

August 2024 Paper 4 **Paper 3 and 4: 1 hour 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
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.

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

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.
A copy of the Periodic Table is printed on page 14.

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	/ 22
Section B	/ 8
Marks Awarded	/ 30

This document consists of **13** printed pages and **1** blank page.

Do not turn over the page until you are told to do so.

Section A [22 marks]

Answer **all** questions.

1 The formulae of some elements and compounds are listed.

Cl_2 CO_2 K

NO NaC*l* ZnO

Complete the sentences below, choosing your answers from the above list.

Each element or compound may be used once, more than once or not at all. Identify the element or compound that:

(a) is a diatomic molecule,

……

… **(b)** reacts with both dilute hydrochloric acid and sodium hydroxide,

……

… **(c)** displaces iodine from sodium iodide,

……

… **(d)** dissolves in water to form a solution with pH less than seven.

…… [3]

[Total: 3]

[Turn over

2 (a) Table 2.1 shows data on three alloys made from tin, copper and silver.

Table 2.1

	alloy 1	alloy 2	alloy 3
tin content / %	95.5	96.5	99.0
copper content / %	0.7	0.5	0.7
silver content / %	3.8	3.0	0.3
melting point / °C	217	220	227

Use the data in Table 2.1 to describe the relationship between the silver content and the melting point.

……

…… [1]

(b) Fig. 2.2 shows four different metals **A**, **B**, **C** and **D** reacting with cold water.

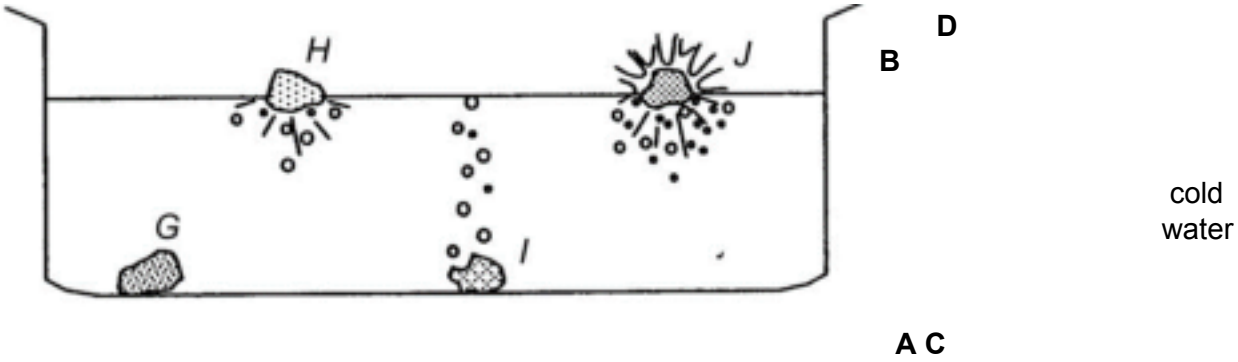


Fig. 2.2

(i) Use the observations in Fig. 2.2 to suggest an order of reactivity of these metals.

most reactive ……

……

……

least reactive …… [1]

(ii) Draw a 'dot and cross' diagram to show the bonding of the gas evolved when metal **B** reacts with cold water.

[1]

[Turn over

(c) Some metals are extracted from their ores by heating with carbon.

Other metals are extracted from their ores by electrolysis.

Fig. 2.3 shows the order of reactivity of five metals, compared to carbon.

most reactive least reactive

calcium	
[carbon]	
zinc	extracted by heating with carbon
copper	
potassium	
sodium	

Fig. 2.3

A student makes this statement:

‘The information in Fig. 2.3 shows that all Group 1 metals are extracted by electrolysis.’

Use information from Fig. 2.3 to explain why this statement is only partly correct.

……

……

…… [2]

[Total: 5]

