Candidate Name: __________________________ (   ) Class: _________

4NA
Session 1

KRANJI SECONDARY SCHOOL
Preliminary Examination
Secondary 4 Normal (Academic)

SCIENCE (CHEMISTRY) **5105/04**
Paper 4 **5107/04**

Papers 3 and 4
Friday **2 August 2024** 1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.

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 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 Examiners' Use	
Paper 3	**20**
Paper 4	**30**
Total	**50**

Set by: Mr Joel Lee

This Question Paper consists of **11** printed pages and **1** blank page.

[Turn over

Section A

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

1 Several substances are listed below.

sulfur dioxide	iodine	zinc
hydrochloric acid	brass	ammonium nitrate
helium	sodium hydroxide	methane

Answer the following questions using the substances from the list.

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

(a) Which substance is a mixture of elements?

…… [1]

(b) Which substance is a monoatomic gas?

…… [1]

(c) Which substance is a major greenhouse gas that contributes to global warming?

…… [1]

(d) Which two substances react to form ammonia gas?

…… [1]

[Total: 4]

2 The table below shows the boiling points of nitrogen, oxygen and argon, which can be obtained from liquid air. Liquid air is air that is cooled until it liquefies.

gas	melting point / °C
nitrogen	-196
oxygen	-183
argon	-186

(a) State the separation process used to obtain these gases from liquid air.

……. [1]

(b) State the gas that is collected first during this process.

……. [1]

(c) At high temperatures in car engines, two of these gases react to form a common atmospheric pollutant.

(i) State the name of this pollutant.

…….. [1]

(ii) State another air pollutant commonly produced in car engines and its health effects.

pollutant ……...

health effects ……...

……. [2]

[Total: 5]

3 The table below lists some information of three metal elements beryllium, magnesium and calcium.

metal	proton number	electronic configuration
beryllium	2	
magnesium	12	
calcium	20	

(a) Complete the table by stating the electronic configuration of the metals. [1]

(b) Based on your answers in part (a), explain why these metals are in the same Group of the Periodic Table.

……

…… [1]

(c) Calcium reacts with chlorine to form calcium chloride.

(i) Draw a dot-and-cross diagram to show the bonding in calcium chloride.
Show outer shell electrons only.

[Proton (atomic) numbers: Ca, 20; C*l*, 17]

[2]

(ii) State one difference between the electrical conductivity of calcium and calcium chloride.

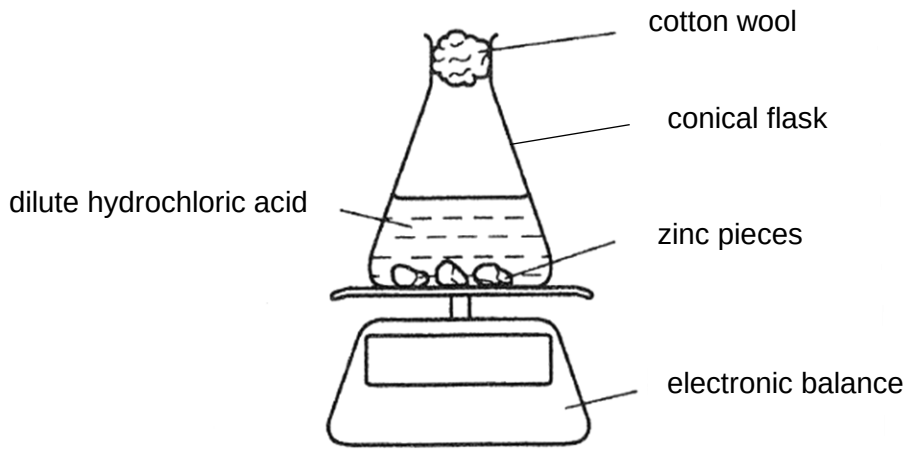
……...

……...

……..[1]

[Total: 5]

4 A student wanted to study the reaction between a metal and an acid. He set up an experiment as shown below.



The reading on the electronic balance is recorded every two minutes. The results are shown in the table below.

time/min	0	2	4	6	8	10
reading on balance / g	4.00	2.50	1.60	1.00	0.70	0.70

(a) The reaction between zinc and hydrochloric acid produces a gas. State the name of the gas and describe a chemical test to confirm its identity.

name of gas ……..

positive test for this gas ..……..

……..

