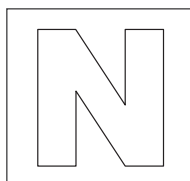


**SECONDARY 4**  
Normal Academic Exam Paper  
**Science Chem NA**

1	Gan Eng Seng	SA1
2	Geylang Methodist	SA1
3	Hua Yi Secondary	SA1
4	Kranji Secondary	SA1
5	Yuying Secondary	SA1
6	Assumption English	SA2
7	Northland Secondary	SA2
8	Seng Kang Secondary	SA2
9	Serangoon Garden	SA2
10	Unity Secondary	SA2





**GAN ENG SENG SCHOOL**  
**Mid-Year Examination 2018**



**CANDIDATE  
NAME**

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**CLASS**

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**INDEX  
NUMBER**

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**SCIENCE (CHEMISTRY)**

**5105, 5107/03**

Paper 3

**04 May 2018**

**Paper 3 & 4: 1 hour 15 minutes**

**Sec 4 Normal (Academic)**

Additional Materials: OTAS

Calculators are allowed in the examination.

---

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, class and index number on the OTAS.

There are **twenty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A, B, C, and D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

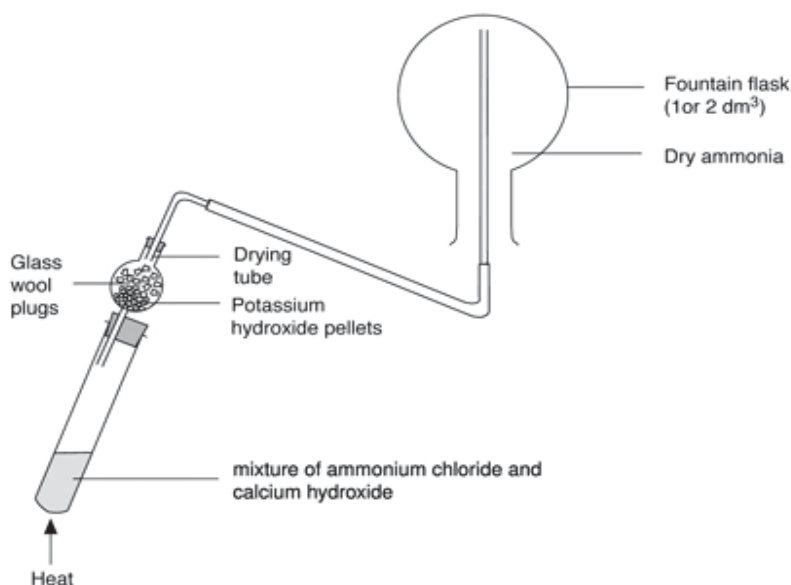
You are advised to spend no longer than 30 minutes on Paper 3.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

A copy of the Periodic Table is found on page 11.

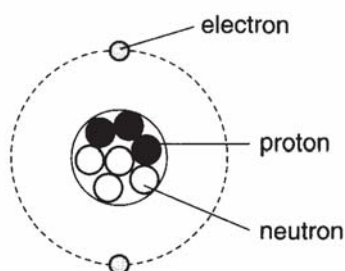
Total Marks
20

- 1 The diagram shows an upward delivery method to collect ammonia gas. What is the nature of ammonia gas?



- A The gas is soluble in water and denser than air.
- B The gas is soluble in water and less dense than air.
- C The gas is insoluble in water and denser than air.
- D The gas is insoluble in water and less dense than air.

- 2 The diagram shows the structure of a particle.



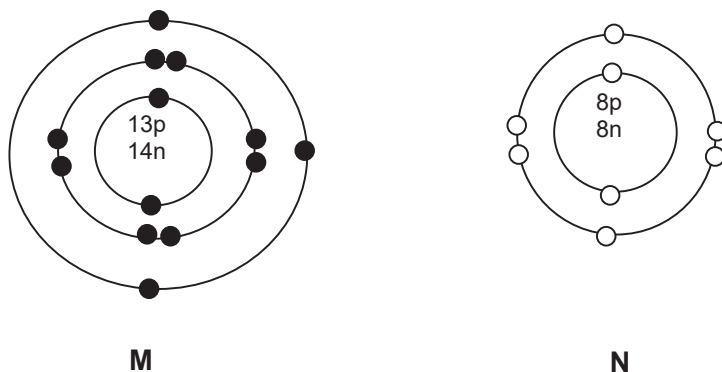
Which of these best describes the above structure accurately?

- A Negative ion
- B Positive ion
- C Isotope
- D Neutral atom



3

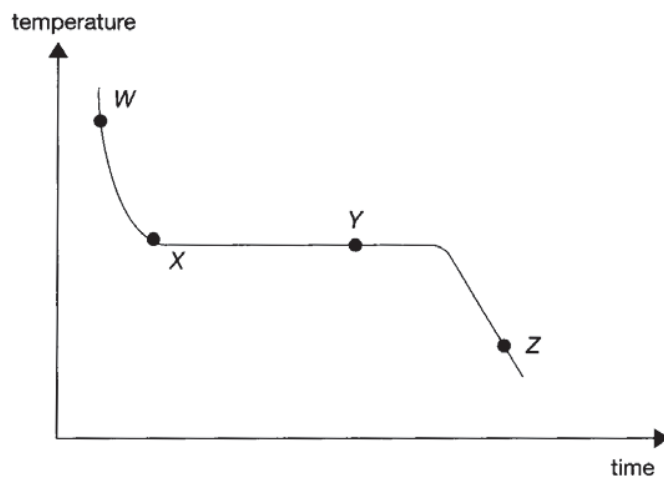
The diagram below illustrates the structures of the atoms of two elements **M** and **N**.



What will be the formula and mass of one mole of this compound when these two elements combine together to form a compound?

	<u>formula</u>	<u>mass of one mole (g)</u>
<b>A</b>	MN	43
<b>B</b>	M <sub>3</sub> N <sub>2</sub>	113
<b>C</b>	MN <sub>2</sub>	70
<b>D</b>	M <sub>2</sub> N <sub>3</sub>	102

4 A sample of liquid naphthalene is cooled.  
The graph shows how the temperature of the naphthalene changed with time as it cooled.



At which point are all the naphthalene particles furthest apart?

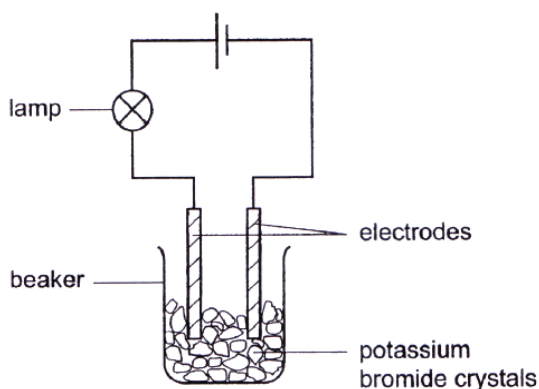
- A** W
- B** X
- C** Y
- D** Z

- 5 Titan is the largest moon of the planet Saturn and it is the only moon in the Solar System with an atmosphere. The following substances are present:

substance	melting point /°C	boiling point /°C
argon	-189	-116
hydrogen	-281	-252
methane	-182	-162
nitrogen	-210	-196

Which of the substances on Titan would be gaseous at -220°C?

- A argon  
 B hydrogen  
 C methane  
 D nitrogen
- 6 The experiment shown is used to test the electrical conductivity of potassium bromide crystals.



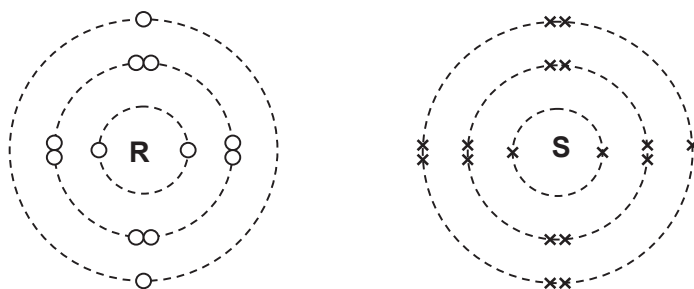
The lamp does not light up.

Distilled water is then added to the beaker and the lamp lights up.

Which statement explains these observations?

- A Distilled water is a good conductor of electricity.  
 B Metal ions are free to move when potassium reacts with water.  
 C Oppositely charged ions are free to move in the solution when potassium bromide dissolves.  
 D Electrons are free to move in the solution when potassium bromide dissolves.

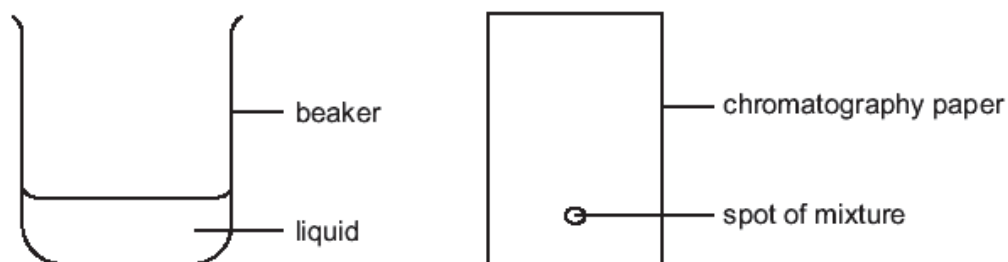
- 7 The electronic structures of two atoms **R** and **S** are shown.



**R** and **S** react to form a compound.

What is the chemical formula of the compound and what type of bonding is formed?

- A  $R_2S$  ; covalent
  - B  $R_2S$  ; ionic
  - C  $RS_2$  ; covalent
  - D  $RS_2$  ; ionic
- 8 A student attempted to separate a mixture of two food dyes using paper chromatography. He prepared the chromatography paper as shown. He then carefully inserted the paper into the beaker containing the liquid. He noticed that there was no separation of the mixture even after 30 minutes.



Which of the following could be a possible explanation for this?

- A The substances in the mixture were not pure.
- B The substances in the mixture were colourless.
- C The mixture was soluble in the liquid.
- D The mixture was not soluble in the liquid.

- 9 The table shows some information about the solubilities of 3 substances.

Substance	Solubility in water	Solubility in ethanol
J	Insoluble	Soluble
L	Soluble	Insoluble
M	Insoluble	Insoluble

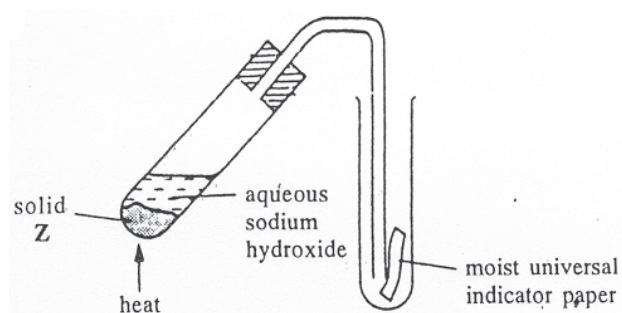
The following operations could be carried out to obtain pure L from a mixture of J, L, M.

1. filter
2. evaporate to dryness
3. add ethanol
4. add water

In what order should the operations be carried out?

- A 1, 2, 3, 4
- B 3, 1, 2 (omit 4)
- C 3, 4, 1, 2
- D 4, 1, 2 (omit 3)
- 10 The apparatus was set up as shown. When the test-tube was heated, the universal indicator paper turned blue.

What could solid Z be?



- A sodium nitrate
- B ammonium chloride
- C potassium carbonate
- D magnesium

- 11** The following shows the pH of some common fruits and vegetables juices.

Lemon	pH 2
Orange	pH 3
Banana	pH 5
Apple	pH 8
Carrot	pH 8
Celery	pH 9
Spinach	pH10

Which of these juices, when added in equal volume gives a mixture which turns moist blue litmus paper red ?

- A** Apple and Celery  
**B** Orange and Spinach  
**C** Lemon and Banana  
**D** Celery and Carrot

- 12** Which statement about the Periodic Table is correct?

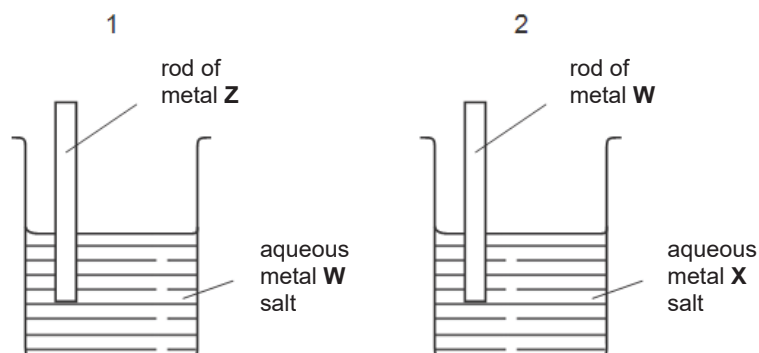
- A** Atoms of all elements in the same Group have the same total number of electrons.  
**B** All Groups contain both metallic elements and non-metallic elements.  
**C** There are more non-metallic than metallic elements.  
**D** In Group VII, the melting and boiling points increase with increasing proton number.

- 13** The positions of four elements are shown on the outline of part of the Periodic Table. Element **X** has a high melting point and is a good conductor of electricity. It forms chlorides  $\text{XCl}_2$  and  $\text{XCl}_3$ .

What is the position of **X** in the Periodic Table?

A simplified periodic table grid is shown. The grid consists of several rows and columns of squares. The first row has a single square in the center. The second row has two squares on the left and a group of six squares on the right. The third row has two squares on the left, a group of six squares in the middle, and two squares on the right. The fourth row has two squares on the left, a group of six squares in the middle, and two squares on the right. The fifth row has two squares on the left, a group of six squares in the middle, and two squares on the right. The labels are placed in the following positions: 'A' is in the second square of the second row; 'B' is in the second square of the third row; 'C' is in the fourth square of the fourth row; and 'D' is in the second square of the fifth row.

- 14 Two different beakers are set up as shown.



In beaker 1, metal **W** is displaced from the solution.

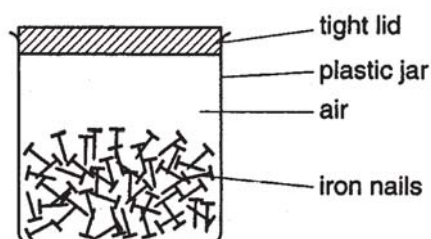
In beaker 2, metal **X** is displaced from the solution.

What is the order of decreasing reactivity of the metals?

most reactive -----> least reactive

- |          |          |          |          |
|----------|----------|----------|----------|
| <b>A</b> | <b>W</b> | <b>X</b> | <b>Z</b> |
| <b>B</b> | <b>Z</b> | <b>W</b> | <b>X</b> |
| <b>C</b> | <b>X</b> | <b>Z</b> | <b>W</b> |
| <b>D</b> | <b>W</b> | <b>Z</b> | <b>X</b> |

- 15 A shopkeeper stores iron nails in an airtight container, as shown in the diagram.



The nails begin to rust after a few days.

How can the rusting of the nails be prevented?

- A** Leave the lid off
- B** Seal the jar in a bag
- C** Put the jar in a warm place
- D** Put a drying agent in the jar

- 16 The table gives the relative concentrations of polluting gases in the air in four different industrialised cities.

In which city are limestone buildings most threatened by pollution?

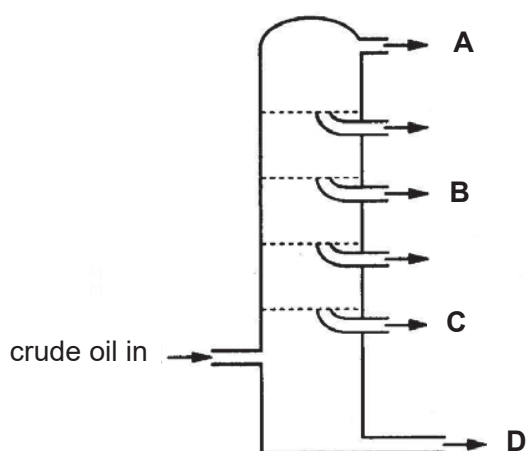
	sulfur dioxide	nitrogen dioxide	carbon monoxide
<b>A</b>	17	46	23
<b>B</b>	32	33	30
<b>C</b>	38	40	11
<b>D</b>	45	14	21

- 17 Which of the following substances is **not** found in a sample of clean air?

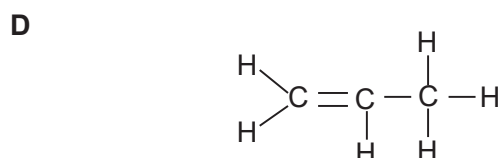
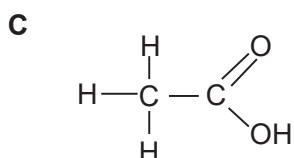
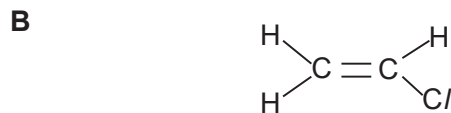
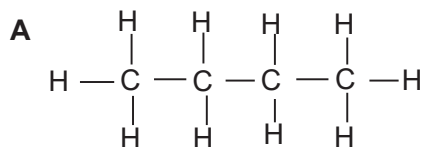
- A** carbon dioxide
- B** neon
- C** oxygen
- D** methane

- 18 The diagram shows levels in a fractionating tower used for the fractional distillation of crude oil.

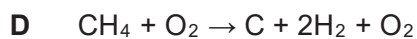
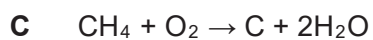
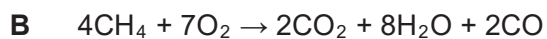
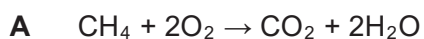
Which level gives the fraction that will be used for making roads?



19 Which of the following shows an unsaturated hydrocarbon?



20 Which of the following equations correctly shows the complete combustion of methane?



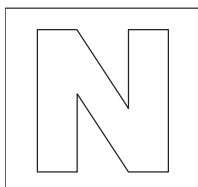
**END OF PAPER**



## The Periodic Table of Elements

Group																		
I	II											III	IV	V	VI	VII	0	
												1 H hydrogen 1						2 He helium 4

The volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).



**GAN ENG SENG SCHOOL**  
**Mid-Year Examination 2018**



**CANDIDATE  
NAME**

**CLASS**

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**INDEX  
NUMBER**

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**SCIENCE (CHEMISTRY)**

**5105, 5107/04**

Paper 4

**04 May 2018**

**Paper 3 & 4: 1 hour 15 minutes**

**Sec 4 Normal (Academic)**

Candidates answer on the Question Paper.

Calculators are allowed in the examination.

---

**READ THESE INSTRUCTIONS FIRST**

Write your class, 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 or graphs.

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

Answer **all** questions in Section A and any **two** questions in Section B.

Indicate your choice of questions in Section B on the cover page.

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.

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.

A copy of the Periodic Table is found on page 10.

	For Examiner's Use	
Section A		
Section B	.....	
	.....	
Total	30	

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

The diagram below shows some elements in the Periodic Table.

[illegible]

Use the chemical symbols from the table to identify the following elements.

- a)** These elements form basic oxides. [1]

---

- b)** Atoms of this element gain two electrons when they form ions. [1]

.....

- c) This element has a melting point below room temperature but a boiling point above room temperature. [1]

.....

- d)** This element has a proton number of 19. [1]

.....

[Total: 4]

2 Mixtures can be separated by physical means. Name a suitable method to separate the following substances from its mixture. [2]

- salt from seawater .....
- petrol from crude oil .....
- water from a mixture of dyes .....
- silver chloride from a mixture of silver chloride .....  
and sodium nitrate solution

[Total: 2 ]

3

Chlorine, bromine, iodine and astatine are elements in Group VII of the Periodic Table. Some of their properties are shown in the table below.

Element	Colour	Physical State at room temperature
Chlorine	Greenish yellow	Gas
Bromine	Reddish brown	Liquid
Iodine	Dark purple	
Astatine		Solid

a) Complete the missing blanks in the table. [2]

b) In an experiment, chlorine gas is bubbled into sodium astatide solution. Write a balanced chemical equation for the reaction. [1]

.....

c) Provide an explanation for the reaction in b). [2]

.....

[Total: 5]

4

The typical composition of the gases from a motorcar engine is given in the table.

Substance	Percentage
argon	0.5
carbon dioxide	8.0
carbon monoxide	5.0
hydrocarbons	0.3
hydrogen	2.0
nitrogen oxides	0.2
water vapour	9.0
other gases	75

a) Suggest the name of the main gas in the 'other gases'. [1]

.....

**b)**

- i)** Name the poisonous gas produced during the **incomplete** combustion of the fuel. [1]

.....

- ii)** Explain why this gas is dangerous to human health. [1]

.....

.....

[Total: 3]

**SECTION B [16 marks]**

Answer **two** out of three questions from this section.

**5**

A new element, Farallium (Fa), has been discovered recently. Information on this element is as follows.

- It has 2 electrons in the outermost shell.
- It does not react with water, steam and acid.
- The solubilities of its compounds in water are given in the table below.

Compound	Solubility in water
Farallium carbonate	Insoluble
Farallium chloride	Soluble
Farallium hydroxide	Insoluble
Farallium nitrate	Soluble
Farallium oxide	Insoluble
Farallium sulfate	Soluble

- a) Suggest whether Farallium is a metal or non-metal. Explain your answer in terms of electronic structure. [2]

.....

.....

- b) Using 'dot and cross' diagram, show the electron arrangement of Farallium oxide. Show only valence electrons. [2]

- c) Starting from Farallium carbonate, state the other reactant to prepare Farallium sulfate. Describe the steps to produce a pure dry sample of Farallium sulfate. [4]

.....

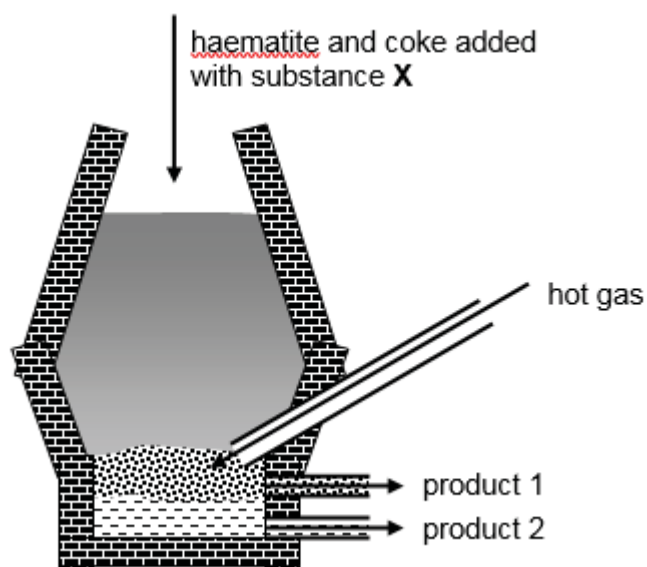
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.....

[Total: 8]

- 6 A blast furnace can be used to manufacture a metal from haematite.