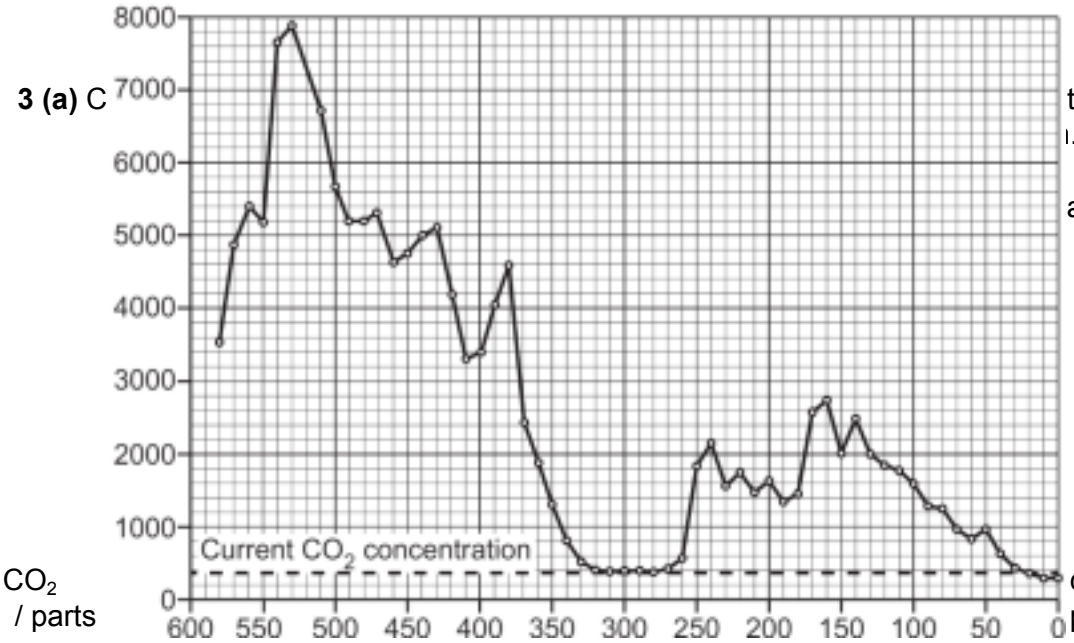
[Turn over

3 (a) C

tration of

l.

atmosphere



current CO_2 concentration

millions of years ago

Fig. 3.1

(i) Carbon dioxide concentration was at its highest about 530 million years ago.

State the value of the concentration of carbon dioxide 530 million years ago.

concentration of carbon dioxide = ... parts per million [1]

(ii) A student says, 'Carbon dioxide concentration was always much higher in the past than it is today.'

Does the graph support this statement? Use values from the graph to explain your answer.

……...

……... [2]

[Turn over

(b) Fig. 3.2 shows the amount of oil burned and the change in the Earth's temperature between the years 1850 and 2010.

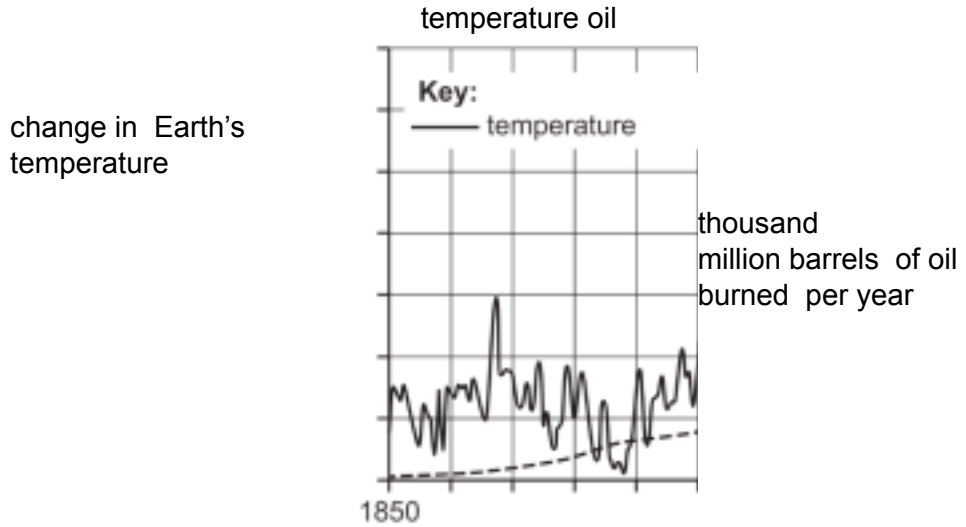


Fig. 3.2

It is suggested that there might be a relationship between the total amount of oil burned per year and the change in Earth's temperature.

Explain how the information in Fig. 3.2 supports this idea.

……

…… [1]

(c) Some scientists fear that climate change may cause other long-term environmental problems.

Describe **two** other long-term environmental problems caused by climate change. 1.

……...

…… 2.

……...

…… [2]

[Total: 6]

[Turn over

4 'Tumsoothe' is a medicine that cures indigestion. It contains 'sodium bicarbonate', $NaHCO_3$.