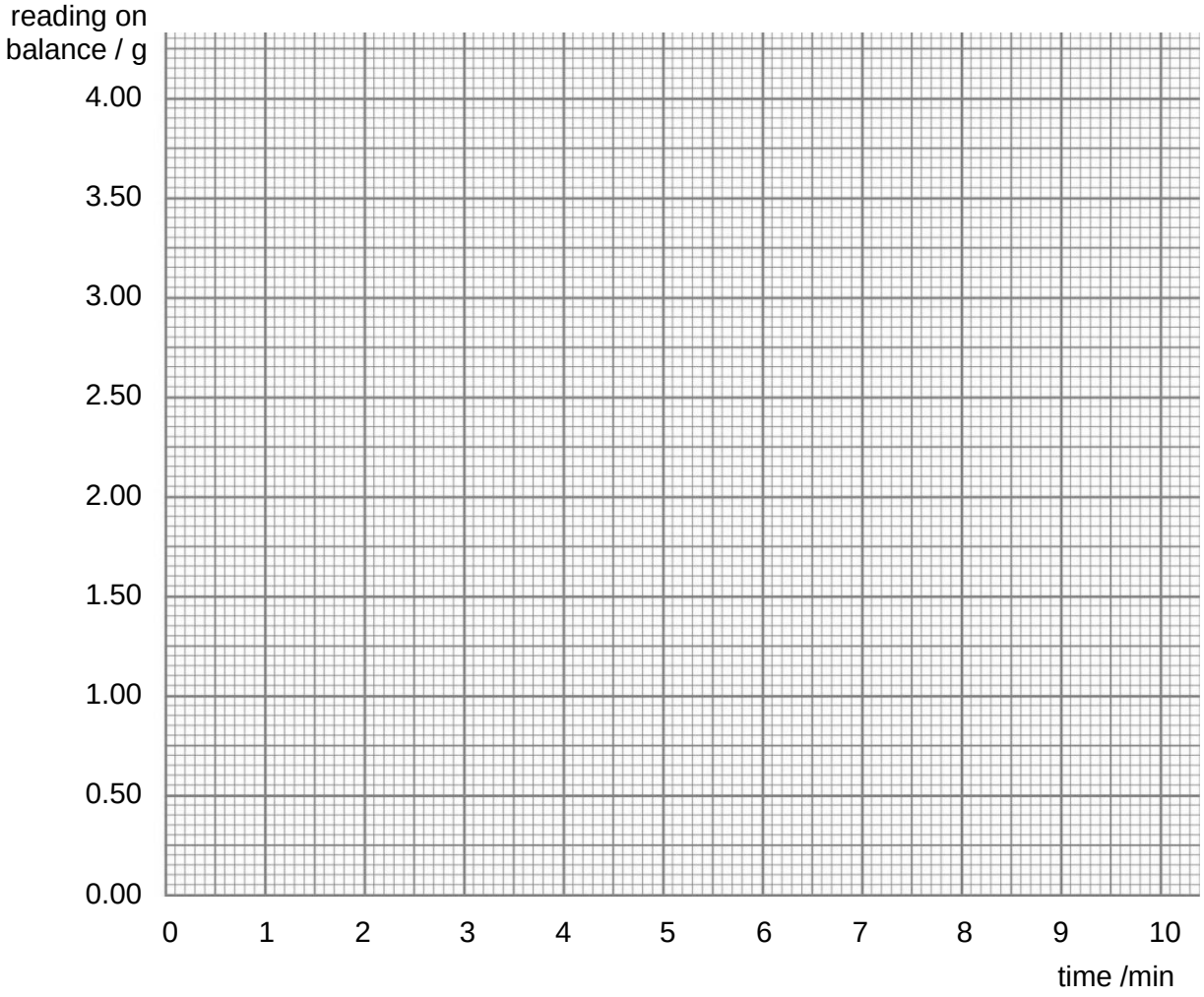
……. [2]

(b) Suggest why the reading on the electronic balance decreases with time.

…….

……. [1]

(c) Plot a graph of the reading on the balance against time. Mark each point with a cross (×). [1]



(d) Draw a curved line of best fit taking into account all your plotted points. [1]

(e) Use your graph to estimate the time that the reaction is completed.

…… min [1]

(f) Another way of studying this reaction is to collect and measure the volume of gas produced as the reaction proceeds. State a suitable piece of apparatus for this.

…… [1]

(g) The student wanted to repeat the experiment with another metal and suggested using sodium. Explain why this should **not** be done.

……

…… [1]

[Total: 8]

Section B

Answer **one** question from this section.

