



MINISTRY OF EDUCATION, SINGAPORE  
in collaboration with  
CAMBRIDGE ASSESSMENT INTERNATIONAL EDUCATION  
General Certificate of Education Normal (Academic) Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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INDEX  
NUMBER

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## SCIENCE

5107/04

Paper 4 Chemistry

For examination from 2024

SPECIMEN PAPER

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 Centre number, index number and name 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.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE ON ANY BARCODES.

#### 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 12.

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 12 printed pages.



Singapore Examinations and Assessment Board



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**Section A**

Answer **all** questions.

- 1 The following is a list of elements.

**chlorine copper fluorine hydrogen**

**iron neon sodium sulfur zinc**

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

Each element may be used once, more than once or not at all.

..... is a metal that does not react with steam.

..... is an inert (unreactive) gas.

..... is the most reactive element in Group 17.

..... reacts with unsaturated vegetable oil to produce margarine.

[3]

[Total: 3]

2 The Periodic Table on page 12 shows the chemical elements in rows (left to right) and columns (up and down).

(a) (i) A column of elements in the Periodic Table is called a group.

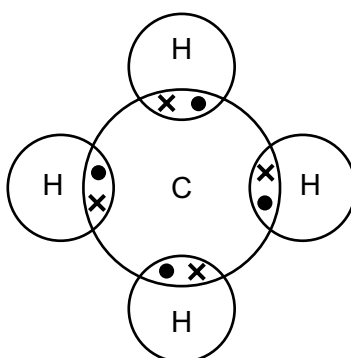
State the name for a row of elements in the Periodic Table.

..... [1]

(ii) State the chemical symbol of the element which has a proton number of 32.

..... [1]

(b) A compound **Y** contains only carbon and hydrogen. The diagram shows the bonding in **Y**. Only the outer electrons are shown for each atom.



(i) Name compound **Y**.

..... [1]

(ii) State the type of bonding present in **Y**.

..... [1]

(c) Compound **Y** can be used as a fuel.

Construct a chemical equation for the reaction when **Y** burns in a plentiful supply of air.

..... [2]

(d) Hydrogen,  $H_2$ , can also be burned as a fuel.

Explain why it is less harmful to the environment to burn hydrogen than compound **Y**.

.....

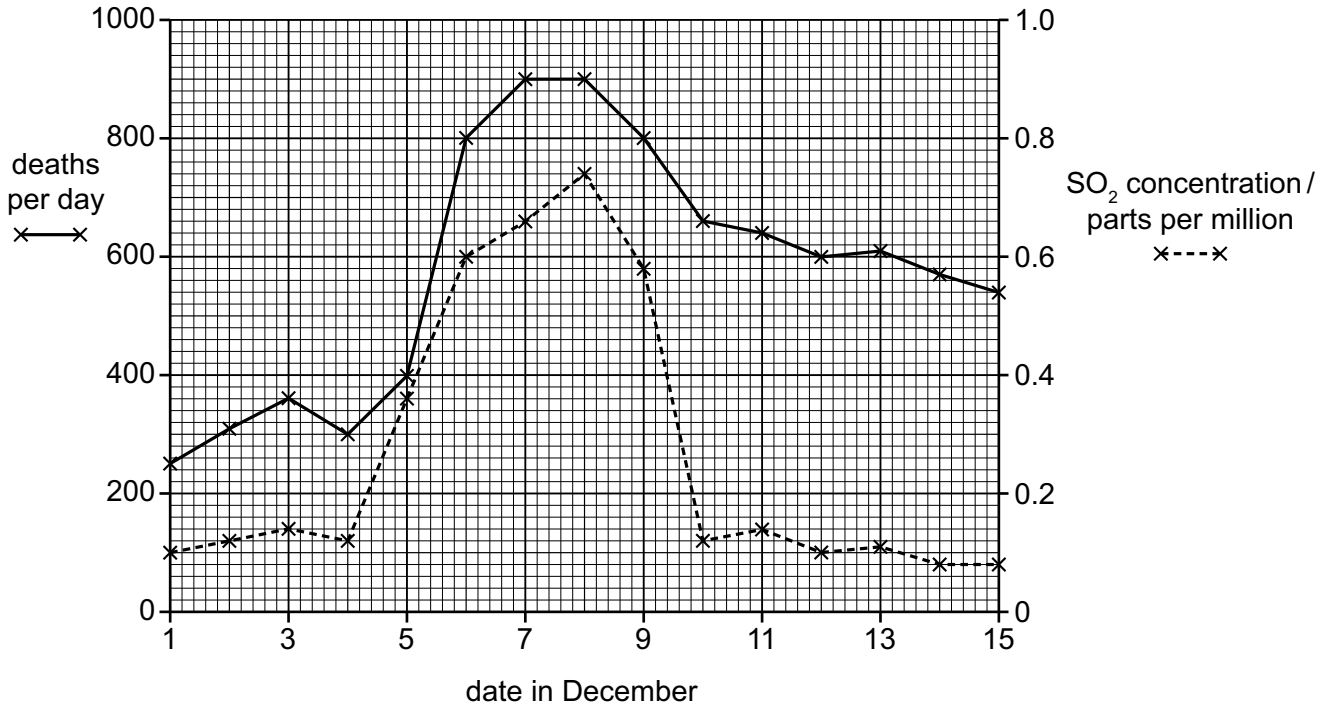
..... [1]

