



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



Cambridge Assessment
International Education

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.

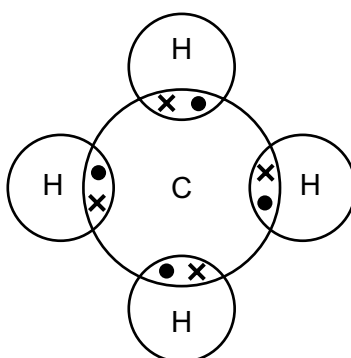
State the name for a row of elements in the Periodic Table.

..... [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**.

.....

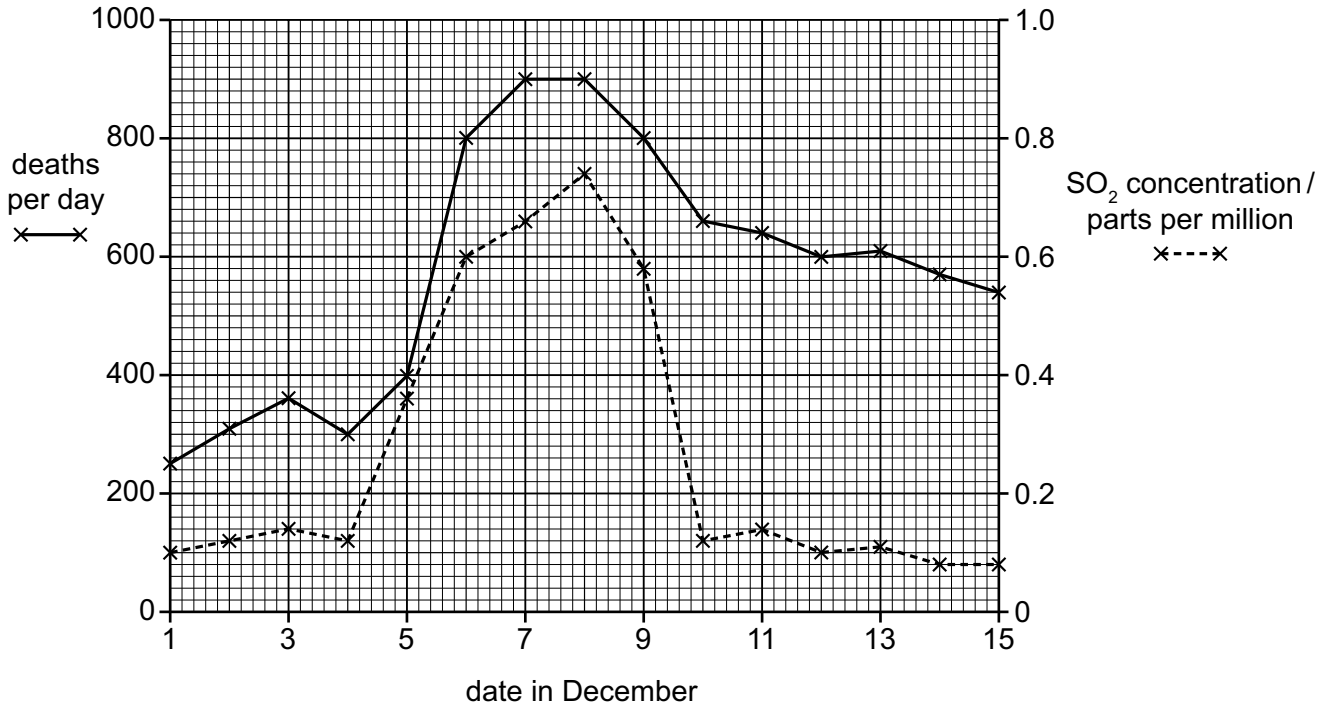
..... [1]

[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, 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]