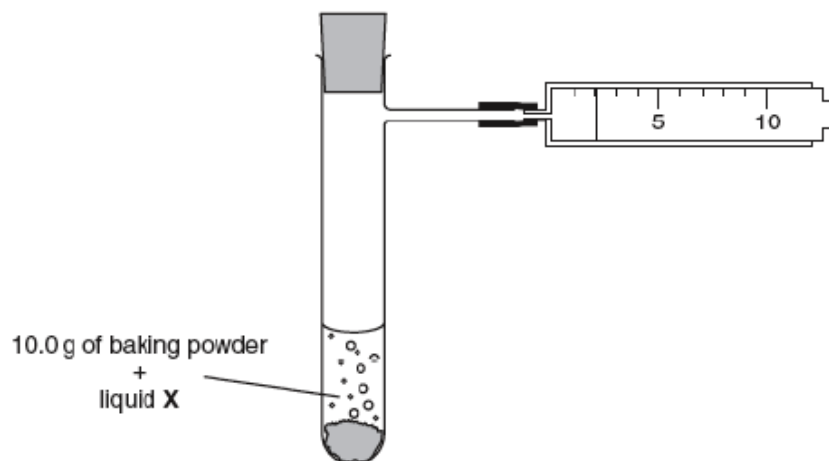
- a)
- i) Haematite, coke and substance X are added to the top of the furnace. Identity substance X and explain why it is necessary to be added to the blast furnace. [2]
- .....
- .....
- ii) Product 1 and product 2 are extracted from the base of the furnace. Name the 2 products. [2]
- Product 1: .....
- Product 2: .....

- iii) Write the chemical equation for the reduction of haematite by carbon monoxide in the blast furnace. State symbols are not required. [1]

.....

Baking powder is a mixture containing sodium hydrogencarbonate and a compound which dissolves **slowly** in water to form an acid.

A student used the apparatus in the figure below to study baking powder.



The results from three experiments are shown in the table below.

experiment	liquid X	temperature of liquid X / °C	volume of gas produced after 5 min / dm <sup>3</sup>
1	water	20	1.0
2	water	50	7.5
3	vinegar (dilute ethanoic acid)	20	8.0

- bi) Suggest which gas is produced in these experiments. [1]

.....

.....

- bii) Suggest an explanation for the difference between volume of gas produced in experiment 1 and for experiment 2. [1]

.....

.....



- biii) Calculate the number of moles of the gas produced in experiment 3 after 5 minutes. [1]

[Total: 8]

7

- a) Alkanes are saturated hydrocarbons. What is a hydrocarbon? [1]

.....  
.....

- b) The following table shows the formulae and boiling points of the first six members of the alkane homologous series.

Name	Formula	Boiling Point (°C)
Methane	CH <sub>4</sub>	-161
Ethane	C <sub>2</sub> H <sub>6</sub>	-89
?	?	?
Butane	C <sub>4</sub> H <sub>10</sub>	-0.5
Pentane	C <sub>5</sub> H <sub>12</sub>	36

The third member of the series is missing from the table.

- i) Write down the **name** and **formula** of the third member. [2]

Name : ..... Formula : .....

- ii) Deduce the boiling point of the third member. .... [1]

- c) Ethene is an alkene.

- i) Draw the structural formula of ethene. [2]

- ii) Ethene undergoes a chemical reaction when it is bubbled into a sample of aqueous bromine. State the colour change you would observe. [1]

.....

iii) What is the name of the chemical reaction in **c(ii)**? [1]

.....  
[Total: 8]

**END OF PAPER**

Group																																			
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0																		
3 Li lithium 7	4 Be beryllium 9	<div> <div>proton (atomic) number</div> <div>atomic symbol</div> <div>relative atomic mass</div> </div>																2 He helium 4																	
11 Na sodium 23	12 Mg magnesium 24	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 -	114 Fl flerovium -	116 Lv livermorium -							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  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).




Answers for Secondary 4 Normal Academic Chemistry 5105/5107 MYE P3 2018

- |       |       |
|-------|-------|
| 1. B  | 11. C |
| 2. B  | 12. D |
| 3. D  | 13. C |
| 4. A  | 14. B |
| 5. B  | 15. D |
| 6. C  | 16. C |
| 7. D  | 17. D |
| 8. D  | 18. D |
| 9. D  | 19. D |
| 10. B | 20. A |



Answers for Secondary 4 Normal Academic Chemistry 5105/5107 Mid Year Exam P4 2018

<b>A1</b>	a) K, Ca	[1]	<b>Markers' Comment</b> Well-answered
	b) S	[1]	Some students need to understand how to relate loss and gain of electrons to the Group Number
	c) Br	[1]	Many students unclear of the physical properties of Group VII elements
	d) K	[1]	Well-answered
<b>A2</b>	a) evaporation b) fractional distillation c) simple distillation d) filtration	1 m for every 2 correct answers	a) Well-answered b) Need to understand difference between fractional distillation and distillation c) Many students wrote chromatography. Should not relate dyes to just chromatography d) Well-answered
<b>A3</b>	a) Colour: black, State: solid	[2]	Many students wrote liquid as the physical state. To clear this misconception
	b) $\text{Cl}_2 + 2\text{NaAt} \rightarrow 2\text{NaCl} + \text{At}_2$	[1]	Many students wrote At instead of $\text{At}_2$ . At is a diatomic molecule.
	c) Chlorine is more reactive than astatine.  Hence, chlorine will displace astatine from sodium astatide solution.	[1] [1]	Poorly answered. Student unclear of displacement concept
<b>A4</b>	(a) nitrogen (from the air)	[1]	Poorly answered. Students did not relate the question to the composition of air which was taught during lesson
	(bi) carbon monoxide.	[1]	Well-answered
	bii) It forms a stable compound with haemoglobin, preventing the blood from carrying oxygen to other parts of body.	[1]	Well-answered
<b>B5</b>	a) It is a metal It loses 2 electrons to form a positive ion with charge $2+$ .	[1] [1]	Well-answered

	<p>b) chemical formula : FaO</p> 	<p>Correct transfer of 2 electrons from Fa to O [1]</p> <p>Correct charge [1]</p>	<p>Some students did not show the full shell of Fa.</p>
	<p>c) other reactant : sulfuric acid</p> <p>Steps to obtain pure sample of Farallium sulfate</p> <ul style="list-style-type: none"> <li>- add <u>excess Farallium carbonate</u> to sulfuric acid and stir and filter to remove excess carbonate</li> <li>- evaporate filtrate till a saturated solution is formed</li> <li>- cool the solution for crystals to form, wash with distilled water and press dry between sheets of filter paper.</li> </ul>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p>	<p>Some students forgot to state the other reactant.</p>
<b>B6</b>	<p>(ai) Substance X is limestone. Substance X removes acidic impurities.</p>	<p>[ 1 ]</p> <p>[ 1 ]</p>	<p>Some students were not able to explain the reason for use of limestone</p>
	<p>(aii) Product 1 : Molten slag Product 2 : Molten iron</p>	<p>[ 1 ]</p> <p>[ 1 ]</p>	<p>Well-answered</p>
	<p>(aiii) <math>\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2</math></p>	<p>[ 1 ]</p>	<p>Poorly answered. Never study notes</p>
	<p>(bi) Carbon Dioxide</p>	<p>[ 1 ]</p>	<p>Some students wrote hydrogen which is wrong.</p>
	<p>(bii) Expt 2 is carried out at a higher temperature than expt 1</p>	<p>[ 1 ]</p>	<p>Most students able to infer that higher temperature leads to more gas formed</p>
	<p>(biii) Volume of gas produced after 5 minutes- <math>8\text{dm}^3</math></p> <p>No of moles = Volume of Gas / <math>24\text{dm}^3</math></p> <p>= <math>8 / 24</math></p> <p>= 0.333 moles (3 s.f)</p>	<p>[ 1 ]</p>	<p>Well-answered</p>
<b>B7</b>	<p>(a) A hydrocarbon is a compound that contains only hydrogen and carbon atoms.</p>	<p>[ 1 ]</p>	<p>Well-answered. But some students did not write full definition and only wrote it contains hydrogen and carbon atoms only.</p>
	<p>(b) i) Propane &amp; <math>\text{C}_3\text{H}_8</math></p>	<p>[ 2 ]</p>	<p>Well-answered</p>
	<p>ii) <math>-50^\circ\text{C}</math> to <math>-30^\circ\text{C}</math></p>	<p>[ 1 ]</p>	<p>Well-answered</p>
	<p>(ci)</p>	<p>[ 2 ]</p> <p>1m for carbon double bond</p>	<p>Well-answered</p>

	$  \begin{array}{c}  \text{H} \quad \quad \text{H} \\  \diagdown \quad \diagup \\  \text{C} = \text{C} \\  \diagup \quad \diagdown \\  \text{H} \quad \quad \text{H}  \end{array}  $ <p>(cii) Reddish-brown solution turns to colourless solution.</p> <p>(ciii) addition reaction</p>	<p>and 1m for correct structural formula</p> <p>[1]</p> <p>[1]</p>	<p>Some students forgot to write the colour change</p> <p>Bromination is also accepted</p>







## Geylang Methodist School (Secondary) Mid-Year Examination 2018

Candidate  
Name

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Class

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Index Number

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**SCIENCE(CHEMISTRY)**

**5105/5107/03**

Paper 3 Multiple Choice

**Sec 4 Normal (A)**

Additional Materials : OAS

**Papers 3 & 4: 1 hour 15 minutes**

**Setter** : Mr Iskander

**3 May 2018**

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### **READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, class and register number on the Optical Answer Sheet in the spaces provided.

There are **twenty** questions in this section. Answer **all** questions. For each question, there are four possible answers, **A, B, C** or **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Answer Sheet.

**Read the instructions on the Optical Answer Sheet very carefully.**

Answers to Paper 3 and Paper 4 must be handed in separately.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised to spend no more than **30 minutes** on **Paper 3**.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

Any rough working should be done in this booklet.

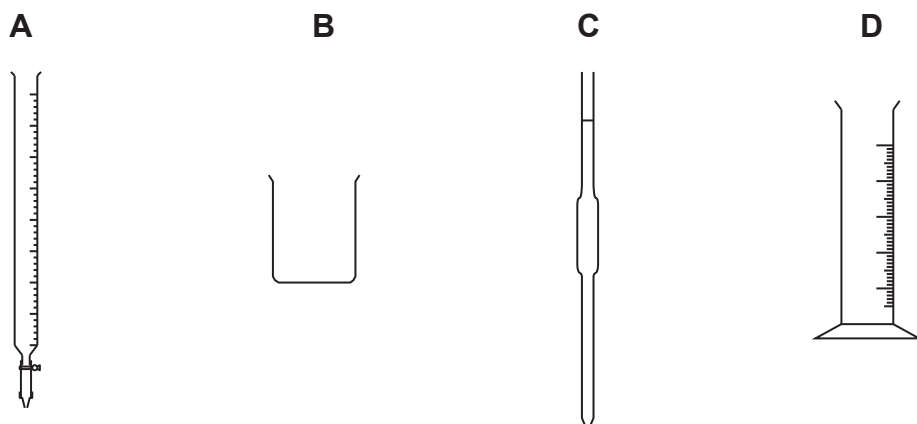
A copy of the Periodic Table is printed on page 8.

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This document consists of **8** printed pages.

### Section A

- 1 Which apparatus is most suitable for measuring  $26.1 \text{ cm}^3$  of liquid?

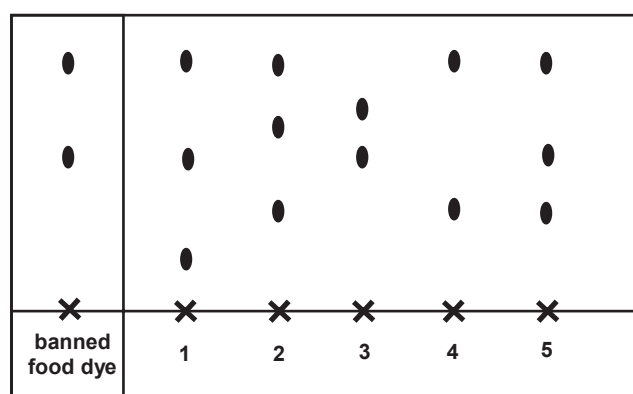


- 2 The table below shows the melting and boiling points of four different substances.

Which substance is a gas at  $0^\circ\text{C}$ ?

substance	melting point / $^\circ\text{C}$	boiling point / $^\circ\text{C}$
<b>A</b>	25	79
<b>B</b>	-3	96
<b>C</b>	12	43
<b>D</b>	-25	-5

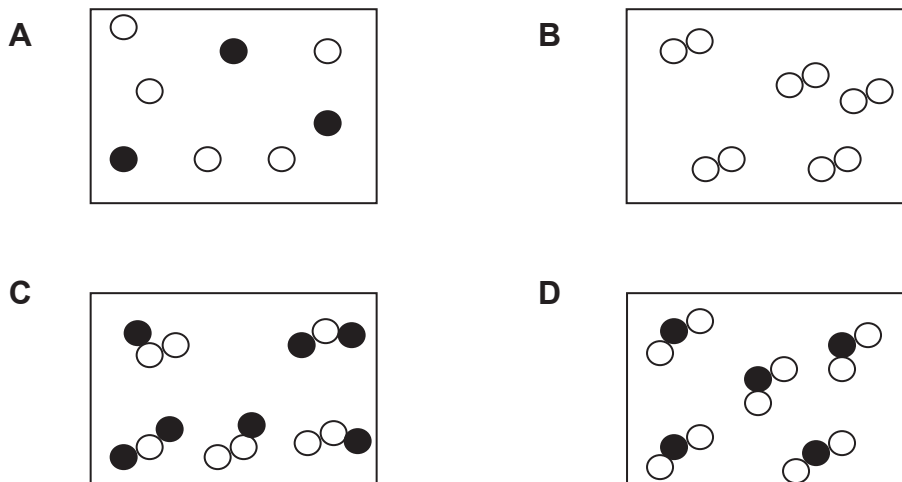
- 3 The diagram shows a chromatogram obtained by using a banned food dye.



Which **two** food dyes contain the banned food dye?

- A** 1 and 5                                      **B** 1 and 3  
**C** 2 and 4                                      **D** 2 and 5

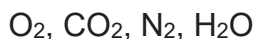
- 4 Which of the following diagrams shows a mixture of elements?



- 5 Scientists recently discovered a new element. The symbol of this new element is  $^{234}_{104}\text{Y}$ .

How many electrons does one atom of **Y** contain?

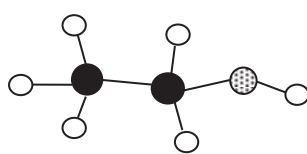
- A** 100                                      **B** 104  
**C** 130                                      **D** 234
- 6 The following gases can be found in the atmosphere.



Which of these covalent compounds has the most number of shared electrons?

- A**  $\text{O}_2$                                       **B**  $\text{CO}_2$   
**C**  $\text{N}_2$                                       **D**  $\text{H}_2\text{O}$
- 7 Which feature of sodium chloride solution enables it to conduct electricity?
- A** The ions are mobile in the solution.  
**B** The ions are packed closely together.  
**C** The electrons are able to move freely.  
**D** The solution contains moving molecules.

- 8** The model shown represents a molecule of ethanol.



## Key

● = carbon

 = oxygen

○ = hydrogen

What is the relative molecular mass,  $M_r$ , of ethanol?

- A** 9
- B** 26
- C** 40
- D** 46
- 9** What is the number of moles of  $\text{C}_3\text{H}_6$  molecules present in 21 g of  $\text{C}_3\text{H}_6$ ?
- A** 0.1 mol
- B** 0.2 mol
- C** 0.5 mol
- D**  $6 \times 10^{23}$

- 10** When potassium is added to water, an explosive reaction takes place. The equation for the reaction is



What are the values of **p**, **q**, **r** and **s**?

	<b>p</b>	<b>q</b>	<b>r</b>	<b>s</b>
<b>A</b>	1	2	3	3
<b>B</b>	1	3	2	3
<b>C</b>	2	2	2	1
<b>D</b>	2	3	1	2

- 11** Which statement about elements in the Periodic Table is correct?
- A** Group 0 elements are unreactive metals.  
**B** Group I elements form covalent chlorides.  
**C** Group VII elements form negative ions.  
**D** The elements become more metallic from left to right across a period.

- 12 Caesium is in the same group of the Periodic Table as sodium and potassium. Which of the following is a property of caesium?

**A** It forms an acidic oxide.  
**B** It does not conduct electricity.  
**C** It has high density and high melting point.  
**D** It produces hydrogen when reacting with water.

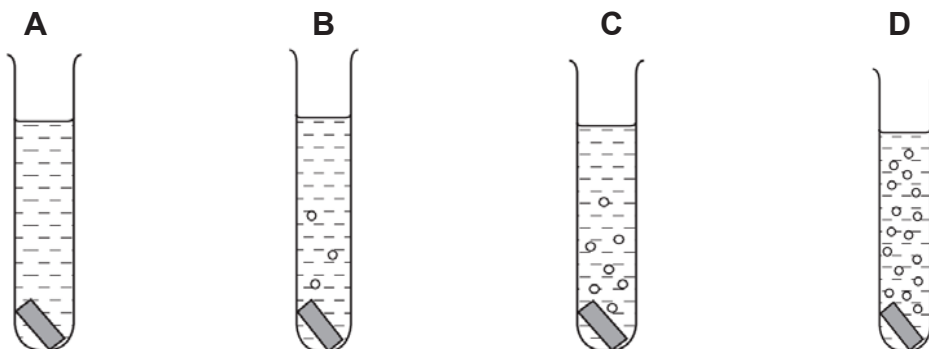
- 13 Fluorine is the first element in Group VII of the Periodic Table.

Which statement about fluorine is **NOT** correct?

**A** Fluorine exists as diatomic molecules.  
**B** Fluorine forms negative ions.  
**C** Fluorine is less reactive than chlorine.  
**D** Fluorine is pale yellow.

- 14 Pieces of copper, iron, magnesium and zinc are added to separate test-tubes containing dilute hydrochloric acid.

Which test-tube contains magnesium and dilute hydrochloric acid?



- | experiment   | <b>X</b> | <b>Y</b> | <b>Z</b> |
|--|----------|----------|----------|
| metal produces hydrogen gas when reacting with hydrochloric acid | yes      | no       | yes      |
| metal can be displaced by iron from its salt solution            | yes      | yes      | no       |

	most reactive	→	least reactive
<b>A</b>	<b>X</b>		<b>Z</b>
<b>B</b>	<b>Y</b>		<b>X</b>
<b>C</b>	<b>Z</b>		<b>Y</b>
<b>D</b>	<b>Z</b>		<b>X</b>

- |          |   |          |   |
|----------|---|----------|---|
| <b>A</b> | 1 | <b>B</b> | 5 |
| <b>C</b> | 7 | <b>D</b> | 9 |

- A** Lead and sodium chloride solution  
**B** Lead (II) oxide and dilute hydrochloric acid  
**C** Lead (II) nitrate solution and dilute hydrochloric acid  
**D** Lead (II) sulfate and sodium chloride solution

- Which row is correct?

	the soil in the garden is	cabbages grow best in soil that is	calcium hydroxide is
<b>A</b>	weakly acidic	strongly alkaline	alkaline
<b>B</b>	weakly acidic	weakly alkaline	alkaline
<b>C</b>	weakly alkaline	strongly acidic	acidic
<b>D</b>	weakly alkaline	weakly acidic	acidic

- 19** The oxide of an element **M** was added separately to dilute nitric acid and aqueous sodium hydroxide. The word equations for the reactions are shown.

- 1 **M** oxide + nitric acid → **M** nitrate + water  
2 **M** oxide + sodium hydroxide → no reaction

Which row describes **M** and its oxide?

	<b>M</b>	oxide of <b>M</b>
<b>A</b>	metal	amphoteric
<b>B</b>	metal	basic
<b>C</b>	non-metal	acidic
<b>D</b>	non-metal	basic

- 20** Which two gases are pollutants of the atmosphere?

- A** carbon dioxide and nitrogen  
**B** carbon monoxide and oxygen  
**C** carbon monoxide and sulfur dioxide  
**D** nitrogen and oxygen

**End of Paper 3**



57	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu
lanthanum	139	cerium	140	praseodymium	141	neodymium	144	promethium	—	samarium	150	europlum	152	gadolinium	157	terbium	159	dysprosium	162	holmium	165	erbium	167	thulium	169	ytterbium	173	lutetium	175
89	Ac	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr
actinium	—	thorium	—	protactinium	—	uranium	238	neptunium	—	plutonium	—	americium	—	curium	—	berkelium	—	californium	—	einsteinium	—	fermium	—	mendelevium	—	nobelium	—	lawrencium	—

The volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).

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## Geylang Methodist School (Secondary) Mid-Year Examination 2018

Candidate  
Name

Class

Index Number

**SCIENCE(CHEMISTRY)**

**5105/5107/04**

Paper 4 Chemistry

**Sec 4 Normal (A)**

No additional materials required

**Papers 3 & 4: 1 hour 15 minutes**

**Setter : Mr Iskander**

**3 May 2018**

**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 on both sides of the paper.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** questions in Section A and any **two** questions in Section B.

Enter the numbers of the Section B questions you have answered on the dotted lines in the grid below.

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 9.

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	/ 14
Section B	
.....	/ 8
.....	/ 8
Total	/30

This document consists of **9** printed pages and **1** blank page.

### Section A

Answer **ALL** questions from this section in the spaces provided.

- 1 Refer to the list of substances and answer the questions.

silver chloride

calcium oxide

carbon dioxide

ammonia

zinc oxide

sodium chloride

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

Name the substance(s) which

- (a) can be prepared by precipitation method.

.....[1]

- (b) can be collected by the downward displacement of air.

.....[1]

- (c) can react with both acid and alkali.

.....[1]

- (d) is added to soil to increase the pH.

.....[1]

- 2 The table shows the percentage of carbon dioxide in the atmospheres of three planets **A**, **B** and **C**, in the solar system.

Planet	percentage of carbon dioxide
<b>A</b>	20
<b>B</b>	0.03
<b>C</b>	75

- (a) State which planet, **A**, **B** or **C**, is the Earth.

.....[1]

- (b) On Earth, volcanoes emit many gases into the atmosphere during volcanic eruptions. State which air pollutant is emitted and how it affects human health.

.....  
 ..... [2]

- (c) The use of motor vehicles causes increased levels of the pollutant carbon monoxide, especially in large cities.

- (i) Explain briefly why the use of motor vehicles causes increased levels of carbon monoxide.

..... [1]

- (ii) Explain why high levels of carbon monoxide in cities are undesirable.

..... [1]

- 3 (a) Complete the table.

element	proton number	arrangement of electrons
lithium	3	
sodium		2.8.1
aluminium		

[1]

- (b) Explain why aluminium is in a different group from lithium and sodium.

.....  
 ..... [2]

- (c) Sodium reacts with fluorine to form the salt sodium fluoride, NaF.

Use 'dot-and-cross' diagram to show the electronic structure of sodium fluoride. Show only the outer shell electrons.