[Total: 7]

3 This question is about gases in the air.

- (a) In December 1952, a large city experienced several days of exceptionally dense fog caused by pollution.

The graph shows the concentration of sulfur dioxide,  $\text{SO}_2$ , in the air of the city, and also the number of people who died, between December 1 and December 15 in 1952.



- (i) Calculate how many more people died on December 8 than on December 1.

..... [1]

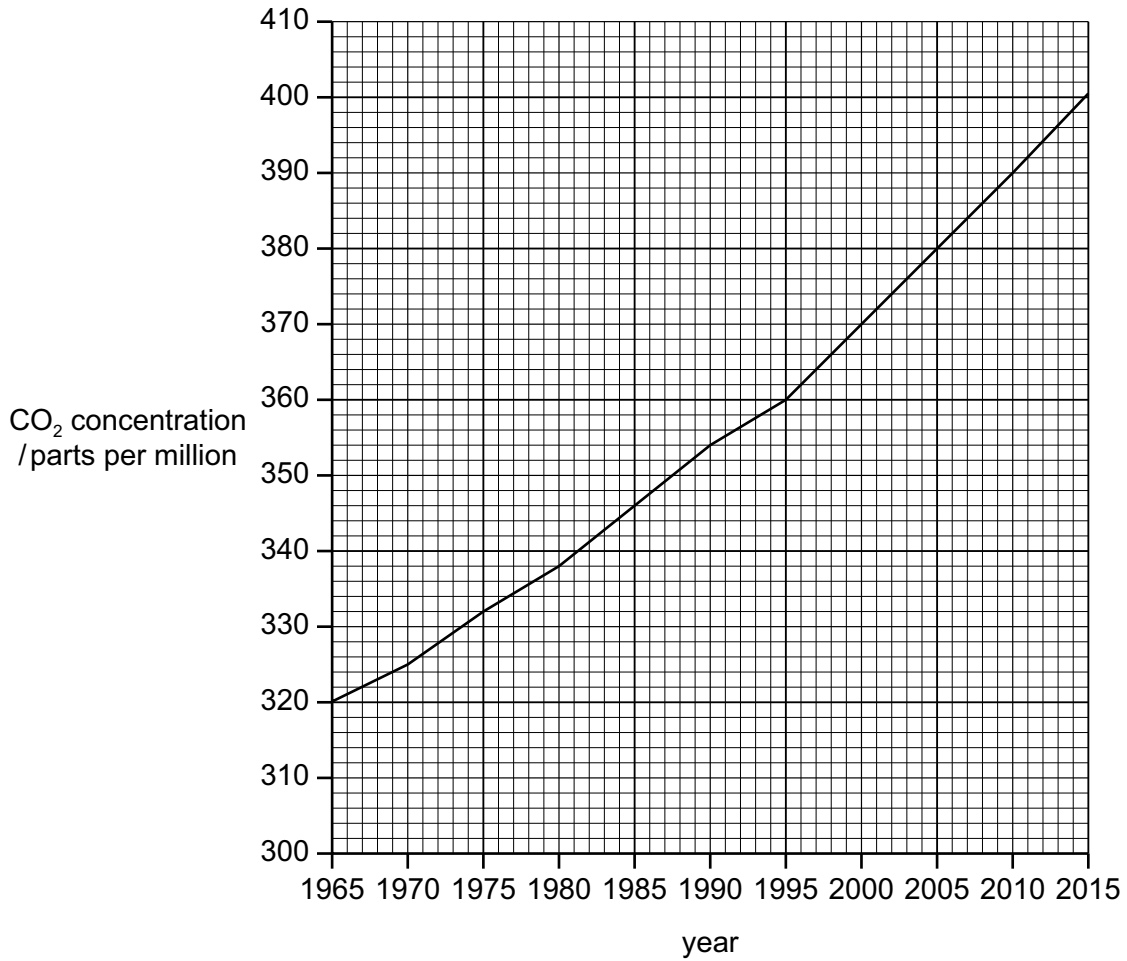
- (ii) It was suggested that there might be a link between the sulfur dioxide concentration and the number of deaths.