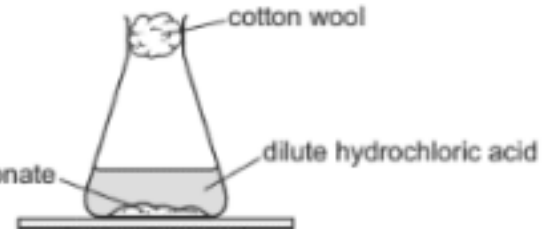
A student uses the apparatus, shown in Fig. 4.1, to study the reaction between dilute hydrochloric acid and Tumsoothe.

rubber bung

300.0 g Tumsoothe

hydrochloric acid

weighing machine



ıction is dilute

Fig. 4.1

$$NaHCO_3(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

(a) The student makes two mistakes in Fig. 4.1.

(i) Fig. 4.2 shows the top view of the weighing machine that was used in Fig. 4.1.

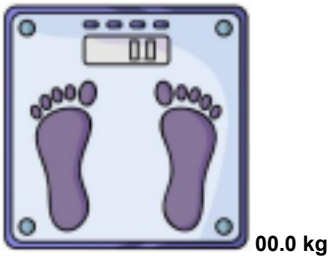


Fig. 4.2

One mistake is the use of weighing machine to measure the mass.

Explain how this mistake will affect the experiment.

……...

……... [1] **(ii)**

Identify the second mistake and suggest how this mistake would be corrected.

mistake …… correction

……

……... [2]

[Turn over

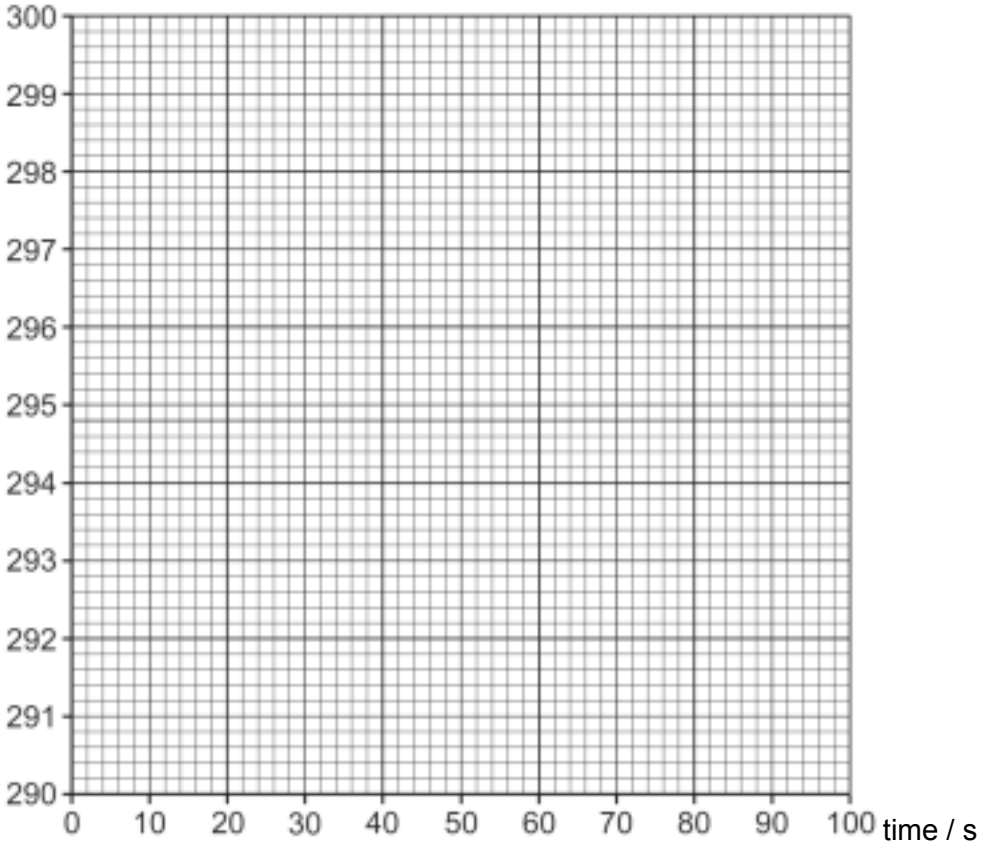
(b) The mistakes in Fig. 4.1 are corrected. The mass is measured every 10 seconds, as shown in Table 4.3.