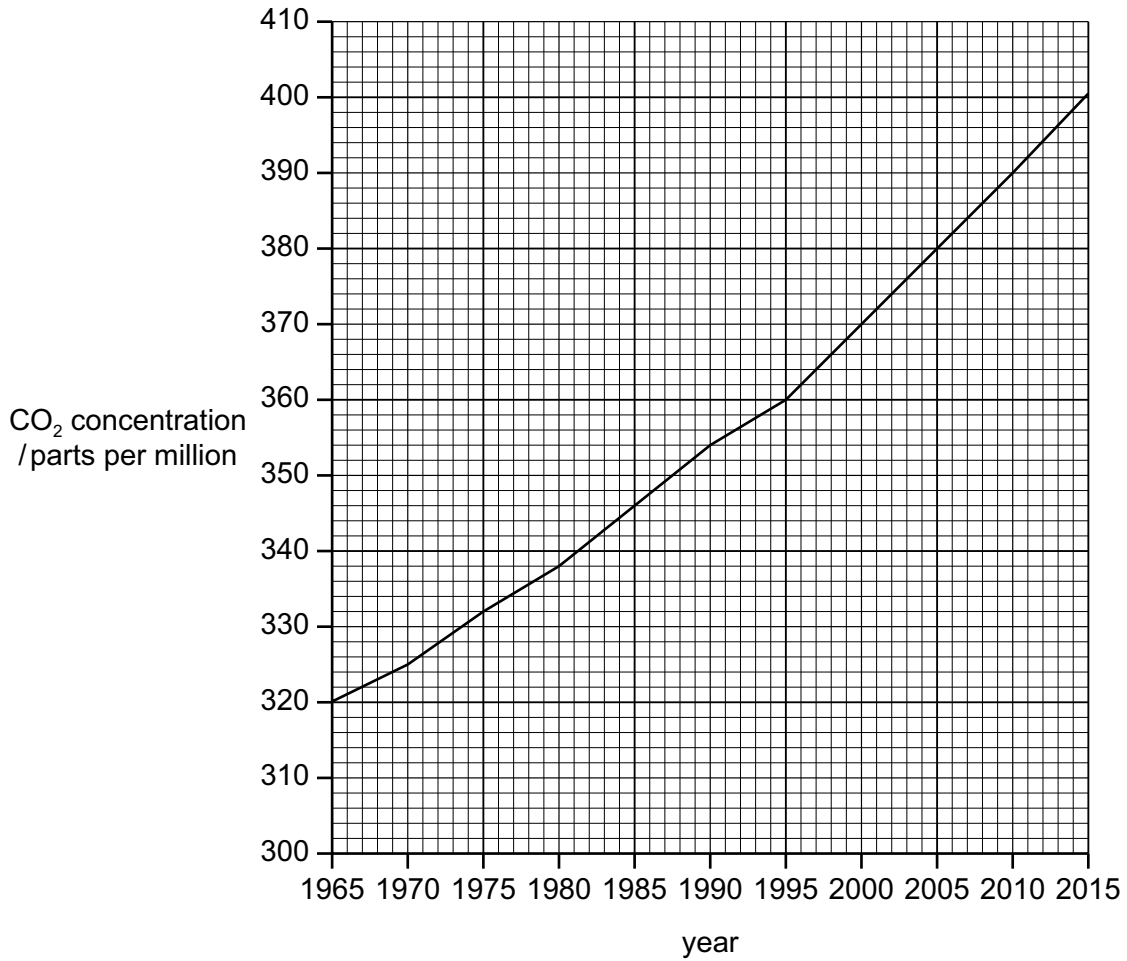
(ii) It was suggested that there might be a link between the sulfur dioxide concentration and the number of deaths.

Explain how the information in the graph supports this idea.

.....
 [1]

- (b) Carbon dioxide, CO₂, 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]

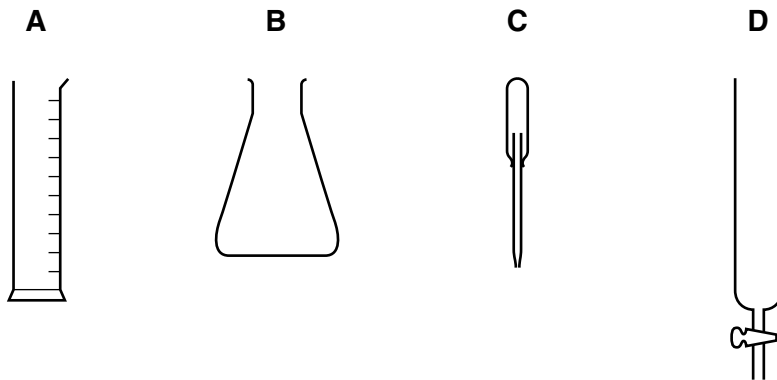
- 4 (a) A student wants to separate the coloured pigments in a plant leaf by chromatography. The student grinds the plant leaf and separates the solids from the green solution.

(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.

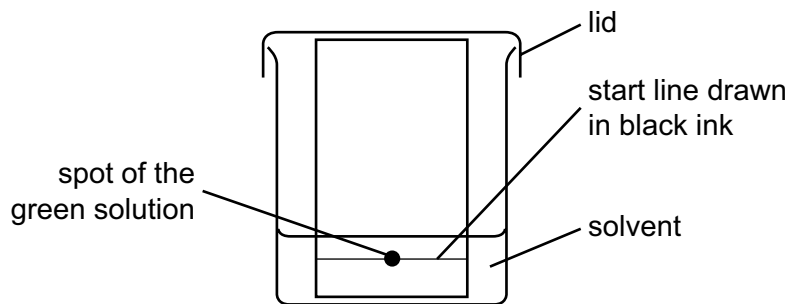
From the diagrams below choose the letter for the most suitable piece of apparatus for this task.