Explain how the information in the graph supports this idea.

.....  
 ..... [1]

- (b) Carbon dioxide, CO<sub>2</sub>, is a gas found in the air. The concentration of carbon dioxide in the air is measured in parts per million.

The change in concentration of carbon dioxide in the air between 1965 and 2015 is shown in the graph.



- (i) Use values from the graph to describe the change in concentration of carbon dioxide in the air between 1965 and 2015.

..... [1]

- (ii) Suggest a reason for this change.

.....  
 ..... [1]

[Total: 4]

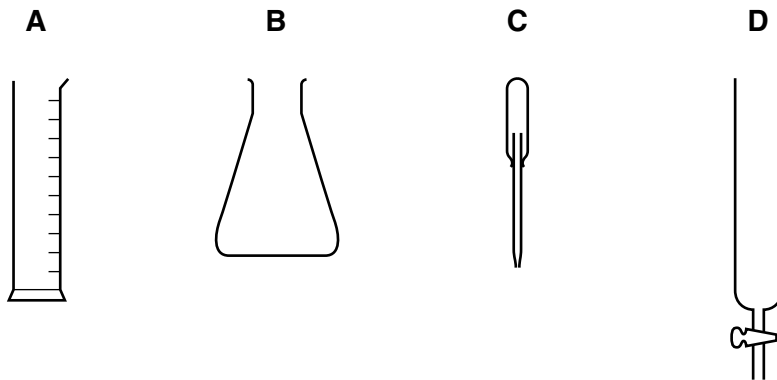
- 4 (a) A student wants to separate the coloured pigments in a plant leaf by chromatography. The student grinds the plant leaf and separates the solids from the green solution.

(i) Identify the method used to separate the solids from the green solution.

..... [1]

(ii) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper.

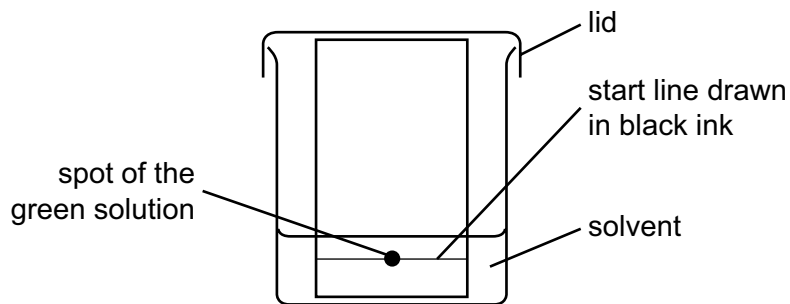
From the diagrams below choose the letter for the most suitable piece of apparatus for this task.



apparatus ..... [1]

(b) The student sets up the chromatography apparatus shown.

The student made two mistakes.



One mistake was to add too much solvent so that the start line was in the solvent.

(i) Explain why this mistake would not lead to the separation of coloured pigments.

.....  
 ..... [1]

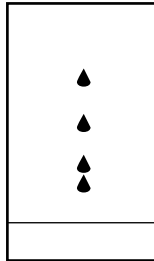
(ii) Identify the second mistake and suggest how this mistake would be corrected.

mistake .....

correction .....

[2]

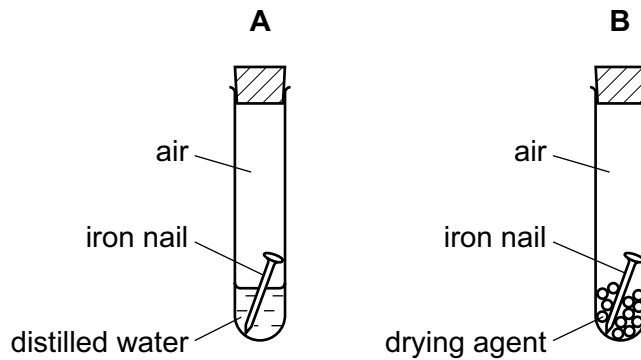
The mistakes were corrected, and the final chromatogram is shown.