[2]

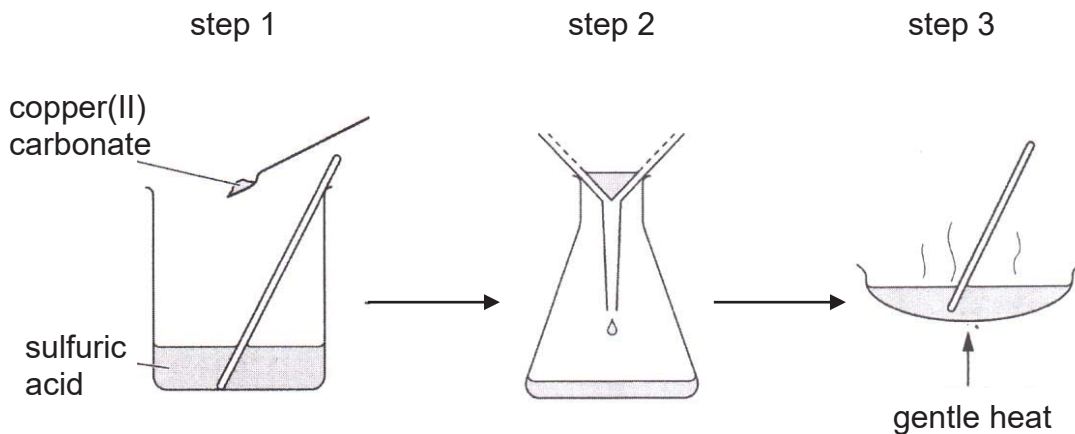
**End of Section A**

### Section B

Answer any **two** questions from this section in the spaces provided.

- 4 Crystals of copper(II) sulfate,  $\text{CuSO}_4$ , can be made by reacting dilute sulfuric acid,  $\text{H}_2\text{SO}_4$  with excess of powdered copper(II) carbonate,  $\text{CuCO}_3$ .

The diagram shows the first three steps used to prepare crystals of this salt.



- (a) (i) Name the processes being used in step 2 and step 3.

process used in step 2 is.....

process used in step 3 is..... [1]

- (ii) Explain why step 3 is carried out.

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

- (b) The liquid from step 3 is allowed to stand for some time to allow the crystals to grow.  
 Describe the next step needed in order to produce a sample of dry copper(II) sulfate crystals.

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

- (c) (i) During step1, a gas is given off.

Name the gas and describe a positive test to identify the gas.

name of the gas.....

test for gas.....

.....[2]

- (ii) Write a balanced chemical equation for the reaction between dilute sulfuric acid and copper(II) carbonate.

.....[1]

- (d) At the start of the experiment there is 24.8 g of copper(II) carbonate.

Calculate the number of moles of 24.8 g of copper(II) carbonate.

amount of copper(II) carbonate = ..... mol [2]

- 5 (a) To which period of the Periodic Table does the element iron belong?

.....[1]

- (b) The symbols for two isotopes of iron are shown below.



- (i) How do these two isotopes differ in their atomic structure?

.....[1]

- (ii) State the number of nucleons present in an atom of the isotope



.....[1]

- (iii) State the number of electrons present in an atom of the isotopes



.....[1]

- (c) Four metal strips of same mass, **W**, **X**, **Y** and **Z**, were added into separate test tubes of cold water. The time taken for the metal strips to react completely are recorded in **Table 5.1**.

metal cube	<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
time taken to react completely / s	80	30	0	50

**Table 5.1**

- (i) Place the four metals in order of their reactivity.

most reactive: .....

.....

.....

Least reactive: .....

[1]



- (ii) Which metal strips, **W**, **X**, **Y** and **Z**, could be potassium and iron respectively?

potassium .....

iron ..... [1]

- (d) Some baked bean cans are made of iron coated with a layer of tin to prevent rusting. If this coating is scratched then the iron underneath starts to rust.

Name the element and the compound which react with the iron to form rust.

element .....

compound ..... [2]

**6** Fluorine, Chlorine, Bromine and Iodine are Group VII elements.

- (a) Complete the table below to show the trend in Group VII elements.

name	molecular formula	state	colour
fluorine	F <sub>2</sub>		
chlorine	Cl <sub>2</sub>	gas	yellowish-Green
bromine		liquid	red
iodine	I <sub>2</sub>	solid	black

[1]

- (b) How many electrons are there in the outer shell of a bromine atom? State a reason for your answer.

.....

..... [2]

- (c) Describe the colour change when gaseous chlorine is bubbled into a colourless solution of potassium bromide. Explain the reason for your observation.

.....

..... [2]

- (d) Write a balanced chemical equation for the reaction in (c)

.....[1]

- (e) Describe the **arrangement** and **movement** of the particles of chlorine and bromine at room temperature.

substance	arrangement	movement
chlorine		
bromine		

[2]

**End of Paper**

Group																	
I	II											III	IV	V	VI	VII	0
		<div>1 H hydrogen 1</div>															
		<div>Key</div>															
		<div>proton (atomic) number atomic symbol name relative atomic mass</div>															
3 Li lithium 7	4 Be beryllium 9											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											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	162
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	—
91	Pa	protactinium	—
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  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).  
www.KiasuExamPaper.com

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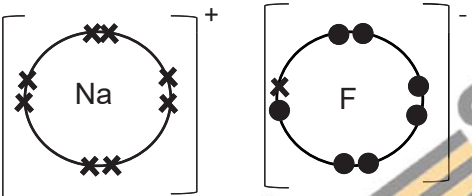
**Geylang Methodist School (Secondary)**  
**Mid Year Examination 2018**  
**SCIENCE(CHEM) 4NA**  
**ANSWER SCHEME**

**Paper 3**

1	2	3	4	5	6	7	8	9	10
A	D	A	A	B	B	A	D	C	C
11	12	13	14	15	16	17	18	19	20
C	D	C	D	C	B	C	B	B	C

**Paper 4 Section A**

1(a)	silver chloride	1												
1(b)	Ammonia	1												
1(c)	Zinc oxide	1												
1(d)	Calcium oxide	1												
2(a)	B	1												
2(b)	Sulfur dioxide is emitted.	1												
	It irritates the eyes / causes breathing problem / respiratory problem.	1												
2(c)(i)	The increase use of motor vehicle will cause an increase of incomplete combustion of petrol	1												
2(c)(ii)	High levels of carbon monoxide will combine with haemoglobin in the blood to prevent absorption of oxygen. Or cause dizziness and respiratory difficulties to human.	1												
3(a)	<table border="1"> <thead> <tr> <th>element</th><th>proton number</th><th>Arrangement of electrons</th></tr> </thead> <tbody> <tr> <td>lithium</td><td>3</td><td>2.1</td></tr> <tr> <td>sodium</td><td>11</td><td>2.8.1</td></tr> <tr> <td>aluminium</td><td>13</td><td>2.8.3</td></tr> </tbody> </table> <p>(½ m 2 correct answers)</p>	element	proton number	Arrangement of electrons	lithium	3	2.1	sodium	11	2.8.1	aluminium	13	2.8.3	1
element	proton number	Arrangement of electrons												
lithium	3	2.1												
sodium	11	2.8.1												
aluminium	13	2.8.3												
3(b)	It has 3 valence electrons [1] while lithium and sodium have 1 valence electron.[1] Thus it will be placed in group 3.	2												

3(c)	 <p>(1m – correct type of bond with charge; 1m – correct electrons drawn)</p>	2
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### Paper 4 Section

4(a)(i)	Step 2: filtration [1] Step 3 : evaporation[1]	2
4(a)(ii)	To obtain a saturated solution	1
4(b)	<b>Filter, rinse crystals with some distilled water</b> [ $\frac{1}{2}$ ] and <b>dry</b> between pieces of filter paper.[ $\frac{1}{2}$ ]	1
4(c)(i)	Carbon dioxide[1] Forms white precipitate with limewater[1]	2
4(c)(ii)	$\text{CuCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$	1
4(d)	$M_r$ of $\text{CuCO}_3 = 64 + 12 + 16 \times 3 = 124$ [1] Mole of $\text{CuCO}_3 = 24.8 \div 124 = 0.200$ (3 sf) mol [1]	2
5(a)	Period 4	1
5(b)(i)	<u>They have different number of neutrons in their nucleus</u>	1
5(b)(ii)	57	1
5(b)(iii)	26	1
5(c)(i)	Order of Reactivity ; X , Z, W, Y	1
5(c)(ii)	Potassium is <b>X</b> and iron is <b>W</b> ( $\frac{1}{2}$ m each correct answer)	1
5(d)	Element: Oxygen Compound: water	1 1

6(a)	<table><tr><th>Name</th><th>Molecular Formula</th><th>State</th><th>Colour</th></tr><tr><td>Fluorine</td><td>F<sub>2</sub></td><td>gas</td><td>Pale yellow</td></tr><tr><td>Chlorine</td><td>Cl<sub>2</sub></td><td>Gas</td><td>Yellowish-Green</td></tr><tr><td>Bromine</td><td>Br<sub>2</sub></td><td>Liquid</td><td>Red</td></tr><tr><td>Iodine</td><td>I<sub>2</sub></td><td>Solid</td><td>Black</td></tr></table> <p>(All 3 correct answer 1 m; 2 correct answers ½ m; 1 or no correct answer 0 m)</p>	Name	Molecular Formula	State	Colour	Fluorine	F <sub>2</sub>	gas	Pale yellow	Chlorine	Cl <sub>2</sub>	Gas	Yellowish-Green	Bromine	Br <sub>2</sub>	Liquid	Red	Iodine	I <sub>2</sub>	Solid	Black	1
Name	Molecular Formula	State	Colour																			
Fluorine	F <sub>2</sub>	gas	Pale yellow																			
Chlorine	Cl <sub>2</sub>	Gas	Yellowish-Green																			
Bromine	Br <sub>2</sub>	Liquid	Red																			
Iodine	I <sub>2</sub>	Solid	Black																			
6(b)	7 outermost shell electrons[1] Bromine is in Group VII [1]	2																				
6(c)	Solution changes from colourless to red/red-brown. [1] As Cl <sub>2</sub> more reactive than bromine, it displaces bromide ions in KBr to form bromine solution.[1]	2																				
6(d)	Cl <sub>2</sub> + 2KBr → Br <sub>2</sub> + 2KCl ( ½ m correct formula and ½ m for balancing equation correctly)	1																				
6(e)	<table><tr><th>Substance</th><th>Arrangement</th><th>Movement</th></tr><tr><td>chlorine</td><td>Particles are far apart. [½]</td><td>Particles move quickly and randomly.[ ½]</td></tr><tr><td>bromine</td><td>Particles are closely packed but no fixed order. [ ½]</td><td>Particles are able to slide past one another freely.[½]</td></tr></table>	Substance	Arrangement	Movement	chlorine	Particles are far apart. [½]	Particles move quickly and randomly.[ ½]	bromine	Particles are closely packed but no fixed order. [ ½]	Particles are able to slide past one another freely.[½]	2											
Substance	Arrangement	Movement																				
chlorine	Particles are far apart. [½]	Particles move quickly and randomly.[ ½]																				
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Name:	Index Number:	Class:
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HUA YI SECONDARY SCHOOL

**4NA**

Mid-Year Examination 2018

**4NA**

**SCIENCE(CHEMISTRY)**

**5105/3**

Paper 3

7 May 2018

1 hr 15 min

Candidates answer on the Optical Answer Sheet provided.  
Additional Materials: Optical Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write your Name, Index Number and Class on all the work you have done.  
Write in dark blue or black pen.  
You may use a pencil for any diagrams, graphs, tables or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**

There are **twenty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.  
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Answer Sheet.

**Read the instructions on the Optical Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

This document consists of **6** printed pages including the cover page.

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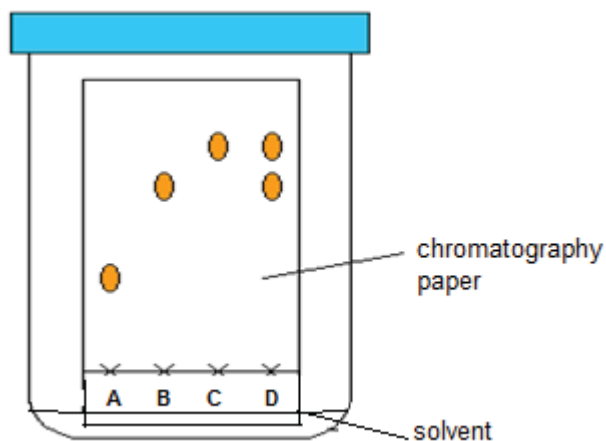
**[Turn Over**

Setter: Chiang Wai Kit

- 1 Which substance is a solid at 20 °C?

	melting point/ °C	boiling point/ °C
<b>A</b>	-117	78
<b>B</b>	-93	9
<b>C</b>	0	100
<b>D</b>	36	130

- 2 The chromatogram of four substances, **A**, **B**, **C** and **D** is shown in the diagram below.

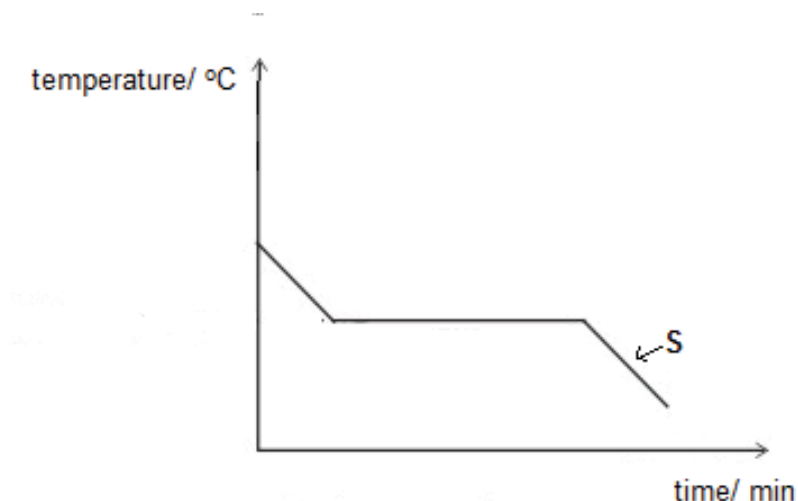


Which of the following statement is **not** true?

- A** Dye **A** is soluble in the solvent.
  - B** Dye **B** is pure.
  - C** Dye **C** is less soluble in the solvent than Dye **B**.
  - D** Dye **D** is a mixture.
- 3 A student wishes to add exactly 19.2 cm<sup>3</sup> of dilute hydrochloric acid to exactly 25.0 cm<sup>3</sup> of aqueous sodium hydroxide as part of a titration experiment. Which pair of apparatus should the student use to measure each of these volumes?

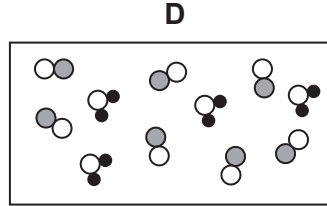
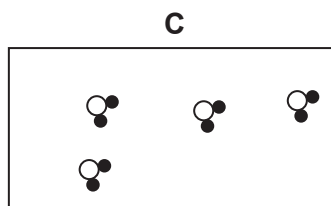
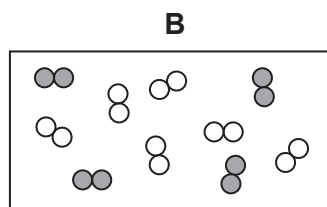
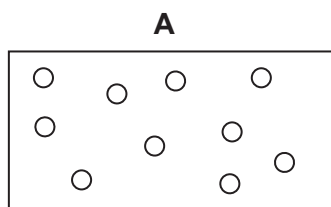
	dilute hydrochloric acid	aqueous sodium hydroxide
<b>A</b>	burette	measuring cylinder
<b>B</b>	burette	pipette
<b>C</b>	pipette	measuring cylinder
<b>D</b>	pipette	burette

- 4 The graph below shows the cooling curve for molten iron.



Which of the following is true at **S**?

- A particles are closely packed in random order
  - B particles gain energy
  - C particles move further apart
  - D particles vibrate about fixed position
- 5 Which of the following diagrams shows a pure compound?



- 6 Which property is **different** for isotopes of the same element?
- A chemical reactions
  - B nucleon number
  - C proton number
  - D size of atom

7 Which change takes place when an atom becomes a positive ion?

- A when an electron is added
- B when an electron is removed
- C when a proton is added
- D when a proton is removed

8 Which of the following statements about ionic compound is correct?

- A They are insoluble in water.
- B They conduct electricity in solid state only.
- C They have high melting points.
- D They are malleable.

9 Element **X** has an electronic structure 2,4 and element **Y** has an electronic structure 2,8,6. What is the type of bonding and the chemical formula of the compound formed when element **X** reacts with element **Y**?

	type of bonding	chemical formula
A	covalent	$XY_2$
B	covalent	$X_2Y$
C	ionic	$XY_2$
D	ionic	$X_2Y$

10 Which elements form an acidic oxide and a basic oxide?

		forms an acidic oxide	forms a basic oxide	
	A	magnesium	sodium	
	B	nitrogen	magnesium	
	C	sodium	sulphur	
	D	sulfur	nitrogen	

11 Substance **X** is used to control soil acidity. What is **X**?

- A calcium chloride
- B calcium hydroxide
- C calcium nitrate
- D calcium sulfate

12 Aqueous solution **X** is added to aqueous ammonium sulfate. The mixture is heated and ammonia gas is produced. What is **X**?

- A ammonium chloride
- B sodium chloride
- C sodium hydroxide
- D sulfuric acid

13 The formula of a nitrate of chromium is  $Cr(NO_3)_3$ . What is the formula of the corresponding oxide?

- A  $CrO$
- B  $CrO_2$
- C  $Cr_2O_3$
- D  $Cr_3O_2$

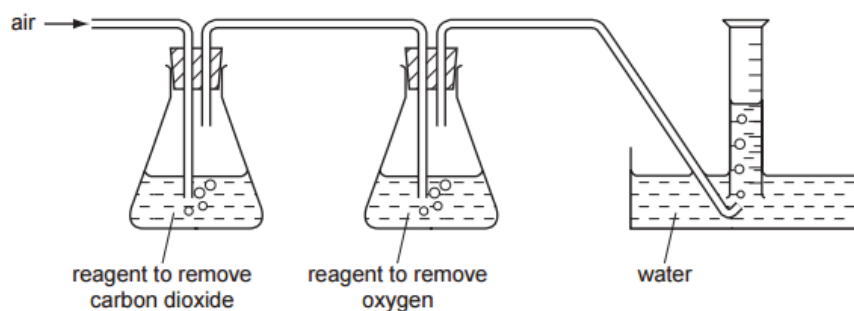
- 14 A data book gives the following information about an element.

appearance	silver-grey solid
melting point	98°C
density	0.97 g/cm <sup>3</sup>
reaction with water	vigorous reaction with cold water

Where is the element likely to be found in the Periodic Table?

- A** Group 0  
**B** Group I  
**C** Group VII  
**D** Transition metal
- 15 Which of the following statements about the change in properties of the elements from left to right across a period is true?
- A** The electrical conductivity of the elements increases.  
**B** The metallic properties decreases.  
**C** The number of electron shell decreases.  
**D** The number of protons in an atom decreases.
- 16 A blast furnace is used to extract iron from iron ore. Why is limestone added to the blast furnace?
- A** to change the ore into iron  
**B** to convert acidic impurities in the ore into slag  
**C** to heat up the furnace  
**D** to produce oxygen for the coke to burn
- 17 Why does a bicycle chain that is coated with oil **not** rust?
- A** Oil dissolves any rust that forms.  
**B** Oil prevents oxygen and water from coming in contact to the chain.  
**C** Oil reacts with rust causing a chemical reaction that removes rust.  
**D** Oil reacts with oxygen so no rust forms.
- 18 Which of the following statements about the need for recycling of metals is **false**?
- A** Fewer landfills are needed to dispose off waste material from metal extraction.  
**B** Recycling helps to conserve resources such as fossil fuels.  
**C** Recycling metals is always cheaper than extracting metals from the Earth.  
**D** Waste materials from metal extraction may lead to air and water pollution.

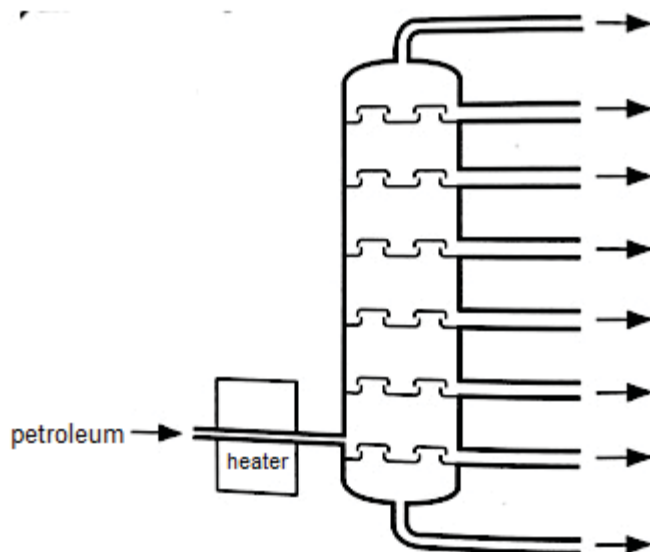
- 19 The diagram shows an experiment on the composition of air.



The volume of the air that passes into the apparatus is  $100\text{ cm}^3$ . What is the volume and the composition of the gas collected in the measuring cylinder?

	volume / $\text{cm}^3$	composition
<b>A</b>	20	nitrogen and other gases
<b>B</b>	20	pure nitrogen
<b>C</b>	80	nitrogen and other gases
<b>D</b>	80	pure nitrogen

- 20 The diagram shows the apparatus used for the fractional distillation of petroleum.



Which statement about the fractional distillation of petroleum is correct?

- A** At each level in the column, only one compound is collected.
- B** The higher up in the column, the higher the temperature.
- C** The fraction collected at the bottom of the column is the most flammable.
- D** The molecules of the fraction collected on the top of the column have the smallest relative molecular masses.

**End of Paper**

Name:	Index Number:	Class:
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HUA YI SECONDARY SCHOOL

**4NA**

Mid-Year Examination 2018

**4NA**

**SCIENCE(CHEMISTRY)**

**5105/4**

Paper 4

7 May 2018

1 hr 15 min

Candidates answer on the Question Paper.  
Additional Materials: NIL

**READ THESE INSTRUCTIONS FIRST**

Write your Name, Index Number and Class on all the work you have done.  
Write in dark blue or black pen.  
You may use a pencil for any diagrams, graphs, tables 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 on the question paper.

**Section B**

Answer **two** out of three questions.  
Write your answers in the spaces provided on the question paper.  
The number of marks is given in brackets [ ] at the end of each question or part question.  
A copy of the Periodic Table is printed on page 9.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **9** printed pages including the cover page.

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**[Turn Over]**

Setter: Ms Chiang Wai Kit

**Section A [14 marks]**

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

- 1 The arrangement of electrons in the atoms of six different elements is shown in the table. The letters do not represent the chemical symbols of the elements.

element	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>
arrangement of electrons in the atoms	2,4	2,6	2,7	2,8,1	2,8,6	2,8,8

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

- (a) Which elements belong to the same group?

..... [1]

- (b) What is the formula of the compound formed between elements **S** and **T**?

..... [1]

- (c) Which element forms a basic oxide?

..... [1]

- (d) Which element has a proton number of 8?

..... [1]

[Total: 4]

- 2 A student reacted the following reactants with sulfuric acid.

reactant	observation	formula of salt formed
lead	small amount of effervescence produced for a few seconds	PbSO <sub>4</sub>
zinc carbonate	effervescence	ZnSO <sub>4</sub>

- (a) The student weighed the salts and found that 5 g of zinc sulfate was produced. Calculate the amount of zinc sulfate produced, in moles.

amount of zinc sulfate = .....mol [2]



- (b) Explain why the reaction of lead and sulfuric acid did **not** go to completion.

.....  
 ..... [2]

- (c) Suggest a more suitable choice of reactants to produce lead sulfate.

reactant 1: .....

reactant 2: ..... [2]

[Total: 6]

- 3 Motor vehicles emit harmful gases to the atmosphere every year. When cars remain stationary with engines turned on, gases such as carbon monoxide may be produced. When cars are accelerating, gases such as nitrogen dioxide may be produced.