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]

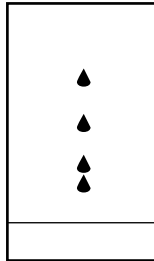
(ii) Identify the second mistake and suggest how this mistake would be corrected.

mistake

correction

[2]

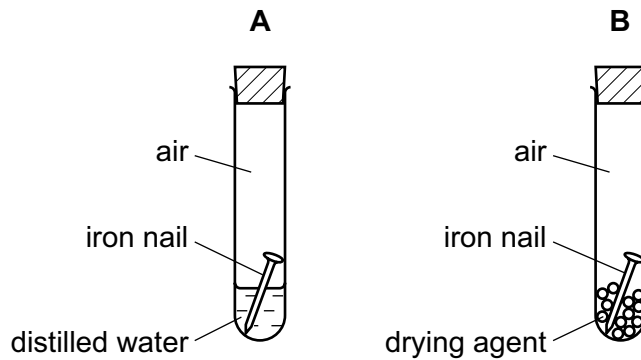
The mistakes were corrected, and the final chromatogram is shown.



(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]

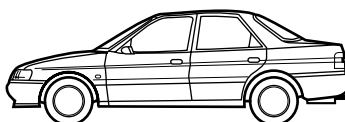
Section B

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, FeCl_2 .

- (i) Explain what is meant by an acidic solution in terms of the relative concentrations of hydrogen ions, H^+ , and of hydroxide ions, 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 Fe_2O_3 is used.

Calculate the mass of Fe_2O_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

.....

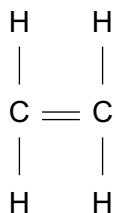
.....

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.

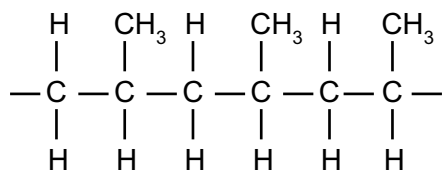
..... [1]

(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]

The Periodic Table of Elements

Group																																																																																																						
1	2																	18																																																																																				
3 Li lithium 7	4 Be beryllium 9	Key proton (atomic) number atomic symbol name relative atomic mass																2 He helium 4																																																																																				
11 Na sodium 23	12 Mg magnesium 24	1 H hydrogen 1	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	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 —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —	119 K potassium 39	120 Ca calcium 40	121 Sc scandium 45	122 Ti titanium 48	123 V vanadium 51	124 Cr chromium 52	125 Mn manganese 55	126 Fe iron 56	127 Co cobalt 59	128 Ni nickel 59	129 Cu copper 64	130 Zn zinc 65	131 Ga gallium 70	132 Ge germanium 73	133 As arsenic 75	134 Se selenium 79	135 Br bromine 80	136 Kr krypton 84	137 Rb rubidium 85	138 Sr strontium 88	139 Y yttrium 89	140 Zr zirconium 91	141 Nb niobium 93	142 Mo molybdenum 96	143 Tc technetium —	144 Ru ruthenium 101	145 Rh rhodium 103	146 Pd palladium 106	147 Ag silver 108	148 Cd cadmium 112	149 In indium 115	150 Sn tin 119	151 Sb antimony 122	152 Te tellurium 128	153 I iodine 127	154 Xe xenon 131	155 Cs caesium 133	156 Ba barium 137	157 La lanthanum 139	158 Ce cerium 140	159 Pr praseodymium 141	160 Nd neodymium 144	161 Pm promethium —	162 Sm samarium 150	163 Eu europium 152	164 Gd gadolinium 157	165 Tb terbium 159	166 Dy dysprosium 163	167 Ho holmium 165	168 Er erbium 167	169 Tm thulium 169	170 Yb ytterbium 173	171 Lu lutetium 175	172 Hf hafnium 178	173 Ta tantalum 181	174 W tungsten 184	175 Re rhenium 186	176 Os osmium 190	177 Ir iridium 192	178 Pt platinum 195	179 Au gold 197	180 Hg mercury 201	181 Tl thallium 204	182 Pb lead 207	183 Bi bismuth 209	184 Po polonium —	185 At astatine —	186 Rn radon —	187 Fr francium —	188 Ra radium —	189 Ac actinium —	190 Th thorium 232	191 Pa protactinium 231	192 U uranium 238	193 Np neptunium —	194 Pu plutonium —	195 Am americium —	196 Cm curium —	197 Bk berkelium —	198 Cf californium —	199 Es einsteinium —	200 Fm fermium —	201 Md mendelevium —	202 No nobelium —	203 Lr lawrencium —
lanthanoids																		71 Lu lutetium 175																																																																																				
actinoids																		103 Lr lawrencium —																																																																																				

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).
 The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.