Table 4.3

time / s	mass / g

0	300.0
10	298.0
20	296.0
30	294.5
40	293.5
50	292.5
60	292.0

(i) Using Table 4.3, plot a graph of mass against time on the axes below. Draw a **curved line** of best fit taking into account all your plotted points.



[2]

(ii) Using your graph, estimate the mass of the conical flask at 100 seconds. mass at 100 s = …… g [1]

[Turn over

(iii) Using the data in Table 4.3, calculate the mass of carbon dioxide gas produced at 60 seconds.

mass of carbon dioxide gas = …… g [1]

(iv) Using your answer in **(b)(iii)**, calculate the amount, in moles, of carbon dioxide gas produced at 60 seconds.

amount of carbon dioxide gas = …… [1]

[Total: 8]

[Turn over

Section B [8 marks]

Answer **one** question from this section.

5 Table 5.1 shows information about some properties of five substances.

Table 5.1

substance	melting point / °C	boiling point / °C	solubility in water	Does the substance conduct electricity?
M	−72	−10	soluble	only when dissolved
N	−98	65	soluble	no
O	−114	78	soluble	no
P	661	1304	soluble	only when molten or dissolved
Q	3550	4830	insoluble	no

(a) Substances **N** and **O** are completely miscible with each other, at room temperature and pressure.

Name the experimental technique used to separate the mixture of substance **N** and substance **O**.

…… [1]

(b) (i) A student deduces that substances **P** and **Q** are ionic compounds.

Using the information in Table 5.1, explain why the student's deduction is incorrect.

……...

……... [1]

(ii) Describe a method that could be used to separate a mixture of substance **P** and substance **Q** to obtain pure samples.

……...

……...

……...

……...

……...

……... [3]

(c) Substance **M** is identified to be sulfur dioxide.

Sulfur dioxide gas can dissolve in rainwater to form acid rain.

(i) Describe a simple test to confirm the presence of acid in a sample of rainwater.

……...

……... [1]

(ii) The acid rain can acidify the soil, and this may make it unsuitable for the growth of many crops.

Suggest a substance that can be added to increase the pH of the soil.
Explain how it works.

……...

……... [2]

[Total: 8]

[Turn over

6 The structures of three organic compounds are shown in Fig. 6.1.

A B C

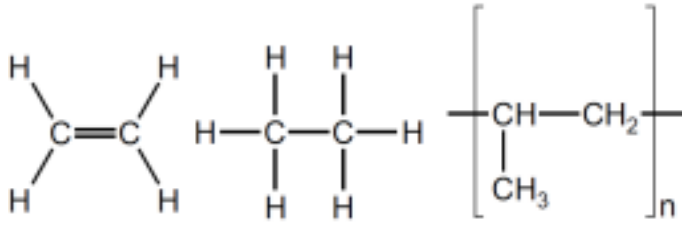


Fig. 6.1

(a) Explain why compound **B** is described as an **unsaturated** compound.

…… [1] **(b)**

Compound **A** can combust in excess oxygen.

Construct a chemical equation for this reaction. State symbols are **not** required.

…… [1] **(c)**

Both compounds **A** and **B** are colourless liquids.

Describe a chemical test to differentiate between compounds **A** and **B**.

test ……..……..……..

observations ……..……...

……... [2]

(d) (i) Suggest the chemical name for compound **C**, which is a polymer.

……... [1]

(ii) Draw the full structural formula (displayed formula) of the monomer from which this compound **C** (polymer) is formed.

[1]

(iii) Describe one physical method and one chemical method used to recycle compound **C**.

physical method ……..……

chemical method ……..……... [2]

[Total: 8]

[Turn over

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The Periodic Table of Elements

Group											
1	2										
				Key			1 H hydrogen 1				
3 Li lithium 7	4 Be beryllium 9			oton (atom umberatom symbolnam relative atomic mass							
11 Na sodium 23	12 Mg magnes ium 24	3	4	5	6	7	8	9	10	11	12
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 mangan ese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybde num 96	43 Tc technet ium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoi ds	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
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfor dium –	105 Db dubnium –	106 Sg seaborg ium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitner ium –	110 Ds darmstadt ium –	111 Rg roentgen ium –	112 Cn coperni cium –

lanthanoids actinoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseody mium 141	60 Nd neodym ium 144	61 Pm prometh ium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolin ium 157	65 Tb terbium 159	66 Dy dyspros ium 163	6 H holm 1
89 Ac actinium –	90 Th thorium 232	91 Pa protactin ium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californ ium –	9 E eins iur

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