- (a) Complete the table below.

name of gas	harmful effect on human/ environment
carbon monoxide	
nitrogen dioxide	

[2]

- (b) Suggest why nitrogen dioxide will be formed when cars accelerate.

.....  
 ..... [2]

[Total: 4]

**Section B [16 marks]**Answer any **two** questions.Answer **all** the questions in the spaces provided.

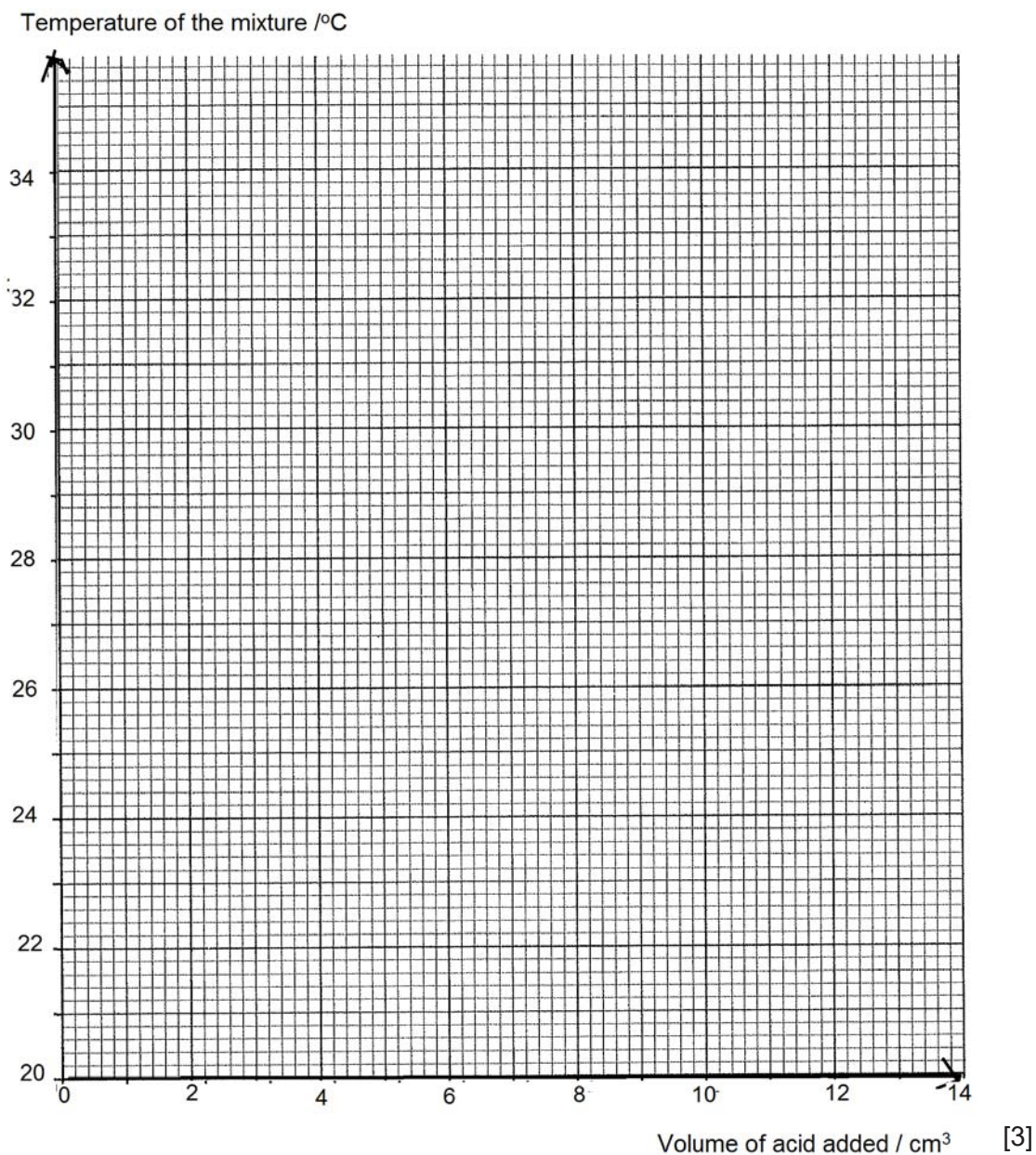
- 4 An experiment is carried out to investigate the reaction between aqueous sodium hydroxide and an acid. In this reaction, sodium sulfate is produced.

A solution of the acid is placed in a burette. A pipette is used to transfer a 20.0 cm<sup>3</sup> portion of aqueous sodium hydroxide into a conical flask. Three drops of universal indicator are added to the conical flask. The mixture is swirled and its temperature is taken.

To this mixture, 2.0 cm<sup>3</sup> of the acid is added with swirling and the highest temperature reached is measured and recorded. This is repeated several times. The results for this experiment are shown in the table.

volume of acid added / cm <sup>3</sup>	0.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0
temperature of the mixture / °C	25.4	27.0	28.6	30.2	31.4	30.1	28.8	27.5

- (a) Plot a graph of the temperature of the mixture against volume of acid added. Draw **two** straight lines that intersect, taking into account all the relevant points, to show the rise and the fall in temperature.



- (b) What is the name of this salts preparation method?

..... [1]

- (c) (i) Complete neutralisation of sodium hydroxide solution occurs at the point where the two graph lines intersect (cross). Use your graph to determine the volume of acid required to exactly neutralise the aqueous sodium hydroxide.

.....cm<sup>3</sup> [1]

- (ii) What was the colour of the Universal Indicator when it was first added into the solution in the conical flask?

..... [1]

- (d) Name the acid used in this experiment.

..... [1]

- (e) Write the ionic equation of this reaction.

..... [1]

[Total: 8]

- 5 A student uses four different metals, **V**, **W**, **X** and **Y** to react with hydrochloric acid solutions. She uses equal volume and concentration of acid and the same mass of metal. Some of the metals react with the acid to give a gas.

The results are shown in the table.

metal	gas given off	time for 20cm <sup>3</sup> of gas to be collected /s
<b>V</b>	yes	4
<b>W</b>	no	none collected
<b>X</b>	yes	43
<b>Y</b>	yes	97

Use the letters, **V**, **W**, **X**, and **Y** to answer the following questions.

- (a) Which metal is the most reactive?

..... [1]

- (b) Which metals are above hydrogen in the reactivity series?

..... [1]

- (c) Which metal can displace **X** from its solution?

..... [1]

- (d) Suggest a method for extracting metal **Y** from its oxide.

..... [1]

(e) Suggest the identity for metal **W**.

..... [1]

(f) (i) Name the gas produced when the metals react with hydrochloric acid.

..... [1]

(ii) Describe a test for the gas produced. Include the observation in your answer.

test.....

observation.....

..... [2]

[Total: 8]

6 (a) The table shows information about halogens.

halogen	physical state	colour
astatine		black
chlorine	gas	
	solid	purplish black
bromine	liquid	

(i) Complete the blanks in the table above. [2]

(ii) Describe and explain what happens when chlorine is bubbled into aqueous sodium bromide.

.....

.....

..... [2]

(iii) Write a balanced chemical equation, with state symbols for the reaction in (a)(ii).

..... [2]

- (b) Chlorine and argon are in the same period in the Periodic Table. Chlorine is reactive while argon is **not**. Use the electronic structures of both chlorine and argon to explain the above statement.

.....

..... [2]

[Total: 8]

**End of Paper**

# The Periodic Table of Elements

Group																	
I	II	<div>1<div>Hhydrogen1</div></div>										III	IV	V	VI	VII	0
		<div>Key<div>proton (atomic) number atomic symbol name relative atomic mass</div></div>															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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 -
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 -					
				Rutherfordium		seaborgium		bohrium		hassium		meitnerium		darmstadtium		roentgenium	
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lanthanoids

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium -	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac actinium -	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium -	Pu plutonium -	Am americium -	Cm curium -	Bk berkelium -	Cf californium -	Es einsteinium -	Fm fermium -	Md mendelevium -	No nobelium -	Lr lawrencium -

actinoids





**4NA Science(Chemistry) Mid-Year Examination 2018**  
**Marking Scheme**

Paper 3 [Total 20]  
 MCQ

1. D	11. B
2. C	12. C
3. B	13. C
4. D	14. B
5. C	15. B
6. B	16. B
7. B	17. B
8. C	18. C
9. A	19. C
10. B	20. D

Paper 4  
 Section A [Total 14]

Question No.				Marks
1	(a)	Q and T		1
	(b)	$S_2T / Na_2O$		1
	(c)	S		1
	(d)	Q		1
		<b>Total :</b>		<b>4</b>
2	(a)	Mr of $ZnSO_4 = 65+32+4(16)= 161$ [1] No. of moles of $ZnSO_4 = 5/161 = 0.0311$ mol [1]		2
	(b)	lead and sulfuric acid forms <u>insoluble</u> lead sulfate [1] which will cover the lead and prevent further reaction. [1]		2
	(c)	lead nitrate and sodium sulfate (any soluble salts of lead and sulfates)		2
		<b>Total :</b>		<b>6</b>
3	(a)	name of gas	harmful effect on human/ environment	2
		carbon monoxide	combines with haemoglobin in blood, causes breathing difficulty and eventually death. (headaches, fatigue accepted)	
		nitrogen dioxide	respiration difficulties, eye irritation, lung irritation, inflammation of lungs.	

				<input type="checkbox"/> causes acid rain (resulting in plant damage, loss of marine life, corrosion on buildings)		
	(b)	The <u>high temperatures</u> in car engines during acceleration [1] causes the nitrogen to undergo combustion with oxygen [1]				2
		<b>Total :</b>				<b>4</b>

Section B [Total 24]

4	(a)	<p>Temperature of the mixture /°C</p> <p>Correct plot points [1] Best fit line [1m each]</p>	3
	(b)	titration	1
	(c)(i)	7.9 cm <sup>3</sup>	1
	(ii)	purple	1
	(d)	sulfuric acid	1
	(e)	H <sup>+</sup> (aq) + OH <sup>-</sup> (aq) → H <sub>2</sub> O (l) (Reject if no state symbols are given)	1
		<b>Total :</b>	<b>8</b>
5	(a)	V	1
	(b)	V, X and Y	1
	(c)	Y	1

	(d)	Heating with carbon	1
	(e)	Copper, Mercury, Silver, Gold, Platinum	1
	(f)(i)	hydrogen	1
	(ii)	Test: Place lighted splint at the mouth of the test tube. Observation: Lighted splint extinguishes with a "pop" sound.	2
6	(i)		
		halogen	physical state
		astatine	<b>solid</b>
		chlorine	gas
		<b>iodine</b>	solid
		bromine	liquid
			colour
			black
			<b>yellowish-green</b>
			purplish black
			<b>reddish brown/ brown</b>
		Every 2 correct ans [1]	2
	(ii)	Colourless solution turns reddish brown. [1] Chlorine is <u>more reactive</u> than bromine, <u>displaces</u> bromine from sodium bromide. [1]	2
	(iii)	$\text{Cl}_2 (\text{g}) + \text{KBr}(\text{aq}) \rightarrow \text{KCl} (\text{aq}) + \text{Br}_2 (\text{aq})$ (1m for chemical eqn) (1m for state symbol)	2
	(b)	Argon atom as a <u>full</u> electronic structure. (reject noble gas)  Chlorine atom <u>has 7 valence electrons</u> which has a / <u>incompletely filled valence electron shell</u> .	1
			1
		<b>Total :</b>	<b>8</b>



1 Which of the following apparatus is most accurate in measuring volume of solutions?

- A beaker
- B measuring cylinder
- C pipette
- D burette

2 The table below shows the melting and boiling points of four substances, J, K, L and M.

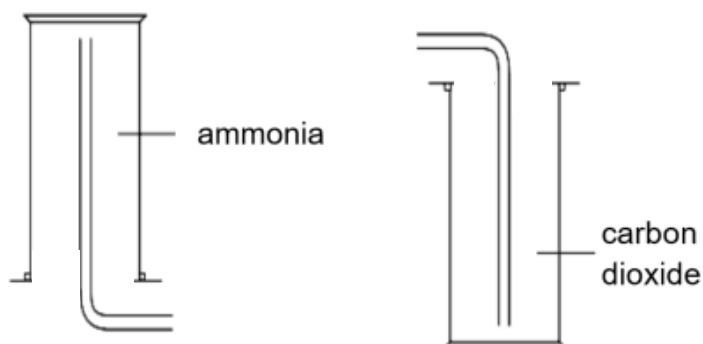
substance	melting point / °C	boiling point / °C
J	-182	-2
K	-23	77
L	-5	65
M	41	182

How many substances are solids at room temperature?

- A 1
- B 2
- C 3
- D 4

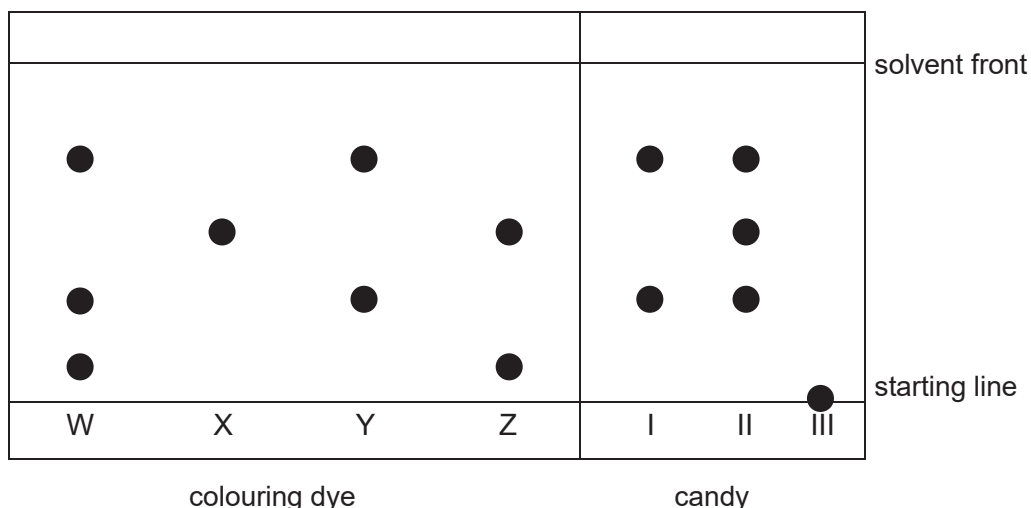
- 3 The three main methods of gas collection are by upward displacement of air, downward displacement of air, and displacement of water.

Ammonia and carbon dioxide are collected by the methods shown below.



What deduction can be made about the properties of the two gases?

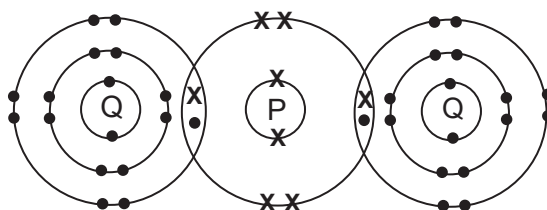
- A Both gases are insoluble in water.  
 B Both gases are acidic in nature.  
 C Both gases are denser than air.  
 D Carbon dioxide is denser than ammonia.
- 4 A chromatography experiment was conducted by a food scientist to find out if banned colouring dyes, W, X, Y and Z, are found in three different candies, I, II and III. The results are as shown below.



Which statement is **not** true?

- A Candy I contains dye Y.  
 B Candy II contains both dyes X and Y.  
 C All colouring dyes are impure substances.  
 D Candy III contains colouring dye(s) that is (are) insoluble in the solvent.

- 5 Which of the following set of substances contain an element, a compound and a mixture?
- A air, copper, steel
- B carbon, carbon monoxide, carbon dioxide
- C hydrogen, sugar solution, magnesium chloride
- D sodium, ammonium nitrate, sodium chloride
- 6 Which of the following properties can be used to determine if a substance is pure?
- A colour
- B density
- C melting point
- D solubility in water
- 7 What do both sulfur atom and sulfide ion have in common?
- A 16 neutrons
- B 16 electrons
- C 32 protons
- D 32 neutrons
- 8 The diagram below shows the bonding between elements P and Q in the molecule,  $PQ_2$ .



Which option represents the electronic structures of atoms P and Q before combining together to form the above molecule?

	P	Q
A	2, 4	2, 8, 6
B	2, 4	2, 8, 7
C	2, 6	2, 8, 7
D	2, 8	2, 8, 8

- 9 Cadmium forms a compound  $\text{Cd}(\text{NO}_3)_2$ .

What is the charge of cadmium ion?

- A +1
- B +2
- C +3
- D +4

- 10 Ammonium nitrate is added to substance W and heated. A gas is liberated that turns moist red litmus paper blue.

What is substance W likely to be?

- A acid
- B alkali
- C metal
- D indicator

- 11 Samples of three oxides, T, U and V, are added separately to dilute hydrochloric acid and aqueous sodium hydroxide.

T and U react with dilute hydrochloric acid but V does not react.

U and V react with aqueous sodium hydroxide but T does not react.

What is the nature of oxides T, U and V?

	type of oxide		
	acidic	amphoteric	basic
A	T	U	V
B	U	T	V
C	V	T	U
D	V	U	T

- 12 A solid element is easily cut with a knife and floats and darts about when placed in water.

Which Group is this element found in?

- A Group 0
- B Group I
- C Group V
- D Group VII



13 Which pair of reactants is best used to prepare a solution of potassium sulfate?

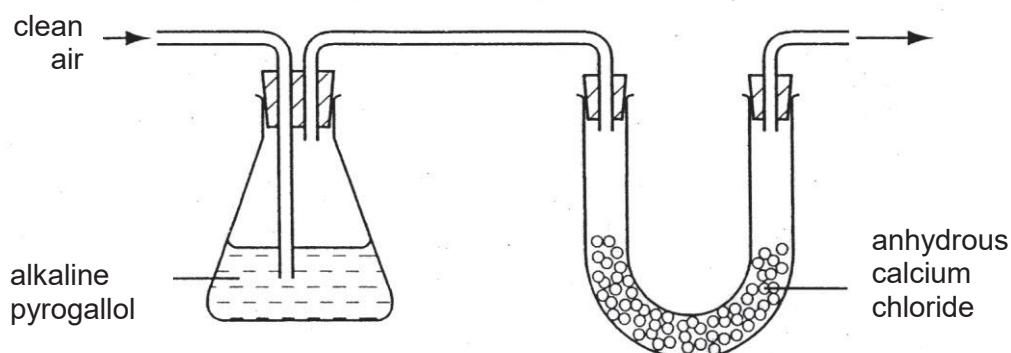
- A potassium and dilute sulfuric acid
- B potassium nitrate and sodium sulfate
- C potassium nitrate and dilute sulfuric acid
- D potassium hydroxide and dilute sulfuric acid

14 Which of the following metal(s) can be obtained by reduction with carbon?

	sodium	aluminium	tin
A	×	✓	✓
B	×	×	✓
C	✓	✓	×
D	✓	×	×

15 Anhydrous calcium chloride is used as a drying agent while the alkaline pyrogallol absorbs oxygen and carbon dioxide gas.

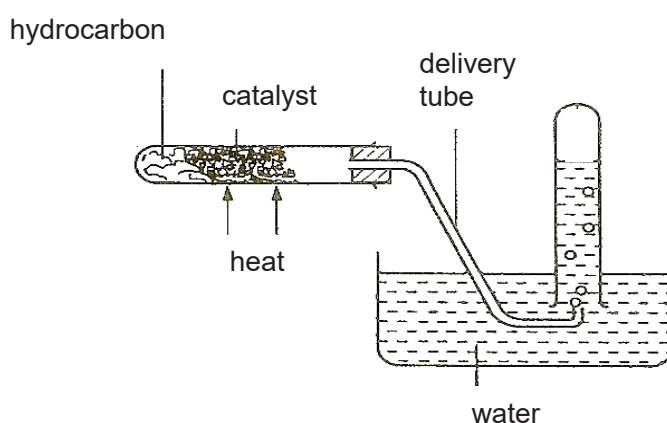
Clean air is passed through the apparatus shown below.



What gases are present in the air leaving the apparatus?

- A nitrogen and argon
- B nitrogen and hydrogen
- C hydrogen and carbon dioxide
- D hydrogen, nitrogen and argon

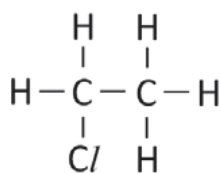
- 16 Which of the following gases lead to respiratory problems and breathing difficulties?
- I. carbon monoxide
  - II. nitrogen dioxide
  - III. sulfur dioxide
- A I only  
B II only  
C II and III only  
D All of the above
- 17 Which of the following air pollutants is **not** found in car exhausts?
- A sulfur dioxide  
B nitrogen dioxide  
C carbon monoxide  
D unburnt hydrocarbons
- 18 What are the colours of the Group VII elements at room temperature and pressure down the Group?
- A light green, pale yellow, reddish brown, black  
B light green, pale yellow, black, reddish brown  
C pale yellow, light green, reddish brown, black  
D pale yellow, light green, black, reddish brown
- 19 The following set-up is used for the cracking of long chain hydrocarbons.



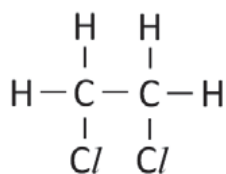
Which of the following is a suitable catalyst?

- A silicon chloride  
B aluminium oxide  
C aluminium nitrate  
D ammonium nitrate

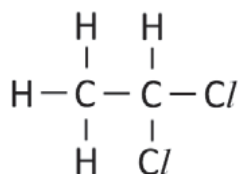
**20** The diagrams below show the structures of three compounds.



1



2



3

Which compounds can be the products of the substitution reaction of ethane with chlorine?

- A** 1 and 2
- B** 1 and 3
- C** 2 and 3
- D** 1, 2 and 3

## The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
		Key																
		proton (atomic) number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
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 (memorium)	117 Ts tennessine -	118 Og oganesson -	119 Nh nihonium -	120 Ds darmstadtium -

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
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 -

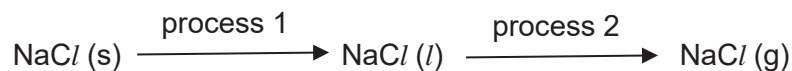
actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

## Section A

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

- 1 When solid sodium chloride is heated from room temperature to 1500°C, it undergoes the following processes.



- (a) Name processes 1 and 2.

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

- (b) Describe the arrangement and movement of particles in sodium chloride **after** process 2.

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

- (c) Draw the dot-and-cross diagram of sodium chloride, showing only the valence electrons.

[1]

- (d) A sample of sodium chloride crystals is mixed with solid sodium carbonate. Jerry adds water to the mixture before filtering.