(iii) State the number of different pigments present in the green solution.

..... [1]

(c) Another student does an experiment to investigate the rusting of iron nails.



For tubes **A** and **B**, predict whether the nail will rust. In each case give a reason.

Does the nail rust in tube **A**? .....

reason .....

Does the nail rust in tube **B**? .....

reason .....

[2]

[Total: 8]

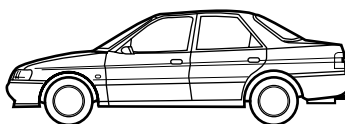
## Section B

Answer **one** question from this section.

- 5 Aluminium, iron and sodium are metallic elements. Aluminium and iron are widely used, but no useful objects can be made out of metallic sodium.



aluminium alloys are  
used in aircraft



iron is used to make  
steel for cars

- (a) (i) State **one** property of a metallic element which is different from a non-metallic element.

.....  
 ..... [1]

- (ii) Use your knowledge of the metals in Group 1 of the Periodic Table to state **one** reason, other than cost, why no useful objects can be made out of metallic sodium.

.....  
 ..... [1]

- (b) Iron reacts readily with dilute hydrochloric acid to form iron(II) chloride,  $\text{FeCl}_2$ .

- (i) Explain what is meant by an acidic solution in terms of the relative concentrations of hydrogen ions,  $\text{H}^+$ , and of hydroxide ions,  $\text{OH}^-$ .

.....  
 ..... [1]

- (ii) Construct a chemical equation for the reaction of iron with dilute hydrochloric acid to form iron(II) chloride.

..... [2]



(iii) Iron(III) oxide also reacts with dilute hydrochloric acid.

In a reaction, 10 mol of  $\text{Fe}_2\text{O}_3$  is used.

Calculate the mass of  $\text{Fe}_2\text{O}_3$  used.

[Relative atomic masses:  $A_r$ : Fe, 56; O, 16]

mass = ..... g [2]

(c) A student did experiments to find the order of reactivity of four metals. He placed a sample of each metal in the four solutions shown in the table. He recorded the results in the table.

solution \ metal	copper	lead	silver	zinc
copper(II) nitrate	x	✓	x	✓
lead(II) nitrate	x	x	x	✓
silver nitrate	✓	✓	x	✓
zinc nitrate	x	x	x	x

key

✓ reaction took place  
x no reaction

List the four metals in order of decreasing reactivity.

most reactive .....

.....

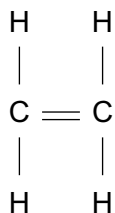
.....

least reactive .....

[1]

[Total: 8]

6 The structural formula of ethene can be drawn as follows.



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

..... [1]

(b) Unsaturated compounds react with aqueous bromine.

(i) Describe the colour change during this chemical reaction.

.....  
 ..... [1]

(ii) Construct a chemical equation for the reaction between ethene and aqueous bromine.

..... [2]

(iii) Name the type of reaction that takes place between ethene and aqueous bromine.

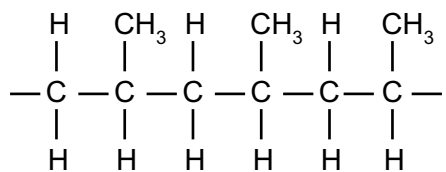
..... [1]

(c) Ethene is used to make the polymer poly(ethene).

Define the term polymer.

..... [1]

(d) A section of a different polymer is shown.



(i) Draw the full structural formula (displayed formula) of the monomer from which this polymer is formed.

[1]

(ii) Suggest the chemical name for this polymer.

..... [1]

[Total: 8]

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## The Periodic Table of Elements

		Group																					
1	2															13	14	15	16	17	18		
3 Li lithium 7	4 Be beryllium 9	<b>Key</b> 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	1 H hydrogen 1																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	3 Sc scandium 45	4 Ti titanium 48	5 V vanadium 51	6 Cr chromium 52	7 Mn manganese 55	8 Fe iron 56	9 Co cobalt 59	10 Ni nickel 59	11 Cu copper 64	12 Zn zinc 65	13 Ga gallium 70	14 Ge germanium 73	15 As arsenic 75	16 Se selenium 79	17 Br bromine 80	18 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 oganeson —						
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<sup>3</sup> at room temperature and pressure (r.t.p.).  
 The Avogadro constant,  $L = 6.02 \times 10^{23} \text{ mol}^{-1}$ .