5 Elements **W**, **X**, **Y** and **Z** are in Group 17 of the Periodic Table. The table below shows the properties of the elements and their reactions with their corresponding $\mathbf{W}^-$, $\mathbf{X}^-$, $\mathbf{Y}^-$ and $\mathbf{Z}^-$ ions.

element	state at room temperature	reaction with $\mathbf{W}^-$ ion	reaction with $\mathbf{X}^-$ ion	reaction with $\mathbf{Y}^-$ ion	reaction with $\mathbf{Z}^-$ ion
W		×	✓	✓	✓
X	liquid	×	×	✓	×
Y	solid	×	×	×	×
Z	gas	×	✓	✓	×

key: ×: no reaction; ✓: reaction took place

(a) Arrange the elements **W**, **X**, **Y** and **Z** in order of increasing reactivity.

…… [1]

(b) Predict the state of element **W** at room temperature.

…… [1]

(c) Group 17 elements exist as diatomic molecules.

(i) Draw a dot-and-cross diagram to show one molecule of fluorine.
Show only outer shell electrons.

[Proton (atomic) number: F: 9]

[2]

(ii) Explain why the elements in Group 17 have low melting points.

…..…….

……...

……..

……. [2]

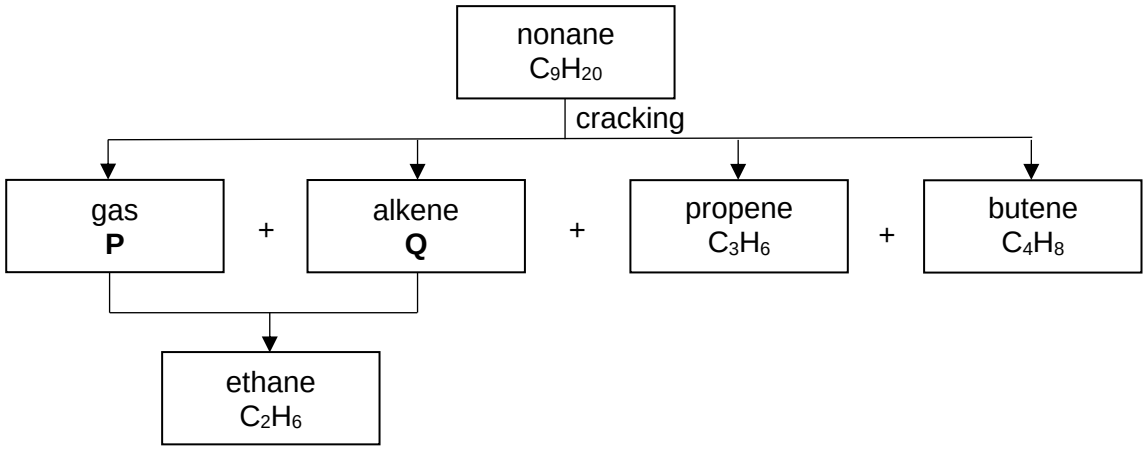
(d) In an experiment, a student bubbles chlorine gas through a solution of sodium iodide.

Write a balanced chemical equation for the reaction.

……..…….. [2]

[Total: 8]

6 Nonane is a hydrocarbon that is found in kerosene. It can undergo cracking to form various alkenes and other products as shown in the reaction scheme below.



(a) State the name and chemical formula of substances **P** and **Q**.

(i) **P** ……. formula …….

(ii) **Q** ……. formula ……. [2]

(b) State a reagent you would use to differentiate between alkene **Q** and ethane and describe the relevant observations that would be made.

reagent ……..

observation for **Q**: ……

……..

observation for ethane: ……

…..……. [2]

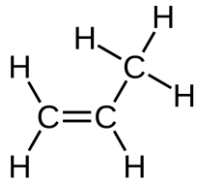
(c) In a reaction, 15 mol of nonane (C_9H_{20}) underwent cracking. Calculate the mass of nonane that underwent cracking.

[Relative atomic masses: A_r: C, 12; H, 1]

mass = …… g [2]

(d) Propene can undergo addition polymerisation to form poly(propene), a plastic that is found in a wide variety of products and processes, including 3D printing.

The structural formula of propene is given below:



(i) Draw the full structural formula of poly(propene), showing three repeating units.

[1]

(ii) Plastics can be recycled to reduce waste and pollution. However, plastic recycling comes with disadvantages. State one issue of recycling plastics.

……...

……...

……. [1]

[Total: 8]

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key 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	3	4	5	6	7	8	9	10	11	12	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 –		

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 –

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