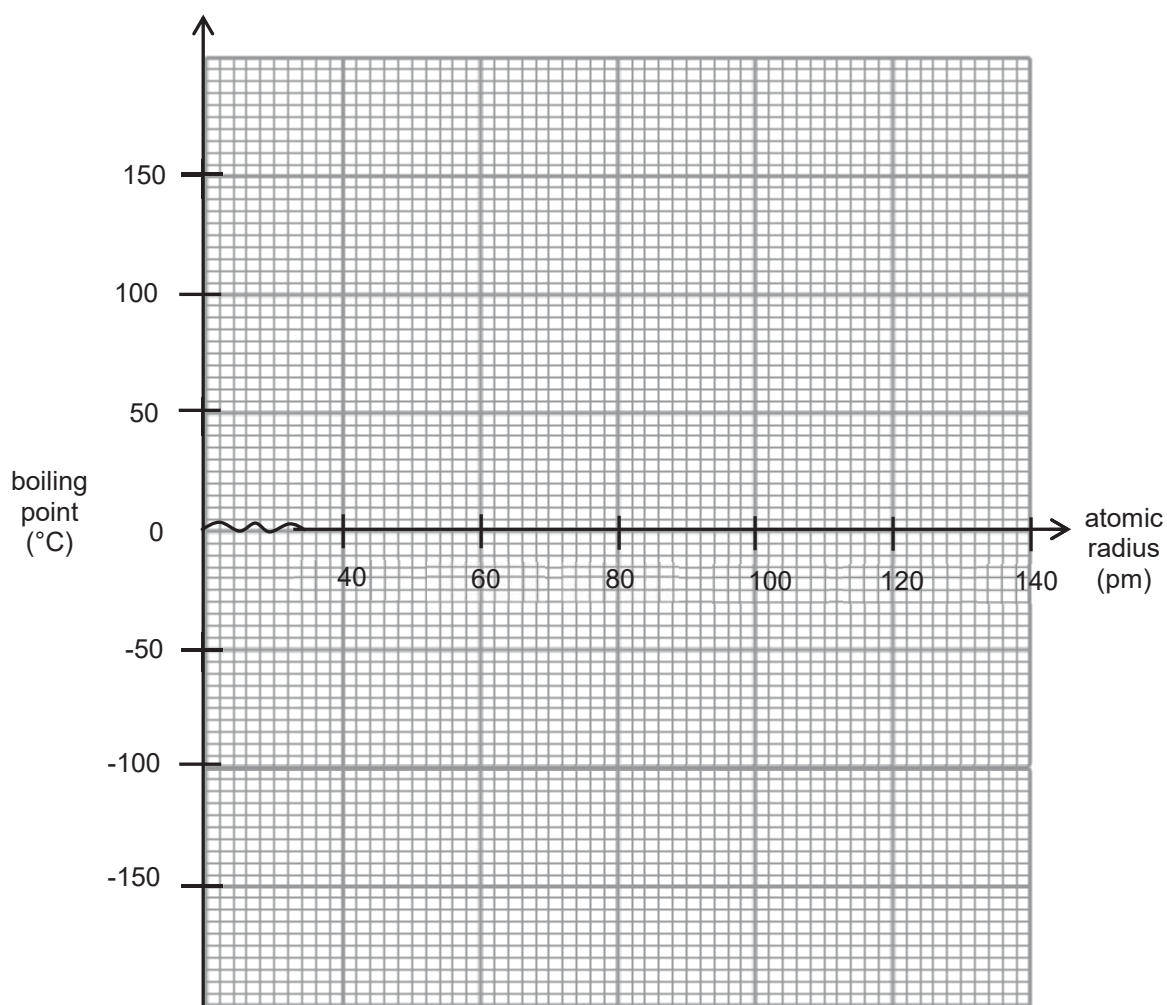
Explain why Jerry is unable to separate the mixture with his method.

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

- 2 The atomic radius (in picometre) of Group VII elements and their boiling points are tabulated below.

Group VII element	atomic radius (pm)	boiling point (°C)
fluorine	42	-190
chlorine	80	-15
bromine	98	65
iodine	120	165

- (a) Using the grid below, plot a best-fit line graph of boiling point against atomic radius. [2]



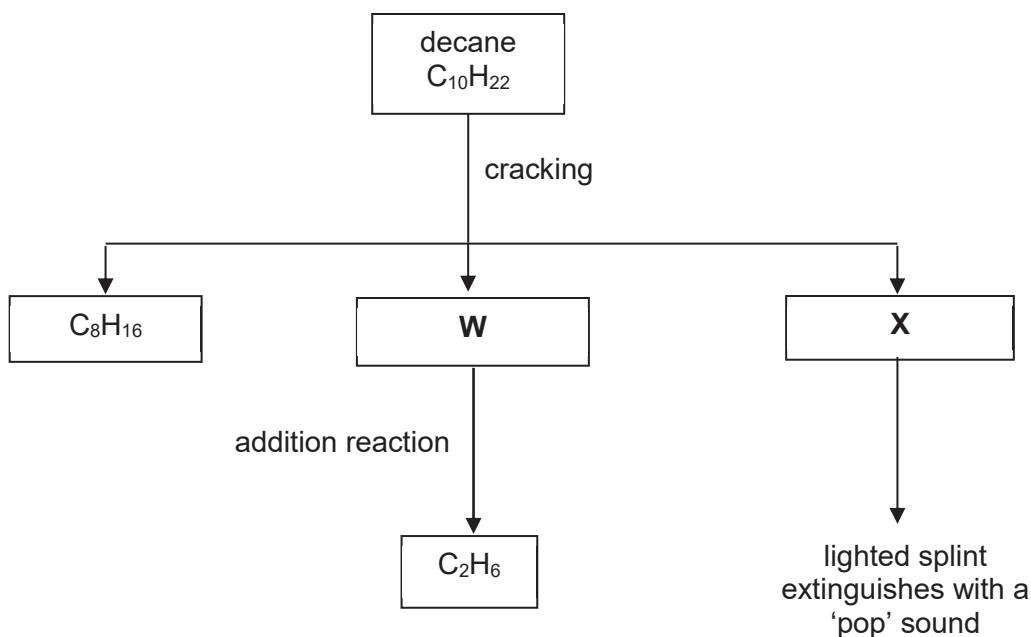
- (b) State the relationship between atomic radius and boiling point of the Group VII elements.

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

- (c) Chlorine gas is bubbled into a solution of potassium bromide. Explain why a reaction takes place.

.....  
.....  
..... [2]

- 3 Decane is a long chain hydrocarbon that undergoes cracking as shown in the flow chart below.



- (a) Identify **W** and **X**.

**W**: .....

**X**: ..... [2]

- (b) State the conditions required for the addition reaction.

..... [1]

- (c) Describe a chemical test that will determine if decane ( $C_{10}H_{22}$ ) is a saturated or unsaturated compound and predict the observation.

Test: .....

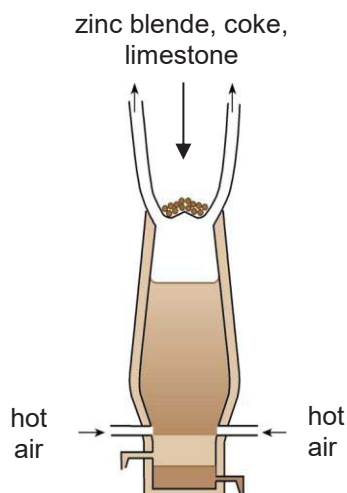
Observation: .....

..... [2]

## Section B

Answer any **two** questions in the spaces provided.

- 4 The ore that zinc is extracted from is called zinc blende (ZnS). The process of zinc extraction is similar to iron extraction and is carried out in a Blast Furnace as shown below.



The main reactions that take place in the extraction of zinc from zinc blende is as shown.

Reaction 1: Zinc blende first reacts with oxygen to form zinc oxide and sulfur dioxide.

Reaction 2: Zinc oxide then reacts with carbon monoxide to obtain zinc metal and carbon dioxide.

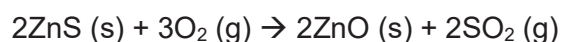
- (a) Write the balanced chemical equation for Reaction 2.

..... [1]

- (b) State the main purpose of adding limestone.

..... [1]

- (c) The chemical equation for Reaction 1 is shown below.



Calculate the mass of oxygen required for complete reaction of 50 kg of zinc blende.

[3]



- (d) Scrap zinc is often recycled in order to save finite zinc which will otherwise be depleted eventually.

Give one **other** reason for recycling scrap zinc.

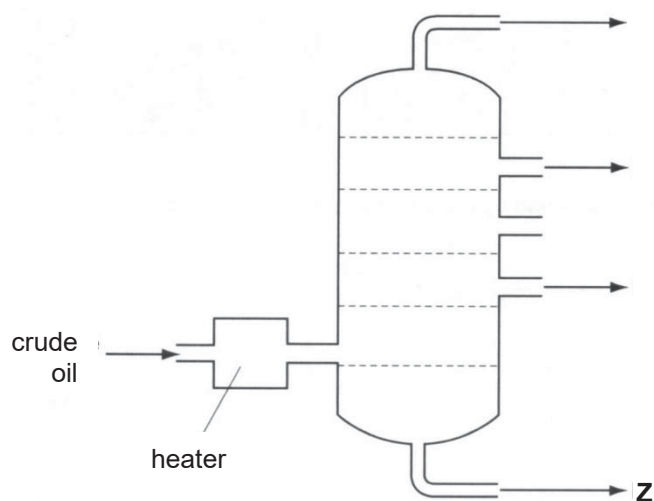
.....  
..... [1]

- (e) Zinc forms a number of useful salts. An example would be zinc carbonate, which is used as a pigment in cosmetics and lotions.

Describe how a pure and dry sample of zinc carbonate can be prepared using **two** suitable reagents.

.....  
.....  
.....  
.....  
..... [2]

- 5 Crude oil is separated into different fractions as shown in the diagram below.



- (a) Describe how the different fractions of crude oil are separated and collected from the set-up above.

.....

.....

.....

.....

.....

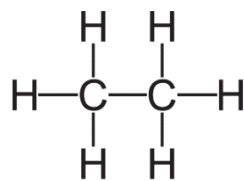
.....

..... [3]

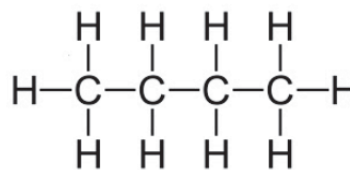
- (b) Name fraction **Z** and state its use.

..... [1]

- (c) The structural formulae of two different molecules found in the fraction collected at the top of the column (petroleum gas) are shown below.



molecule **J**



molecule **K**

- (i) Explain why molecules of **K** have a higher boiling point compared to molecules of **J**.

.....  
.....  
.....  
.....[2]

- (ii) Comment on the electrical conductivity of both molecules **J** and **K**.

.....  
.....  
.....[2]

- 6** Alcohols are a family of organic compounds with the functional group –O–H. The table below shows some information of the first 4 members.

number of carbon atoms	name	molecular formula	boiling point (°C)
1	methanol	CH <sub>3</sub> OH	65
2	ethanol	C <sub>2</sub> H <sub>5</sub> OH	79
3		C <sub>3</sub> H <sub>7</sub> OH	97
4	butanol	C <sub>4</sub> H <sub>9</sub> OH	117

- (a)** Using the information provided, give two reasons why the members belong to the same homologous series.

.....  
 .....  
 ..... [2]

- (b)** Name the third member alcohol, C<sub>3</sub>H<sub>7</sub>OH.

..... [1]

- (c)** Suggest the full structural formula of methanol.

[1]

- (d)** A student makes the following claim:

“An example of a hydrocarbon is alcohol.”

State if the claim is correct and explain your answer.

.....  
 .....  
 ..... [2]

- (e) Aside from melting and boiling point, predict one **other** trend in physical property of alcohols as the number of carbon atoms increases.

.....

..... [1]

- (f) Write the balanced chemical equation for the incomplete combustion of methanol to give carbon monoxide and water.

..... [1]

**End of Paper**

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## Section A: MCQs (10 marks)

1	D	6	C	11	D	16	D
2	A	7	A	12	B	17	A
3	D	8	C	13	D	18	C
4	C	9	B	14	B	19	B
5	C	10	B	15	A	20	D

## Section B: Structured Questions (30 marks)

1	(a)	Process 1: melting Process 2: boiling	1 m
	(b)	The particles are <u>spread far apart in a disorderly arrangement, and move rapidly and randomly in all directions.</u>	1 m
	(c)		1 m
	(d)	Both sodium chloride and sodium carbonate are <u>soluble</u> and their solutions will pass through the filter paper.	1 m
2	(a)	1 m – plot points correctly 1 m – draw straight line passing through all points	2 m
	(b)	As the atomic radius increases, the boiling point increases.	1 m
	(c)	Chlorine, <u>being more reactive than bromine,</u> gains electrons more readily and is able to <u>displace bromine</u> from potassium bromide to form potassium chloride and bromine.	1 m 1 m
3	(a)	Nickel catalyst, 200°C	1 m
	(b)	W: C <sub>2</sub> H <sub>4</sub> / ethene X: H <sub>2</sub> / hydrogen	1 m 1 m
	(c)	Test: Add aqueous bromine into decane. Observation: Reddish brown aqueous bromine will remain reddish brown.	1 m 1 m
4	(a)	ZnO + CO → Zn + CO <sub>2</sub>	1 m
	(b)	To remove acidic impurities.	1 m
	(c)	Mass of ZnS = 50 x 1000 = 50000 g No. of moles of ZnS = 50000/(65+32) = 515.46 moles (5 s.f.)	1 m

		Comparing mole ratio ZnS : O <sub>2</sub> 2 : 3 No. of moles of O <sub>2</sub> = 515.46/2 x 3 = 773.20 moles Mass of O <sub>2</sub> = 773.20 x (16x2) = 24742 g = 24800 g (3 s.f.)	1 m allow ecf 1 m
	(d)	To prevent land pollution as landfills are required to bury scrap zinc. / To save finite fossil fuels which is otherwise used in the extraction of zinc.	1 m
	(e)	Mix <u>aqueous zinc nitrate</u> and <u>aqueous sodium carbonate</u> . <u>Filter</u> mixture to obtain the <u>residue</u> . <u>Wash</u> and <u>dry</u> between pieces of filter paper.	1 m 1 m
5	(a)	Crude oil is <u>heated</u> and <u>vapourised</u> . Then, the vapours rise up the column and are separated based on <u>different boiling points</u> . The fraction with the <u>lowest boiling point</u> is cooled, condensed and collected at the <u>top</u> of the column, while the fraction with the <u>highest boiling point</u> is cooled, condensed and collected at the <u>bottom</u> of the column.	1 m 1 m 1 m
	(b)	Bitumen, to make road surfaces	1 m
	(c)(i)	K molecules are <u>bigger</u> and have <u>stronger intermolecular forces of attraction</u> . <u>More energy</u> is required to overcome the forces of attraction. Therefore, it will have a <u>higher boiling point</u> .	1 m 1 m
	(c)(ii)	Both molecules <u>cannot conduct electricity</u> in any state due to the absence of <u>free mobile electrons or ions to carry charges</u> .	1 m 1 m
6	(a)	Alcohols are a family of organic compounds with the same functional group (-OH), the same general formula (C <sub>n</sub> H <sub>2n+1</sub> OH), show a gradual change in physical properties (such as boiling point).	2 m (any 2)
	(b)	propanol	1 m
	(c)	$  \begin{array}{c}  \text{H} \\    \\  \text{H}-\text{C}-\text{O}-\text{H} \\    \\  \text{H}  \end{array}  $	1 m
	(d)	The claim is <u>not correct</u> . A hydrocarbon is an organic compound containing <u>only hydrogen and carbon</u> , but alcohol has an <u>oxygen atom</u> in its molecule.	1 m 1 m
	(e)	As the number of carbon atoms increases, Flammability decreases Viscosity increases, Density increases	1 m (any)
	(f)	CH <sub>3</sub> OH + O <sub>2</sub> → CO + 2H <sub>2</sub> O	1 m







# YUYING SECONDARY SCHOOL

## MID-YEAR EXAMINATION

### Secondary 4 Normal (Academic)

NAME

CLASS

REG. NO

## SCIENCE

5105/3, 5105/4

Chemistry

14 May 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: Multiple Choice Answer Sheet

Setter: Miss Ham Jia Yun

### READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet and the separate Answer Sheet.

#### Paper 3

There are **twenty** questions on this paper. Answer **all** questions.

For each question there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised not to spend more than 30 minutes on Paper 3.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

**Read the instructions on the Answer Sheet very carefully.**

#### Paper 4

Answer **all** questions in Section A and any **two** questions in Section B.

Write in dark blue or black pen on both sides of the paper.

You may use a pencil for any diagrams, graphs, tables or rough working.

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

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.

The use of an approved calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page 13.

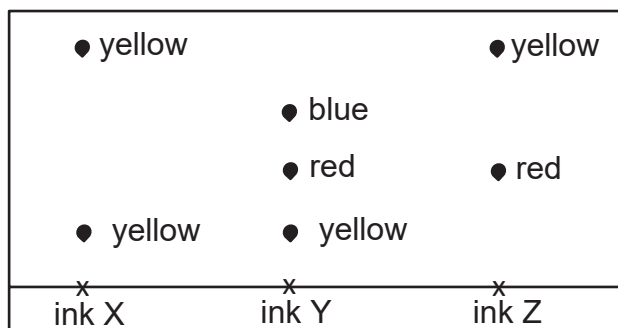
For Examiner's Use	
Total	50

This document consists of **13** printed pages.

### Paper 3

Answer **all** the questions in this paper on the separate Answer Sheet.  
The total mark for this section is 20.

- 1 The diagram shows a chromatogram obtained from three different inks, X, Y and Z.



How many different **yellow** dyes are present in the inks?

- |     |     |
|-----|-----|
| A 1 | B 2 |
| C 3 | D 4 |
- 2 Which row describes the test for hydrogen?

	test	observation
A	glowing splint	relights
B	limewater	white precipitate forms
C	red litmus	turns blue
D	lighted splint	flame extinguished with a 'pop' sound

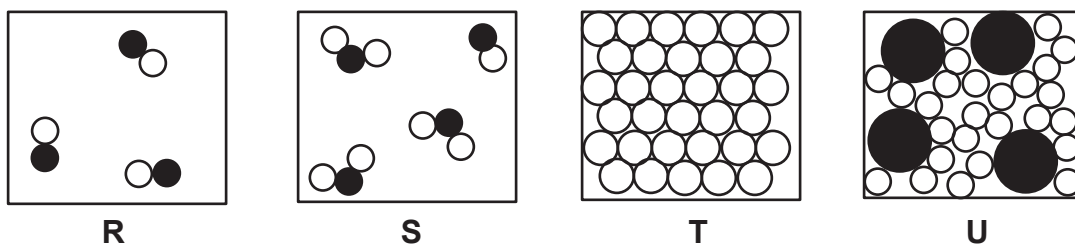
- 3 The nucleus of an atom has neutrons and protons. Electrons are found in different shells around the nucleus.  
Which statement correctly describes an atom?

- A Neutrons and electrons have the same relative mass.  
B The nucleus contains most of the mass of an atom.  
C The protons and electrons repel each other.  
D The nucleus has a neutral charge.

- 4 Which substance is a solid at 20 °C?

	melting point/ °C	boiling point/ °C
A	-117	78
B	-93	69
C	0	100
D	36	130

- 5 The diagrams show the arrangement of particles in four substances labelled **R**, **S**, **T** and **U**.



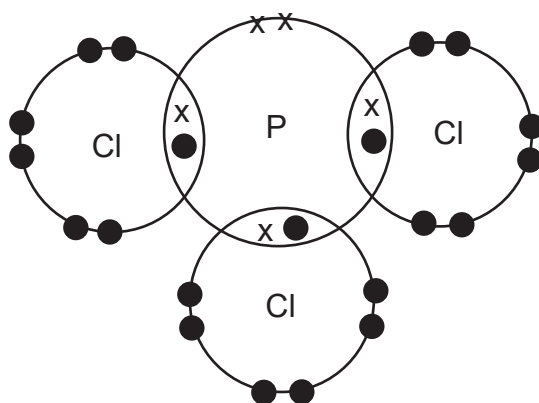
Which row correctly describes these four substances?

	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>
A	compound	compound	element	compound
B	element	compound	compound	mixture
C	element	mixture	compound	compound
D	compound	mixture	element	mixture

- 6 What change occurs when an atom forms a positive ion?

- A An electron is added.
- B An electron is removed.
- C A proton is added
- D A proton is removed.

- 7 The dot-and-cross diagram shows a molecule of phosphorus trichloride.



In the molecule of phosphorus trichloride,

- A the phosphorus atom and chlorine atoms share three pairs of electrons.
- B the phosphorus atom and chlorine atoms share three pairs of protons.
- C the phosphorus atom gives the chlorine atoms three protons.
- D the phosphorus atom gives the chlorine atoms three electrons.

8 What is the relative molecular mass of a fluorine molecule,  $F_2$ ?

- A 9
- B 18
- C 19
- D 38

9 A hydrocarbon  $C_xH_y$  has a relative molecular mass of 44.  
What are the values of  $x$  and  $y$ ?

	$x$	$y$
A	3	6
B	3	8
C	6	3
D	6	6

10 Salts can be prepared by reacting dilute hydrochloric acid with

1. a metal,
2. a metal oxide,
3. a metal carbonate.

Which reactants can be used with dilute hydrochloric acid to prepare copper(II) chloride?

- A 1 and 2 only      B 1 and 3 only      C 2 and 3 only      D 1, 2 and 3

11 For which acid-base reaction is the titration method used?

- A an insoluble acid with an insoluble base
- B an insoluble acid with a soluble base
- C a soluble acid with an insoluble base
- D a soluble acid with a soluble base

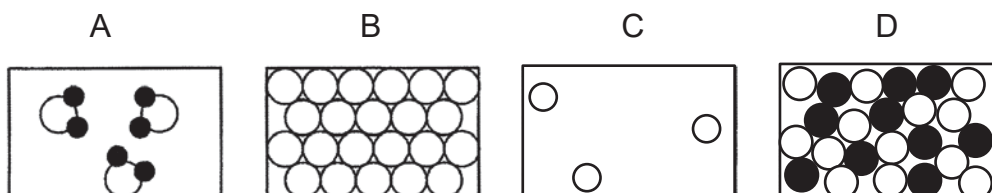
12 Which compound contains three different non-metallic elements?

- A  $C_2H_5Br$       B  $LiBH_4$       C  $Na_2CO_3$       D  $KNO_3$

13 Which property of an element determines its position in the Periodic Table?

- A mass number
- B proton number
- C neutron number
- D nucleon number

14 Which diagram represents the arrangement of atoms in an alloy?



15 Which substance has the properties of a metallic element?

	melting point/ °C	boiling point/ °C	heat conductivity
A	-102	-34	good
B	-102	-34	poor
C	1535	2750	good
D	1535	2750	poor

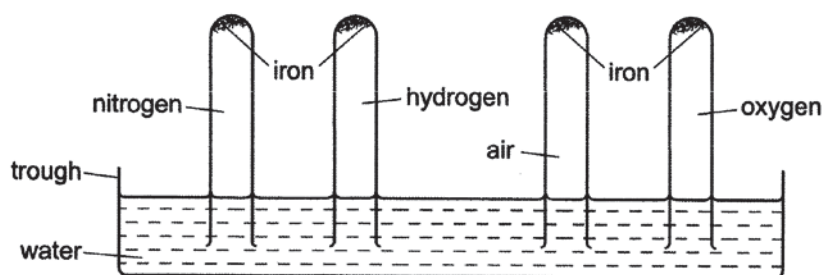
16 Which of the following is a property of **all** metals?

- A They conduct electricity.
- B They are soluble in water.
- C They have high melting points.
- D They react with dilute sulfuric acid

17 What is the volume of oxygen in 100 cm<sup>3</sup> of air measured at room temperature?

- A 10 cm<sup>3</sup>
- B 20 cm<sup>3</sup>
- C 80 cm<sup>3</sup>
- D 100 cm<sup>3</sup>

- 18 The experiment shown in the diagram is set up.

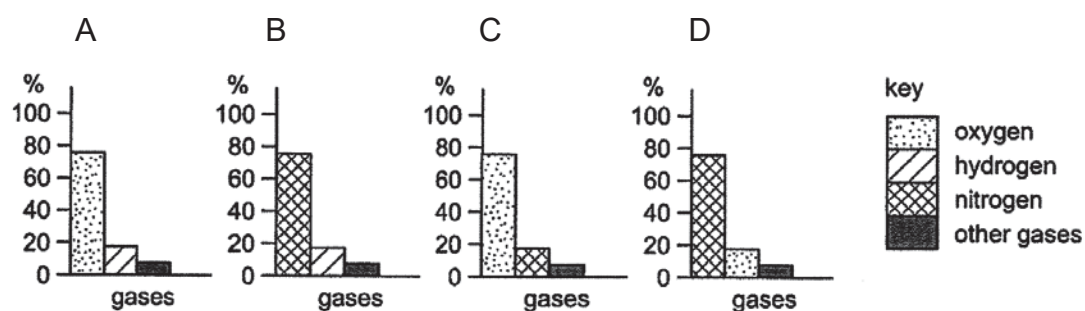


The apparatus is left for one month.

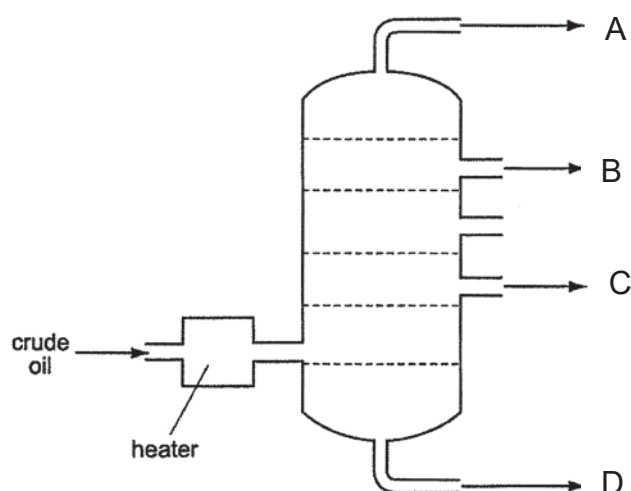
The water level rises the most in the tube containing

- A nitrogen.
- B hydrogen.
- C air.
- D oxygen.

- 19 Which bar chart best represents the approximate composition by volume of air?



- 20 The diagram shows a fractionating column.  
Which fraction is used for making roads?

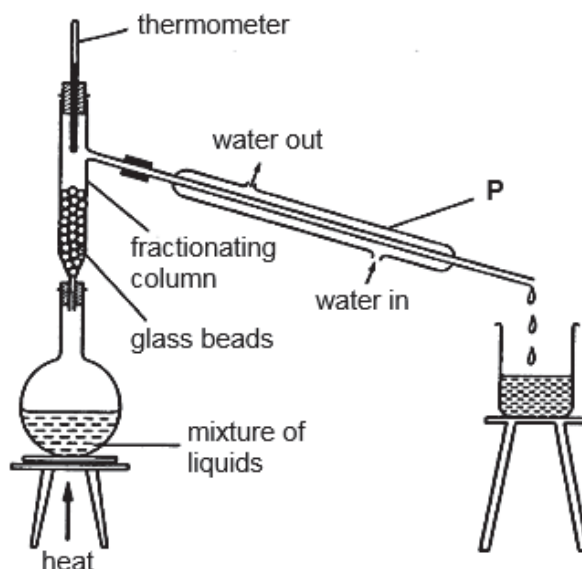


**Paper 4 (Section A)**

Answer **all** the questions in this section.

The total mark for this section is 14.

- 1 Ethanol boils at  $78^{\circ}\text{C}$ , butanol boils at  $118^{\circ}\text{C}$  and water boils at  $100^{\circ}\text{C}$ . The following apparatus was set up to separate a mixture of these three liquids.



- (a) What is the name of this method of separation? [1]

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- (b) Name the apparatus labelled **P**. [1]

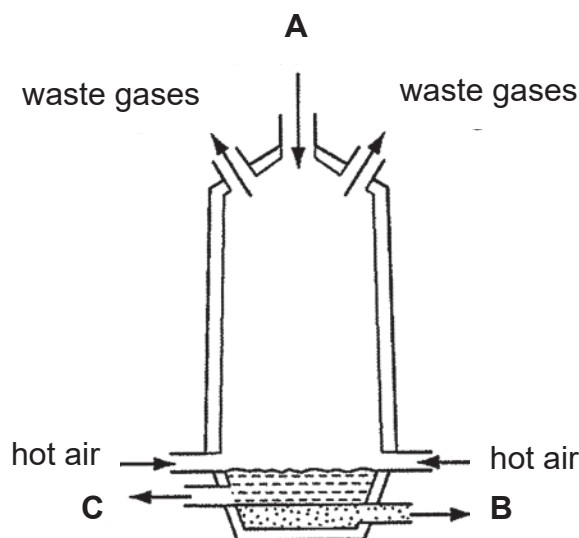
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- (c) Name the three liquids, ethanol, butanol and water, that will be collected as the distillate in the correct sequence. [1]

sequence of substance collected	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
name of liquid			



- 2 The diagram below shows the extraction of iron in a blast furnace.



- (a) (i) State the chemical names of the three starting materials added at **A**. [2]

\_\_\_\_\_ and \_\_\_\_\_ and \_\_\_\_\_

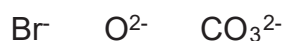
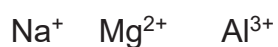
- (ii) Suggest the identity of two gases present in the waste gases. [1]

\_\_\_\_\_ and \_\_\_\_\_

- (b) Write the balanced chemical equation for the reaction to produce substance **B**. [2]

\_\_\_\_\_

- 3 The formulae of ionic compounds can be deduced from the charges on the ions present. The following list shows the symbols of some common ions.



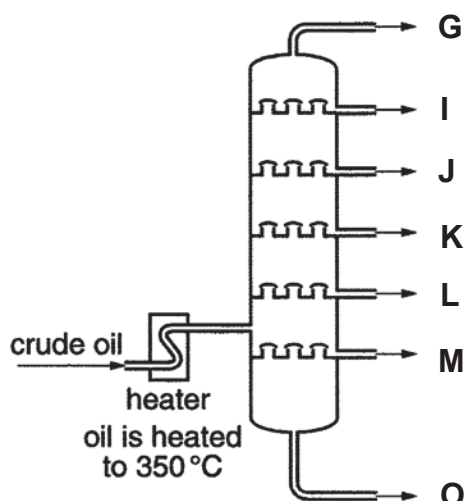
Write the chemical formula and calculate the relative molecular mass for each of the following compounds. [6]

chemical name	chemical formulae	relative molecular mass
sodium oxide		
magnesium bromide		
aluminium carbonate		

**Paper 4 (Section B)**

Answer any **two** questions in this section in the spaces provided.  
The total mark for this section is 16.

- 4 (a) Crude oil is a mixture of different hydrocarbons.
- (i) Name the process by which liquids such as petrol and diesel are obtained from crude oil. [1]
- \_\_\_\_\_
- (ii) What physical property of all the fractions makes this separation process possible? [1]
- \_\_\_\_\_
- (b) The diagram shows the fractions obtained after the process named in (a)(i) was carried out. The fractions are labelled **G, I, J, K, L, M** and **O**.



- (b) (i) Which of the letters **G** to **O** represents the fraction with the lowest boiling point? [1]
- \_\_\_\_\_
- (ii) Name one compound likely to be present in the fraction you named in (b)(i). [1]
- \_\_\_\_\_

- (iii) Name the fraction **L**, and state its use. [2]

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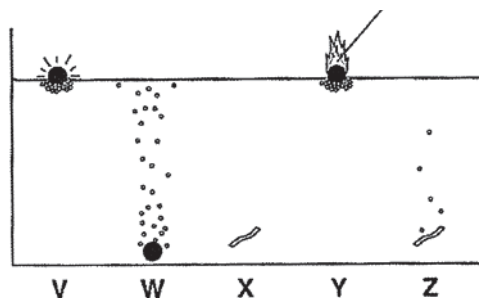
- (iv) **I** undergoes complete combustion to produce water and a gas. [2]  
Name the gas produced and describe a test to identify it.

Name: \_\_\_\_\_

Test: \_\_\_\_\_

Observation: \_\_\_\_\_

- 5 Five metals **V**, **W**, **X**, **Y** and **Z** are placed in a trough of cold water. The results observed are shown in the diagram.



- (a) Complete the table with the letters **V**, **W**, **X**, **Y** and **Z** to identify the [3]  
given metals.

metal	letter <b>V</b> , <b>W</b> , <b>X</b> , <b>Y</b> and <b>Z</b>
calcium	
copper	
magnesium	
potassium	
sodium	

- (b) Four of the metals react with cold water to produce a gas.

- (i) Name the gas. [1]

\_\_\_\_\_

- (ii) Describe a test and its observation to identify this gas named in (b)(i). [2]

Test: \_\_\_\_\_

Observation: \_\_\_\_\_

- (iii) Use a 'dot and cross' diagram to show the bonding in the compound named in (b)(i). [2]

6 Carbon monoxide and oxides of nitrogen are common pollutants in the air.

(a) Name a source of each pollutant and state **one** problem that each pollutant can cause.

(i) carbon monoxide [2]

source: \_\_\_\_\_

problem: \_\_\_\_\_

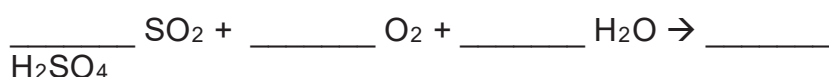
(ii) oxides of nitrogen [2]

source: \_\_\_\_\_

problem: \_\_\_\_\_

(b) Sulfur dioxide,  $\text{SO}_2$ , is released into the atmosphere due to volcanic eruptions. The sulfur dioxide then reacts with water vapour and oxygen to produce sulfuric acid.

(i) Balance the chemical equation for the reaction. [1]



(ii) The sulfur dioxide dissolves in rainwater to form acid rain. This phenomenon causes the decrease in pH levels of soils.

Describe a test to show that the soil is acidic. [2]

test: \_\_\_\_\_

observation: \_\_\_\_\_

(iii) Name a substance farmers often add to soils to reduce its acidity. [1]

\_\_\_\_\_

**END OF PAPER**

## The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
3 Li lithium 7	4 Be beryllium 9	<div>Key</div> <div>proton (atomic) number atomic symbol relative atomic mass</div>										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	2 He helium 4	
												13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5		
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 F/ flerovium -		116 Lv livermorium -			

lanthanoids

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium -	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac actinium -	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium -	Pu plutonium -	Am americium -	Cm curium -	Bk berkelium -	Cf californium -	Es einsteinium -	Fm fermium -	Md mendelevium -	No nobelium -	Lr lawrencium -

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



Paper 3

1	2	3	4	5
B	D	B	D	D
6	7	8	9	10
B	A	D	B	C
11	12	13	14	15
D	A	B	D	C
16	17	18	19	20
A	B	D	D	D

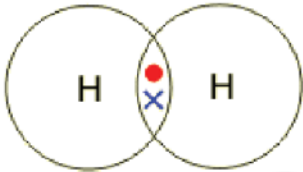
Section A

1	a	Fractional Distillation		
	b	condenser		
	c	1 <sup>st</sup> : ethanol, 2 <sup>nd</sup> : water, 3 <sup>rd</sup> : butanol		
2	a	iron(III) oxide, carbon and calcium carbonate (1m for two correct)		
	b	carbon dioxide/ carbon monoxide/ nitrogen/ argon/ oxygen		
	c	$\text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow 2 \text{Fe} + 3 \text{CO}_2$		
3		chemical name	chemical formulae	relative molecular mass
		sodium oxide	$\text{Na}_2\text{O}$	62
		magnesium bromide	$\text{MgBr}_2$	184
		aluminium carbonate	$\text{Al}_2(\text{CO}_3)_3$	234

Section B

4	a	i	Fractional Distillation	
		ii	Different boiling points	
	b	i	G	
		ii	methane	
		iii	Diesel. Fuel for diesel engines	
		iv	Name: carbon dioxide test: bubble the gas through limewater/ calcium hydroxide observation. If the gas is carbon dioxide, a white precipitate is formed.	
5	a		metal	letter <b>V, W, X, Y and Z</b>
			calcium	W
			copper	X
			magnesium	Z
			potassium	Y
			sodium	V
		2 correct- 1m, 4 correct- 2m, all correct- 3m		
	b	i	hydrogen	
		ii	Test: insert a lighted splint into the test-tube	



			Observation: If the gas is hydrogen, the lighted splint extinguishes with a pop sound
		iii	 <p>Deduct <math>\frac{1}{2}</math> m for each mistake, include legend</p>
6	a	i	<p>source- incomplete combustion of carbon containing fuels in motor vehicle engines</p> <p>problem- poisonous as it forms a stable compound with haemoglobin in our blood, preventing it from carrying oxygen</p>
		ii	<p>source- lightning activities</p> <p>problem- it combines with rainwater to form acid rain which damages buildings and lungs</p>
	b	i	2, 1, 2, 2
		ii	<p>Test: place moist both blue and red litmus paper into the soil.</p> <p>Observation: red moist litmus paper remains red, blue litmus paper turns red. *accept any possible answers</p>
		iii	calcium hydroxide



Name: ..... ( ) Class: .....

**ASSUMPTION ENGLISH SCHOOL  
PRELIMINARY EXAMINATION 2018**

**SCIENCE (CHEMISTRY)  
5105 / 03  
5107 / 03**



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**LEVEL:** Sec 4 Normal (Academic) **DATE :** 1 August 2018  
**CLASSES:** Sec 4/3, 4/4 **DURATION:** 1 hour 15 minutes  
(Papers 3 & 4)

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Additional Materials provided: 1 sheet of OAS paper

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**INSTRUCTIONS TO CANDIDATES**

**Do not open this booklet until you are told to do so.**

Write your NAME, INDEX NUMBER and CLASS at the top of this page and on the OAS paper. **Shade your index number on the OAS paper.**

There are 20 questions in this paper. Answer **ALL** questions. For each question, there are four possible answers A, B, C and D. Choose the correct answer and record your choice in soft or 2B pencil on the OAS paper provided. **DO NOT fold or bend the OAS paper.**

At the end of the examination, hand in your OAS paper and Question Papers separately.

**INFORMATION FOR CANDIDATES**

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 the last page of Paper 4.

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**This question paper consists of 9 printed pages including this page.**

**[Turn over**

1. Substance **X** can be condensed using a water-cooled condenser.

What is the melting point and boiling point of this substance?

	melting point / °C	boiling point / °C
<b>A</b>	−78	−33
<b>B</b>	−94	105
<b>C</b>	−119	−1
<b>D</b>	−130	36

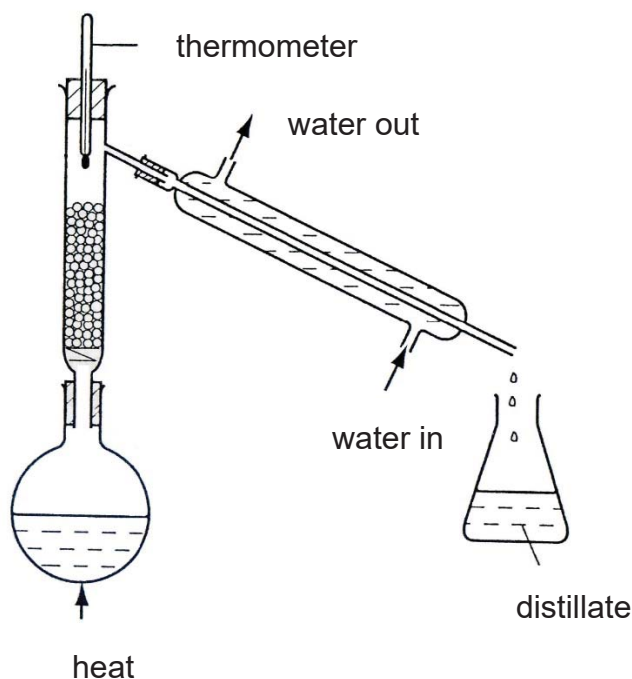
2. Which apparatus is the most suitable to measure exactly 21.50 cm<sup>3</sup> of a solution?

- A** beaker
- B** gas syringe
- C** burette
- D** measuring cylinder

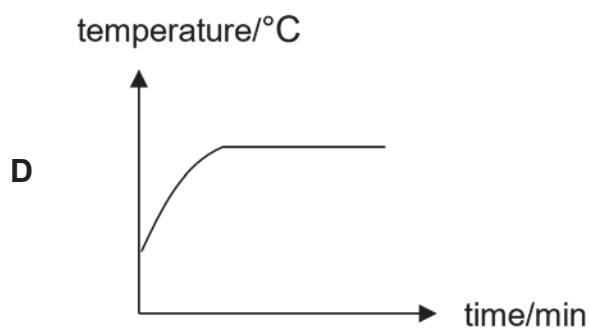
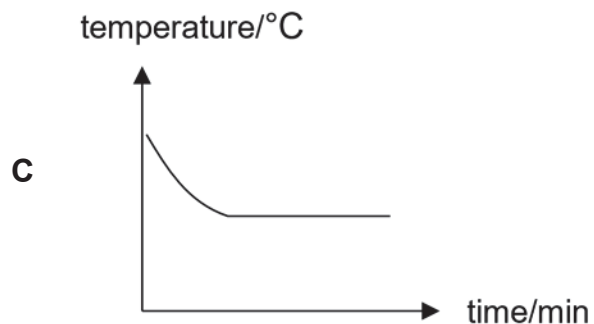
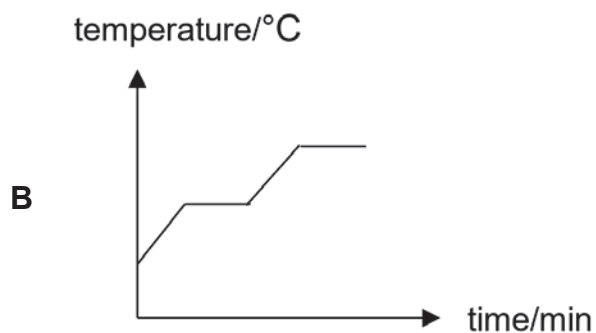
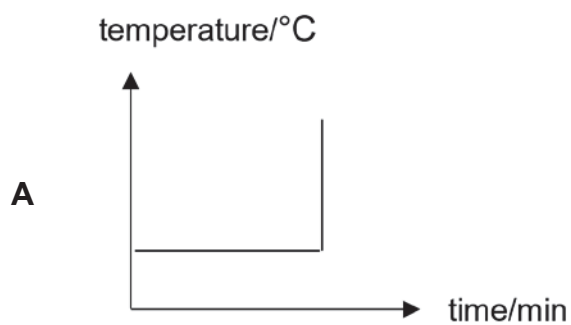
- 3.** Which statement is likely to be a pure compound?

- A** a colourless liquid which boils over a range of temperatures from 27°C to 40°C  
**B** a grey substance which can be separated using a magnet  
**C** green crystals which melt at 80°C  
**D** a suspension which leaves a residue during filtration




4. The following apparatus was used to separate a mixture of three miscible liquids, **P**, **Q** and **R**. The boiling points of the three liquids are  $80^{\circ}\text{C}$ ,  $53^{\circ}\text{C}$  and  $108^{\circ}\text{C}$  respectively.



Which graph correctly indicates the thermometer reading when the mixture is heated from room temperature to  $80^{\circ}\text{C}$ ?



- (i) It has a charge of +1.
- (ii) It has a nucleon number of four.
- (iii) It has a proton number of three.

 = an atom of P  
 = an atom of Q  
 = an atom of R

7. What is the formula of the compound?

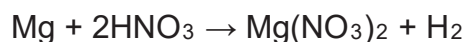
- A**  $PQ_3PQ_2RPQ_3$                       **B**  $Q_3P_9R$   
**C**  $QP_3QP_2RQP_3$                       **D**  $Q_3P_6R_3$

8. What is the relative molecular mass of the compound given the new key as shown below?

Key:



- A** 60    **B** 61  
**C** 90    **D** 126
- 9.** What is the ionic equation of the chemical reaction between sodium hydroxide and hydrochloric acid?
- A**  $\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$   
**B**  $\text{NaOH} (\text{aq}) + \text{HCl} (\text{aq}) \rightarrow \text{NaCl} (\text{aq}) + \text{H}_2\text{O} (\text{l})$   
**C**  $\text{Na}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{NaOH} (\text{aq})$   
**D**  $\text{H}^+ (\text{aq}) + \text{Cl}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$
- 10.** Magnesium reacts with dilute nitric acid to form a salt and hydrogen gas. The chemical equation is shown below.



What is the mass of magnesium nitrate formed with 96 g of magnesium metal?

- A** 24 g                      **B** 148 g  
**C** 444 g                  **D** 592 g

- 13.** The diagram below shows an outline of the Periodic Table.

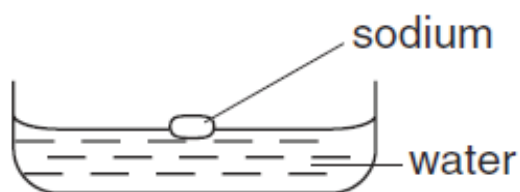
[illegible]

Which two elements have similar chemical properties?

- A** X and W                      **B** V and X  
**C** Y and Z                      **D** W and Y



14. When sodium reacts with water, a solution and a gas are produced.



The solution is tested with litmus papers and the gas is tested with a splint. What are the expected observations?

	litmus paper	splint
<b>A</b>	blue to red	glowing splint relights
<b>B</b>	blue to red	lighted splint "pops"
<b>C</b>	red to blue	glowing splint relights
<b>D</b>	red to blue	lighted splint "pops"

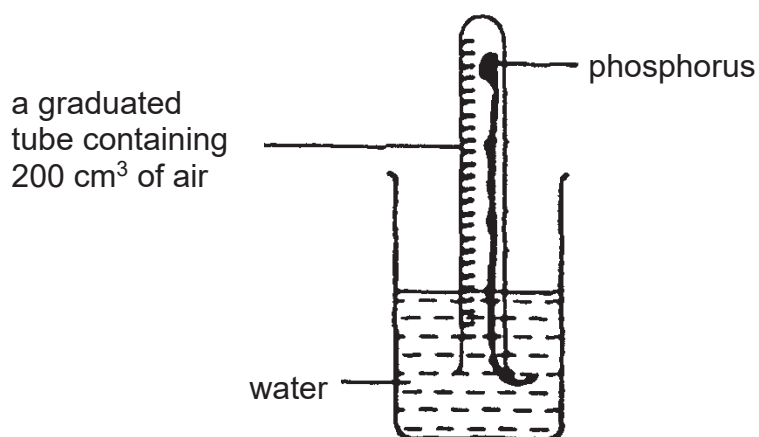
15. Which is the correct statement for both chlorine and iodine?

- A** They are diatomic molecules.
- B** They are gases at room temperature and pressure.
- C** They are colourless liquids.
- D** They are very soluble in water.

16. Which is the main constituent of natural gas?

- A** oxygen
- B** ethane
- C** methane
- D** nitrogen

17. Carbon monoxide is a pollutant emitted from car exhausts. Which property makes it harmful to humans?
- A It has no colour, taste or smell.
  - B It irritates the eyes.
  - C It forms a stable compound with blood.
  - D It combines with haemoglobin in the blood.
18. An apparatus is used to measure the percentage of oxygen in air. Phosphorus reacts with oxygen in the air to form phosphorus(V) oxide.



The initial volume of air in the tube is 200 cm<sup>3</sup>. What is the volume of gas remaining in the apparatus after the reaction?

- A 42 cm<sup>3</sup>
- B 100 cm<sup>3</sup>
- C 158 cm<sup>3</sup>
- D 200 cm<sup>3</sup>

19. Which list shows a homologous series?

<b>A</b>	
<i>name</i>	<i>formula</i>
ethane	C <sub>2</sub> H <sub>6</sub>
propane	C <sub>3</sub> H <sub>8</sub>
butane	C <sub>4</sub> H <sub>10</sub>

<b>B</b>	
<i>name</i>	<i>formula</i>
ethane	C <sub>2</sub> H <sub>6</sub>
propene	C <sub>3</sub> H <sub>6</sub>
butene	C <sub>4</sub> H <sub>8</sub>

<b>C</b>	
<i>name</i>	<i>formula</i>
lithium	Li
sodium	Na
potassium	K

<b>D</b>	
<i>name</i>	<i>formula</i>
water	H <sub>2</sub> O
ice	H <sub>2</sub> O
steam	H <sub>2</sub> O

20. A student investigated the reaction of vegetable oils with hydrogen. 100 cm<sup>3</sup> of hydrogen was bubbled through 1 g samples of four different vegetable oils. The volume of hydrogen remaining after each experiment was recorded.

vegetable oil	volume of hydrogen remaining/ cm <sup>3</sup>
<b>P</b>	100
<b>Q</b>	87
<b>R</b>	63
<b>S</b>	0

Which vegetable oil(s) is / are unsaturated?

**A** P, Q and R only

**B** Q and R only

**C** Q, R and S only

**D** S only

- End of Paper 3 -

Name: ..... ( ) Class: .....

**ASSUMPTION ENGLISH SCHOOL  
PRELIMINARY EXAMINATION 2018**

**SCIENCE (CHEMISTRY)**

**5105 / 04**

**5107 / 04**



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**LEVEL:** Sec 4 Normal (Academic)

**DATE :** 1 August 2018

**CLASSES:** Sec 4/3, 4/4

**DURATION:** 1 hour 15 minutes  
(Papers 3 & 4)

---

Additional Materials provided: NIL

---

**INSTRUCTIONS TO CANDIDATES**

**Do not open this booklet until you are told to do so.**

Write your NAME, INDEX NUMBER and CLASS at the top of this page.

Write in dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams or graphs.

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

Answer **all** questions in Section A and any **two** questions in Section B.

Enter the numbers of the Section B questions you have answered  
on the dotted lines in the grid below.

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 the last page of  
Paper 4.

For Examiner's Use	
Paper 3	20
Section A	14
Section B	16
Total	50

At the end of the examination, hand in your OAS paper and Question Papers separately.

The number of marks is given in brackets [ ] at the end of each question or part question.

---

**This question paper consists of 13 printed pages including this page.**

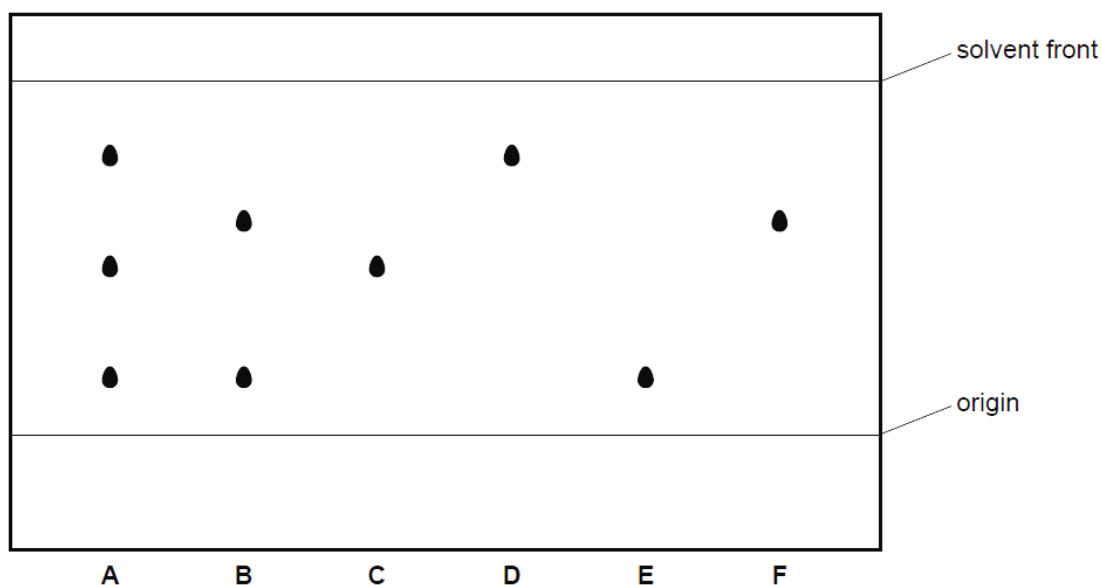
**[Turn over**

### Section A [14 marks]

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

- 1 The diagram shows the results of an experiment to separate and identify the colours present in two paints, **A** and **B**.

Substances **C**, **D**, **E** and **F** are single colours.



- (a) State one difference and one similarity between paints **A** and **B**.

Difference: .....

.....

Similarity: .....

.....

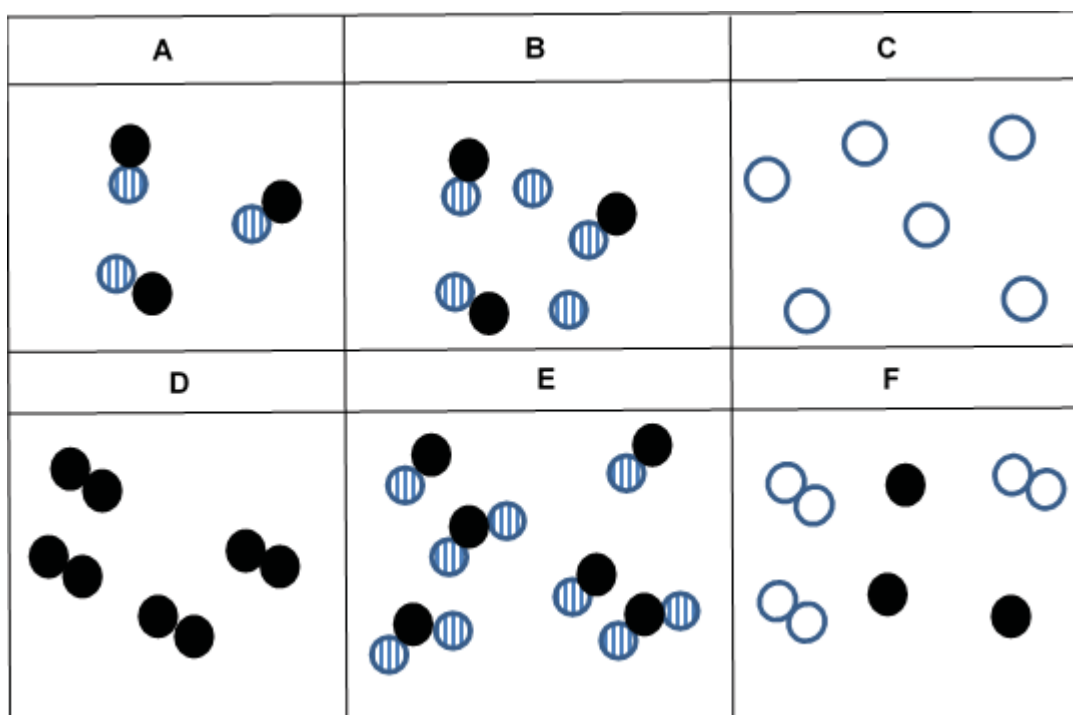
[2]

- (b) Which coloured substances are present in paint **A**?

.....

[1]

2 The diagrams below show elements, compounds and mixtures.



State the letter(s) for the diagram(s) which matches the descriptions below.

(a) an element ..... [1]

(b) a mixture of an element and a compound ..... [1]

- 3 In industries, magnesium oxide is used to line the interior of machines as it is heat resistant.

(a) In the space below, draw a dot-and-cross diagram to represent magnesium oxide, showing all electrons.

[2]

(b) With reference to its structure and bonding, explain why magnesium oxide is used to line the interior of machines.

.....  
 .....  
 .....

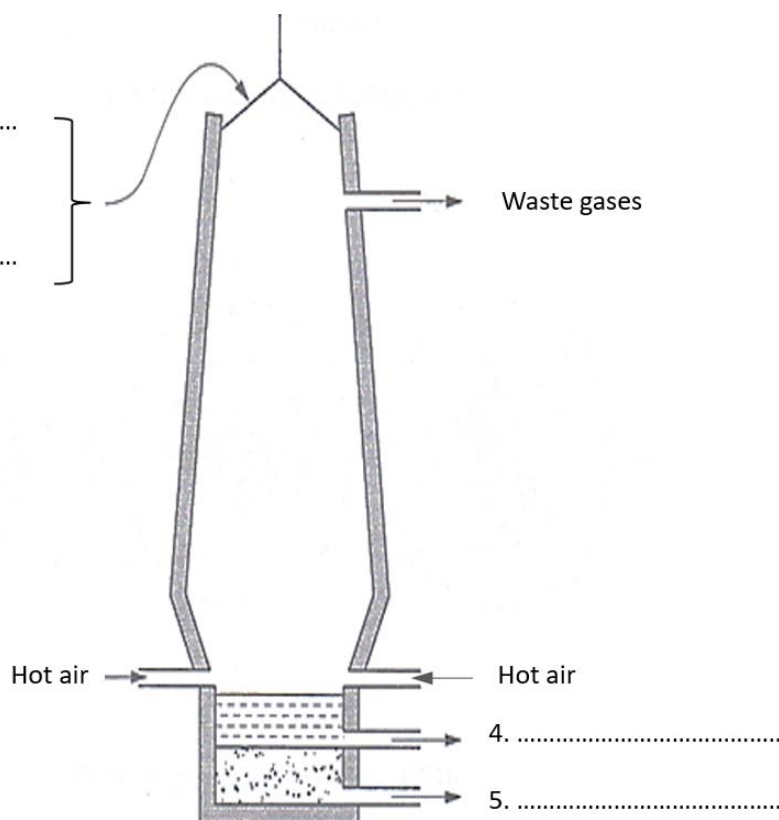
[2]

- 4 Iron is extracted from its ore in a Blast Furnace.

(a) Complete the labels in the figure below.

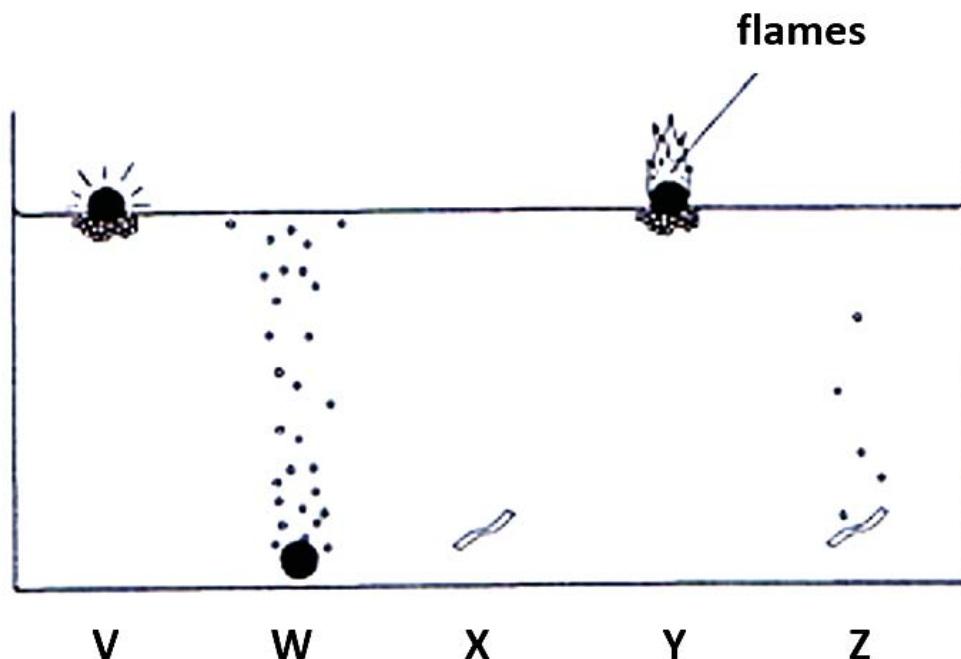
**Raw materials**

1. ....  
 2. Coke  
 3. ....



[2]

- (b) Five metals – **V**, **W**, **X**, **Y** and **Z**, are placed in a trough of cold water. The results observed are shown in the diagram below.



- (i) Complete the table to identify metals **V**, **W**, **X**, **Y** and **Z**.

metal	letter <b>V</b> , <b>W</b> , <b>X</b> , <b>Y</b> or <b>Z</b>
calcium	
copper	
magnesium	
potassium	
sodium	

[2]

- (ii) Write a balanced chemical equation for the reaction between sodium and cold water.

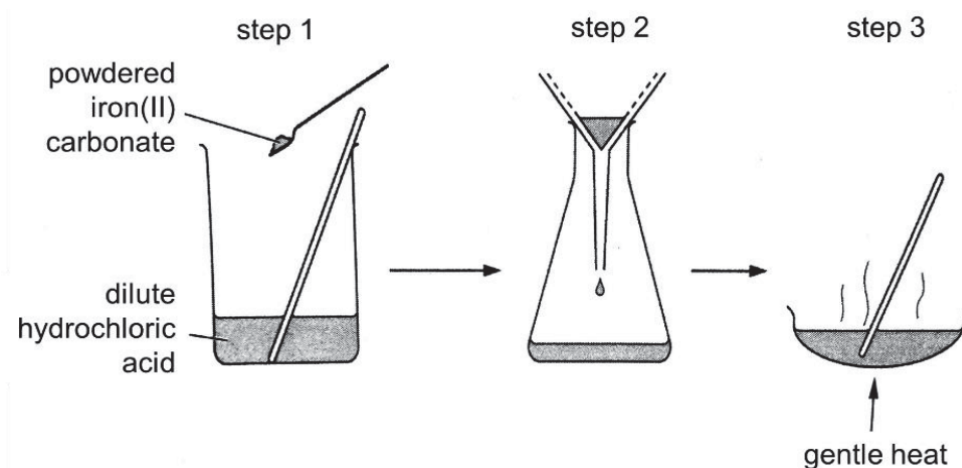
..... [1]



### Section B [16 marks]

Answer any **two** questions from this section in the spaces provided.

- 5** Iron(II) chloride can be made by reacting with dilute hydrochloric acid with an excess of powdered iron(II) carbonate.



- (a)** Explain why an excess of iron(II) carbonate has to be used.

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

- (b)** In the reaction between iron(II) carbonate and dilute hydrochloric acid, a gas is produced.

Name the gas and describe a positive test to identify the gas.

Name of gas: .....

Test for gas: .....

Observation: ..... [2]

- (c)** The liquid from step 3 is allowed to stand for some time to allow crystals to grow.

Describe the subsequent steps that are needed in order to obtain a dry sample of the iron(II) chloride crystals.

.....  
 .....  
 ..... [2]

- (d) Explain why crystallisation is not a necessary step for obtaining the dry salt of silver chloride.

.....

..... [1]

- (e) An article describes the method of making iced-coffee (cold-brew).

*“Cold-brew involves soaking coffee beans in room-temperature water over a long time to extract the coffee. It is then distilled and served over ice. It removes the need to use hot water to extract coffee, which tends to “bring out” the acids in coffee beans. Some people prefer the absence of the sour taste in such coffees.”*

Describe a simple method that can be used to verify the claim that cold-brew method produces coffee that is less acidic.

.....

.....

..... [2]

- 6 (a) Bronze is made up of two different metals. It consists of 88% copper and 12% tin.

(i) What is the name given to a mixture of metals?

..... [1]

(ii) Using the arrangement and structure of the atoms, explain why bronze is used to make statues and medals rather than using pure copper or pure tin.

.....  
.....  
..... [2]

(iii) In the box below, draw the arrangement of the atoms in bronze.



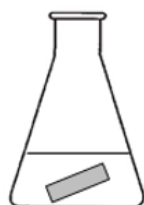
○ copper atom

● tin atom

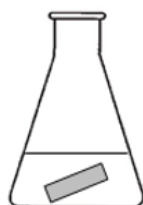
[1]

- (b) Three conical flasks labelled **A**, **B** and **C** were each filled with 50 cm<sup>3</sup> of dilute hydrochloric acid.

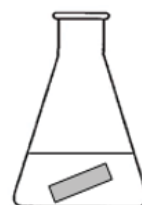
10 g of metals **X**, **Y** and **Z** were placed in the respective conical flasks as shown below.



**Flask A**  
Metal **X** in 50 cm<sup>3</sup> of  
dilute hydrochloric acid



**Flask B**  
Metal **Y** in 50 cm<sup>3</sup> of  
dilute hydrochloric acid



**Flask C**  
Metal **Z** in 50 cm<sup>3</sup> of  
dilute hydrochloric acid

After 5 minutes, the metals **X**, **Y** and **Z** were removed from the conical flasks. The metals were dried and weighed. The masses of the metals before and after placing in the conical flasks were recorded in the table below.

	Mass of <b>X</b> / g	Mass of <b>Y</b> / g	Mass of <b>Z</b> / g
<b>before</b>	5.0	5.0	5.0
<b>after</b>	2.4	5.0	3.6

- (i) Arrange the metals **X**, **Y** and **Z** in decreasing order of reactivity.

..... [1]

- (ii) Suggest a possible identity for metal **Y**. Explain your answer.

.....  
..... [2]

- (iii) If **Z** is zinc, construct a balanced chemical equation between **Z** and dilute hydrochloric acid.

..... [1]

7 Crude oil can be separated into various fractions through fractional distillation.

(a) Which fraction has the lowest boiling point?

..... [1]

(b) The molecular formula of one of the hydrocarbons present in the various fractions is propene,  $C_3H_6$ .

(i) Draw the structural formula of propene.

[1]

(ii) Propene undergoes a reaction with hydrogen. State the name of this type of reaction and describe the conditions required for the reaction to take place.

Name of reaction: .....

Conditions required: ..... [2]

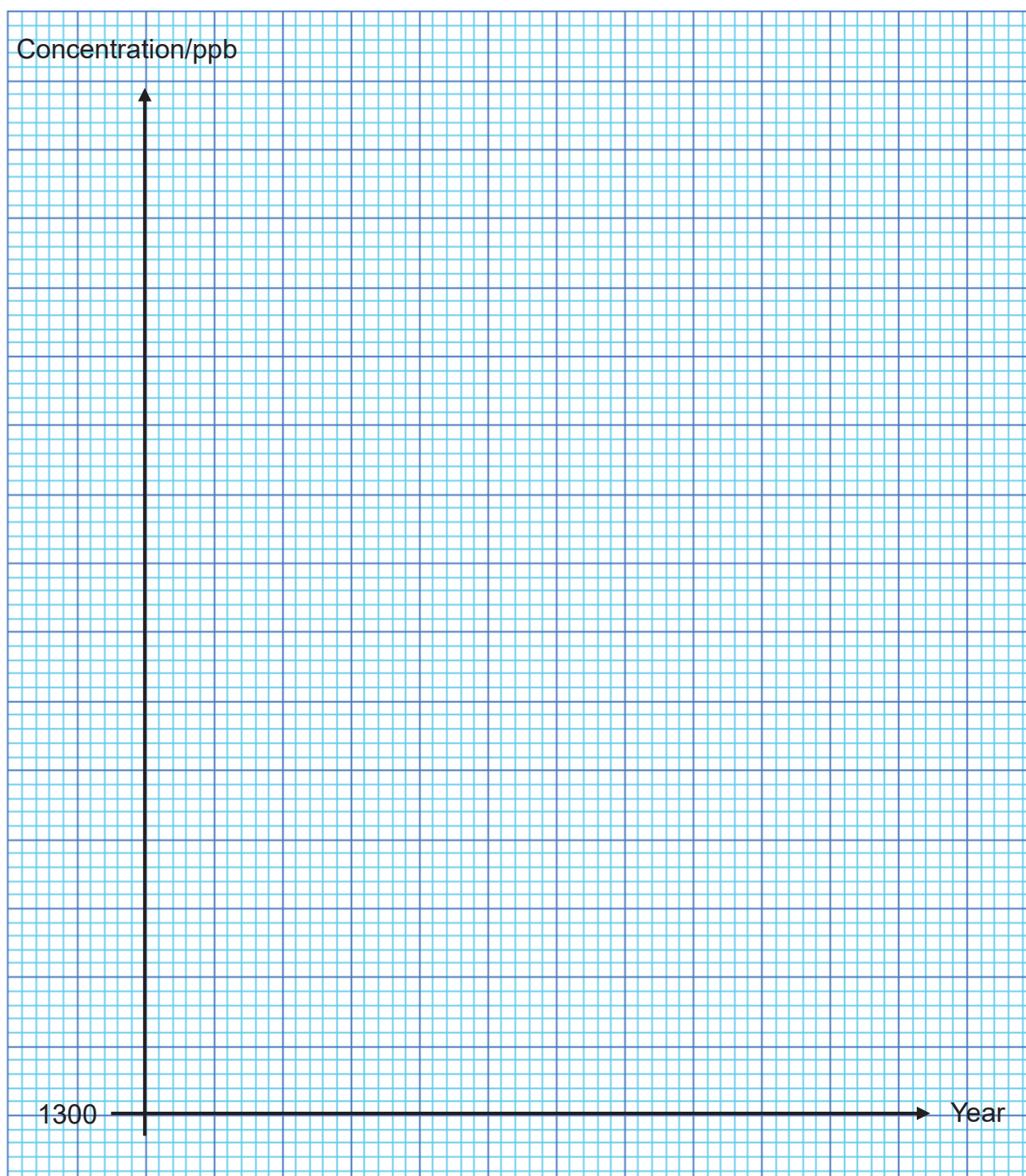
(c) Unburnt hydrocarbons can get into the air from the incomplete combustion of fossil fuels.

The table below shows the concentration of hydrocarbons in the air in a city from 2007 to 2011. The concentration is measured in parts per billion (ppb).

year	concentration / ppb
2007	1930
2008	1650
2009	1670
2010	1550
2011	1410

- (i) Plot a graph of concentration of hydrocarbons in the air against the year based on the data provided in the table.

Draw a line of best fit for your plotted points.



[2]

- (ii) Describe, using the information from the graph, the general trend of the concentrations of hydrocarbons in the air over the years.

.....

..... [2]

**- End of Paper 4 -**

1300

## The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		<div>Key</div> <div>proton (atomic) number atomic symbol name relative atomic mass</div>															
3 Li lithium 7	4 Be beryllium 9											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											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 -		

2  
He  
helium  
4

### Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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
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 –

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



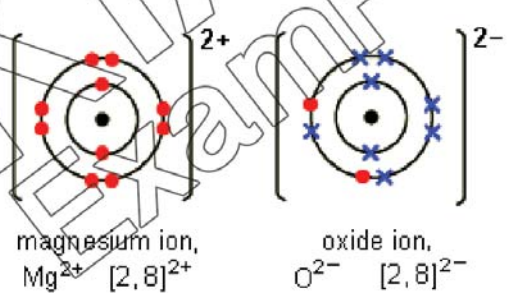


**ASSUMPTION ENGLISH SCHOOL  
PRELIMINARY EXAMINATION 2018  
SCIENCE (CHEMISTRY)**

**Paper 3**

1	2	3	4	5	6	7	8	9	10
D	C	C	B	D	B	C	A	A	D
11	12	13	14	15	16	17	18	19	20
A	A	D	D	A	C	D	C	A	C

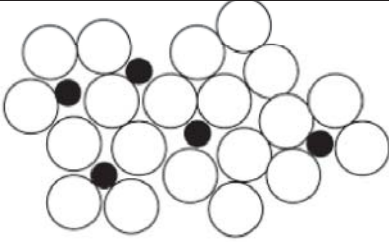
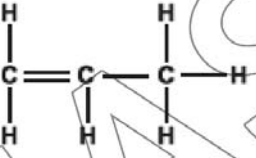
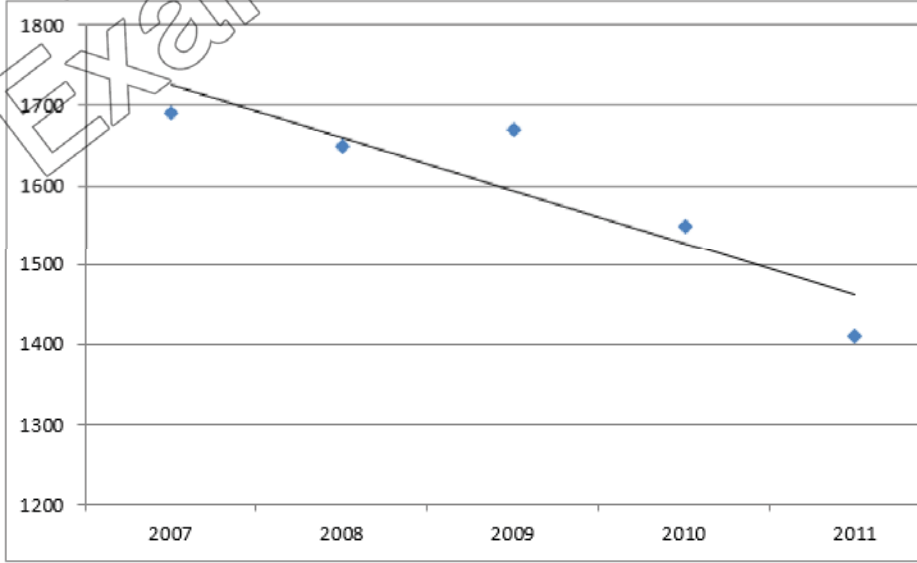
**Paper 4 – Section A**

1	(a)	<p><u>Difference:</u></p> <ul style="list-style-type: none"> <li>•Paint A is made up of 3 colours whereas Paint B is made up of 2 colours.</li> <li>•Paint A is made up of colours C and D which are not found in Paint B.</li> <li>•Paint B contains colour F which is not found in Paint A.</li> </ul> <p><u>Similarity:</u></p> <ul style="list-style-type: none"> <li>•Both Paints A and B both contain colour E.</li> </ul> <p><b>1 difference: [1]</b> <b>1 similarity: [1]</b></p>	
	(b)	Coloured substances C, D and E.	[1]
2	(a)	C, D	[1]
	(b)	B	[1]
3	(a)	 <p>Correct electron diagram of Magnesium cation: [1] Correct electron diagram of Oxide anion: [1]</p>	
	(b)	<p>Magnesium oxide has <u>strong electrostatic forces of attraction between oppositely-charged ions</u> which require <u>large amount of heat energy to overcome it</u>. Therefore, it has a high melting point and can withstand high temperatures.</p>	[1] [1]

4	(a)	1. Limestone / Calcium carbonate 3. Haematite / Iron(III) oxide 4. Molten slag 5. Molten iron  <b>Every 2 correct labels: [1]</b> <b>Total: [2]</b>													
	(b)	(i)	<table><tr><th>metal</th><th>letter V, W, X, Y or Z</th></tr><tr><td>calcium</td><td>W</td></tr><tr><td>copper</td><td>X</td></tr><tr><td>magnesium</td><td>Z</td></tr><tr><td>potassium</td><td>Y</td></tr><tr><td>sodium</td><td>V</td></tr></table> <b>5 correct: [2]</b> <b>3 – 4 correct: [1]</b> <b>0 – 2 correct: [0]</b>	metal	letter V, W, X, Y or Z	calcium	W	copper	X	magnesium	Z	potassium	Y	sodium	V
metal	letter V, W, X, Y or Z														
calcium	W														
copper	X														
magnesium	Z														
potassium	Y														
sodium	V														
	(ii)	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$		[1]											

**Paper 4 – Section B**

4	(a)	To ensure that all the acid has been reacted.	[1]
	(b)	Name of gas: carbon dioxide gas	[1]
		Test for gas: Bubble the gas through limewater. A white precipitate is formed.	[1]
	(c)	1. Filter the mixture to remove crystals. 2. Wash the crystals with a little distilled water. 3. Dry the crystals between sheets of filter paper.  <b>3 correct steps: [2]</b> <b>2 correct steps: [1]</b> <b>0-1 correct step: [0]</b>	
	(d)	Silver chloride is already an insoluble salt and can be obtained by filtration.	[1]
	(e)	<u>Method 1: Use of universal indicator solution / paper</u>  The cold-brew coffee will show a yellow colour while the hot brew coffee will show an orange colour.  <u>Method 2: Use of a pH meter</u>  The pH of the cold-brew coffee will be higher than that of a hot brew coffee.  <b>Method used: [1]</b> <b>Expected results: [1]</b>	

5	(a)	(i)	Alloy	[1]
		(ii)	In an alloy, the <u>atoms of different metals have different sizes</u> , leading to a disorderly arrangement.  When <u>a force is applied</u> , the atoms of different sizes <u>cannot slide over each other easily</u> .  This makes bronze stronger and harder than pure copper or pure tin.	[1]  [1]
		(iii)		[1]
	(b)	(i)	X, Z, Y	[1]
		(ii)	Y is copper / silver / gold / platinum.  Y is an <u>unreactive metal</u> as it <u>did not react</u> with dilute hydrochloric acid.	[1]  [1]
		(iii)	$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$	[1]
6	(a)		Petroleum gas	[1]
	(b)	(i)		[1]
		(ii)	Name of reaction: Hydrogenation / Addition reaction with hydrogen  Conditions required: 200°C, Nickel catalyst	[1]  [1]
	(c)	(i)	  Correct plotted points and axis: [1] Best-fit line: [1]	

		(ii)	There is an overall decrease in the concentration of hydrocarbons from 1930 ppb to 1410 ppb.	[1]
			There is a slight increase in the concentration of hydrocarbons from 2008 to 2009.	[1]

KIASU  
Exampaper



NAME:		INDEX NO:		CLASS:	
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**NORTHLAND SECONDARY SCHOOL  
PRELIMINARY EXAMINATION  
Secondary Four Normal Academic**

**SCIENCE CHEMISTRY**

**5105/5107**

**Paper 3**

**14 August 2018**

Additional Materials: OTAS

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

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, index number and class on the work you hand in.

There are **twenty** questions on this paper. Answer **all** questions.

For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS Sheet.

Answers to Paper 3 and Paper 4 must be handed in separately.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised to spend no more than **30 minutes** on **Paper 3**.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 10.

The use of an approved scientific calculator is expected, where appropriate.

**Setter: Miss Haw Yubin**

**Vetter: Mdm Kumari**

This document consists of **10** printed pages including the cover page.

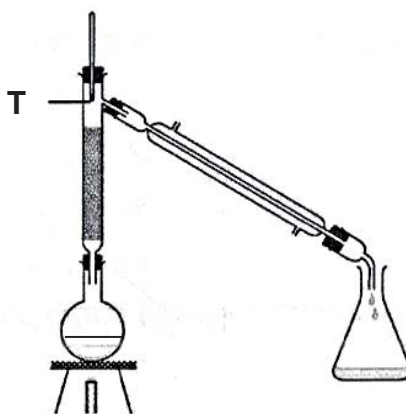
**[Turn over**

- 1 A solid is thought to be pure benzoic acid.

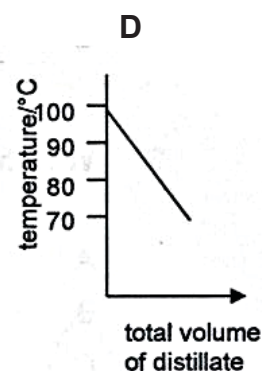
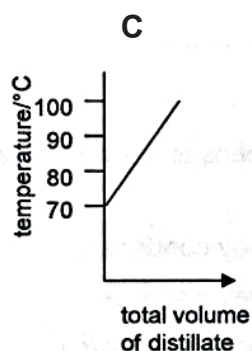
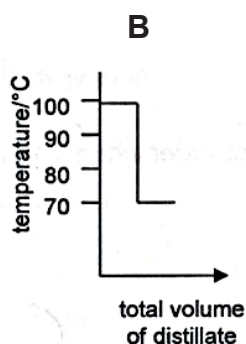
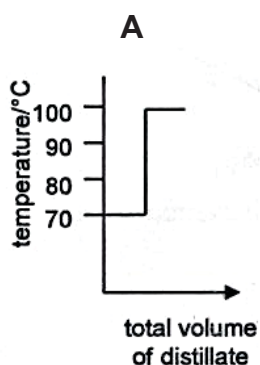
Which of the following is the best way to test its purity?

- A Determine its density and compare it with the actual value.
- B Determine its melting point.
- C Measure its pH.
- D Weigh it, burn it in oxygen, and then weigh the products.

- 2 The diagram shows the apparatus used to separate hexane (boiling point  $70^{\circ}\text{C}$ ) and heptane (boiling point  $98^{\circ}\text{C}$ ).



Which graph would be obtained if the temperature at point T was plotted against the total volume of distillate collected?





- 3 The table gives data about four substances.

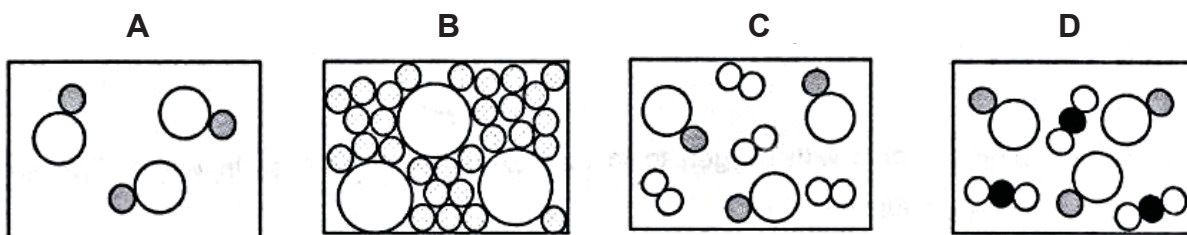
In which substance are the particles arranged randomly at room temperature?

	melting point/°C	boiling point/°C
<b>A</b>	-120	-10
<b>B</b>	10	40
<b>C</b>	650	1500
<b>D</b>	1800	2400

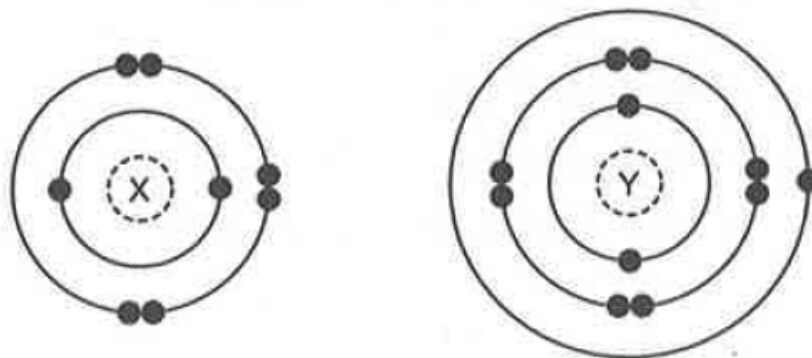
- 4 Which properties of a neutron are correct?

	relative charge	relative mass
<b>A</b>	-1	$\frac{1}{1836}$
<b>B</b>	0	$\frac{1}{1836}$
<b>C</b>	0	1
<b>D</b>	+1	1

- 5 Which diagram represents a mixture of an element and a compound?



- 6 The electronic structures of two atoms **X** and **Y** are shown.

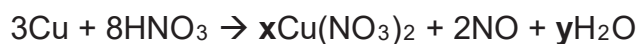


**X** and **Y** combine together to form a compound.

Which row describes the type of bonding and the formula of the compound?

	type of bonding	formula
<b>A</b>	covalent	$\text{YX}_2$
<b>B</b>	covalent	$\text{Y}_2\text{X}$
<b>C</b>	ionic	$\text{YX}_2$
<b>D</b>	ionic	$\text{Y}_2\text{X}$

- 7 Copper and nitric acid react together to form copper (II) nitrate, nitrogen monoxide and water as shown below.



What values for **x** and **y** balance the equation?

	<b>x</b>	<b>y</b>
<b>A</b>	3	4
<b>B</b>	3	8
<b>C</b>	4	3
<b>D</b>	4	8

8 Two statements about isotopes are given.

1 Isotopes of the same element have the same number of protons.

2 Isotopes of the same element have the same nucleon number.

Which of the following is true?

**A** Both statements are correct and statement 2 explains statement 1.

**B** Both statements are correct but statement 2 does not explain statement 1.

**C** Statement 1 is correct but statement 2 is not correct.

**D** Statement 2 is correct but statement 1 is not correct.

9 The oxide of an element **P** was added separately to sulfuric acid and aqueous sodium hydroxide.

The word equations for the reactions are shown.

**P** oxide + sulfuric acid → **P** sulfate + water

**P** oxide + sodium hydroxide → no reaction

Which row describes **P** and its oxide?

	<b>P</b>	<b>P</b> oxide
<b>A</b>	metal	acidic
<b>B</b>	metal	basic
<b>C</b>	non-metal	acidic
<b>D</b>	non-metal	amphoteric

- 10 A student tests four different solutions with Universal Indicator.

solution	W	X	Y	Z
colour with Universal Indicator	blue	violet	green	red

What are the pH values of the four solutions?

	W	X	Y	Z
A	2	7	4	1
B	4	8	9	5
C	9	13	7	2
D	12	14	5	8

- 11 Flowers of a hydrangea bush are blue when grown in acidic soil and pink when the soil is alkaline.

Which substance should be added to the soil of a hydrangea with blue flowers so that it produces pink flowers?

- A calcium hydroxide
  - B calcium sulfate
  - C hydrochloric acid
  - D sodium chloride
- 12 Element X is a solid at room temperature.  
It needs to lose one electron per atom to gain the electronic structure of a noble gas.  
It has the least reactivity with water in its group.

What is X?

- A astatine
- B caesium
- C fluorine
- D lithium

**13** Four elements have the following electronic configurations.

**P 2.8.1**

### Q 2.8.2

## R 2.8.6

### S 2.8.8

Which statement is correct?

**A** All four elements are in the same group in the Periodic Table.

**B** All four elements are in the same period in the Periodic Table.

**C** **P** is a metal, but **Q**, **R** and **S** are non-metals.

**D**    **Q** is a metal, but **P**, **R** and **S** are non-metals.

**14** What is a property of all metals?

**A** They are soluble in water.

**B** They conduct electricity.

**C** They have high melting points.

**D** They react with dilute sulfuric acid.

**15** Part of the Periodic Table is shown.

A blank periodic table grid is shown. The grid consists of 18 columns and 6 rows. The elements are marked as follows:

- W** is located in the second row, second column.
- X** is located in the first row, fifteenth column.
- Y** is located in the third row, fifteenth column.
- Z** is located in the first row, eighteenth column.

There is an additional empty box located above the main grid, centered between the fourth and sixth columns.

Which two elements can react with iron (II) chloride separately to undergo a displacement reaction?

## A W and X

**B**      **W** and **Y**

**C**      **X and Y**

## D Z and X

- 16** The table gives the relative concentrations of polluting gases in the air in four different cities.

In which city are limestone buildings most threatened by air pollution?

	sulfur dioxide	nitrogen dioxide	methane
<b>A</b>	16	45	23
<b>B</b>	32	33	30
<b>C</b>	38	40	10
<b>D</b>	46	14	25

- 17** Kerosene, lubricating oil and naphtha are three fractions obtained when crude oil is distilled.

Which of the following is the correct order for their boiling points?

	lowest	→	highest
<b>A</b>	kerosene	lubricating oil	naphtha
<b>B</b>	kerosene	naphtha	lubricating oil
<b>C</b>	lubricating oil	kerosene	naphtha
<b>D</b>	naphtha	kerosene	lubricating oil

- 18** Two gases, **X** and **Y**, have the following properties.

- **X** dissolves in aqueous sodium hydroxide but **Y** is insoluble.
- **Y** burns in excess oxygen to give **X** and water only.
- **Y** does **not** decolourise aqueous bromine.

What are gases **X** and **Y**?

	<b>X</b>	<b>Y</b>
<b>A</b>	carbon dioxide	ethane
<b>B</b>	carbon dioxide	ethene
<b>C</b>	carbon monoxide	ethane
<b>D</b>	carbon monoxide	ethene

- 19** A student investigated the reaction of vegetable oils with hydrogen. 100 cm<sup>3</sup> of hydrogen was bubbled through 1 g samples of four different vegetable oils containing a suitable catalyst.

The volume of hydrogen remaining after each experiment was recorded.

vegetable oil	volume of hydrogen remaining/cm <sup>3</sup>
<b>P</b>	100
<b>Q</b>	85
<b>R</b>	61
<b>S</b>	0

Which vegetable oil(s) is/are unsaturated?

- A** P, Q and R
- B** Q and R only
- C** Q, R and S
- D** S only
- 20** A hydrocarbon, C<sub>16</sub>H<sub>34</sub>, is broken down during the process of cracking to produce ethene, another hydrocarbon **X** and hydrogen.

The equation for the reaction is shown.



Which row describes hydrocarbon **X**?

	formula of <b>X</b>	<b>X</b> belongs to the homologous series
<b>A</b>	C <sub>8</sub> H <sub>28</sub>	alkane
<b>B</b>	C <sub>8</sub> H <sub>16</sub>	alkene
<b>C</b>	C <sub>14</sub> H <sub>28</sub>	alkene
<b>D</b>	C <sub>14</sub> H <sub>30</sub>	alkane

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The volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).



NAME:

INDEX NO:

CLASS:



**NORTHLAND SECONDARY SCHOOL**  
**PRELIMINARY EXAMINATION**  
**Secondary Four Normal Academic**

**SCIENCE CHEMISTRY**

**5105/5107**

**Paper 4**

**14 August 2018**

Candidates answer on the Question Paper.  
 No Additional Materials are required.

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

**READ THESE INSTRUCTIONS FIRST**

Write your name, index number and class on the work you hand in.  
 Write in dark blue or black pen on both sides of the paper.  
 You may use an HB pencil for any diagrams or graphs.  
 Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions 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.  
 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.

SECTION		FOR EXAMINER'S USE
A		14
B		8
		8
TOTAL		30

**Setter: Miss Haw Yubin**

**Vetter: Mdm Kumari**

This document consists of **11** printed pages including the cover page.

**[Turn over**

## Section A

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

- 1 The table lists the number of protons, neutrons and electrons in several different particles.

particle (not chemical symbols)	number of protons	number of neutrons	number of electrons
<b>C</b>	1	0	1
<b>D</b>	3	3	2
<b>E</b>	7	7	7
<b>F</b>	8	9	8
<b>G</b>	8	10	8
<b>H</b>	9	10	10

Which of the particles, **C**, **D**, **E**, **F**, **G** and **H** in the table, fit each of the following descriptions?

- (a) an atom with a mass number of 19 ..... [1]
- (b) an atom with 5 electrons in its outer shell ..... [1]
- (c) an ion of a metal ..... [1]

**2** Sodium atom can form  $\text{Na}^+$  ions.

- (a) Describe, in terms of electrons, how a sodium atom becomes a sodium ion,  $\text{Na}^+$ .

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

- (b) Name the type of chemical bonding present in sodium oxide.

..... [1]

- (c) Draw a 'dot and cross' diagram to show the arrangement of all the electrons in a molecule of sodium oxide.

[2]

- 3 (a) Each element in Group VII consists of molecules which are diatomic.

Explain the meaning of *diatomic*.

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

- (b) All the elements in Group VII of the Periodic Table react with hydrogen.

Fluorine reacts in the dark, explosively, at very low temperatures. Chlorine reacts in the presence of sunlight, explosively, at room temperature. Bromine reacts in the presence of sunlight if heated to about 200°C.

Suggest **two** conditions needed for iodine to react with hydrogen.

1. ....  
 2. .... [2]

- (c) Describe an observation that could be made when aqueous bromine is added to potassium iodide solution.

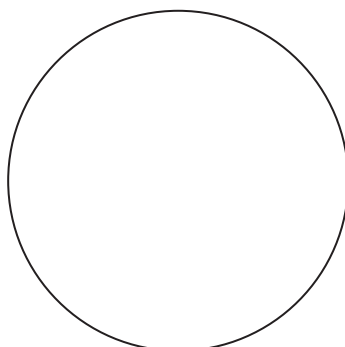
.....  
 ..... [1]

- 4 (a) State why coating iron with grease prevents iron from rusting.

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

- (b) Using the circle below, sketch a pie chart to show the percentage of each gas in the air.

Label each section with the name of the gas.

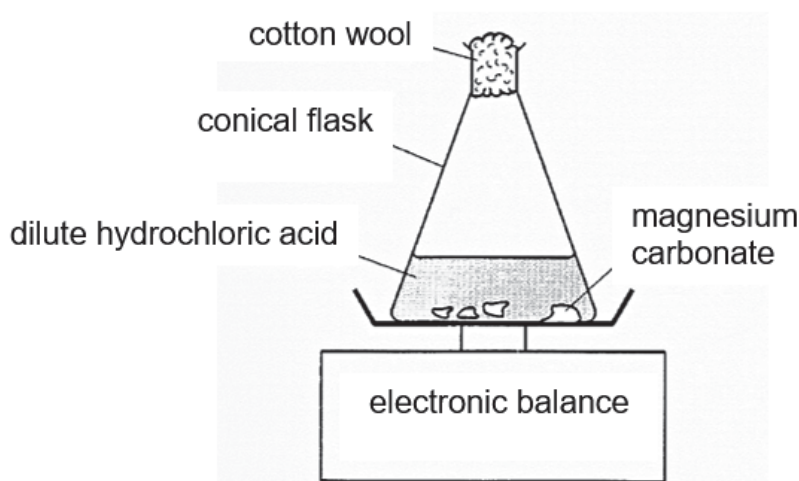


[2]

## Section B

Answer any **two** questions from this section in the spaces provided.

- 5 Emily investigated the reaction of magnesium carbonate,  $\text{MgCO}_3$ , with dilute hydrochloric acid,  $\text{HCl}$ .



- (a) (i) At the end of the experiment, a gas is given off.  
Name the gas and describe a positive test to identify the gas.

name of gas .....

positive test for gas .....

..... [1]

- (ii) A solution of a salt, magnesium chloride, is left at the end of the experiment.

Describe how you can obtain crystals of magnesium chloride from this solution.

.....

.....

.....

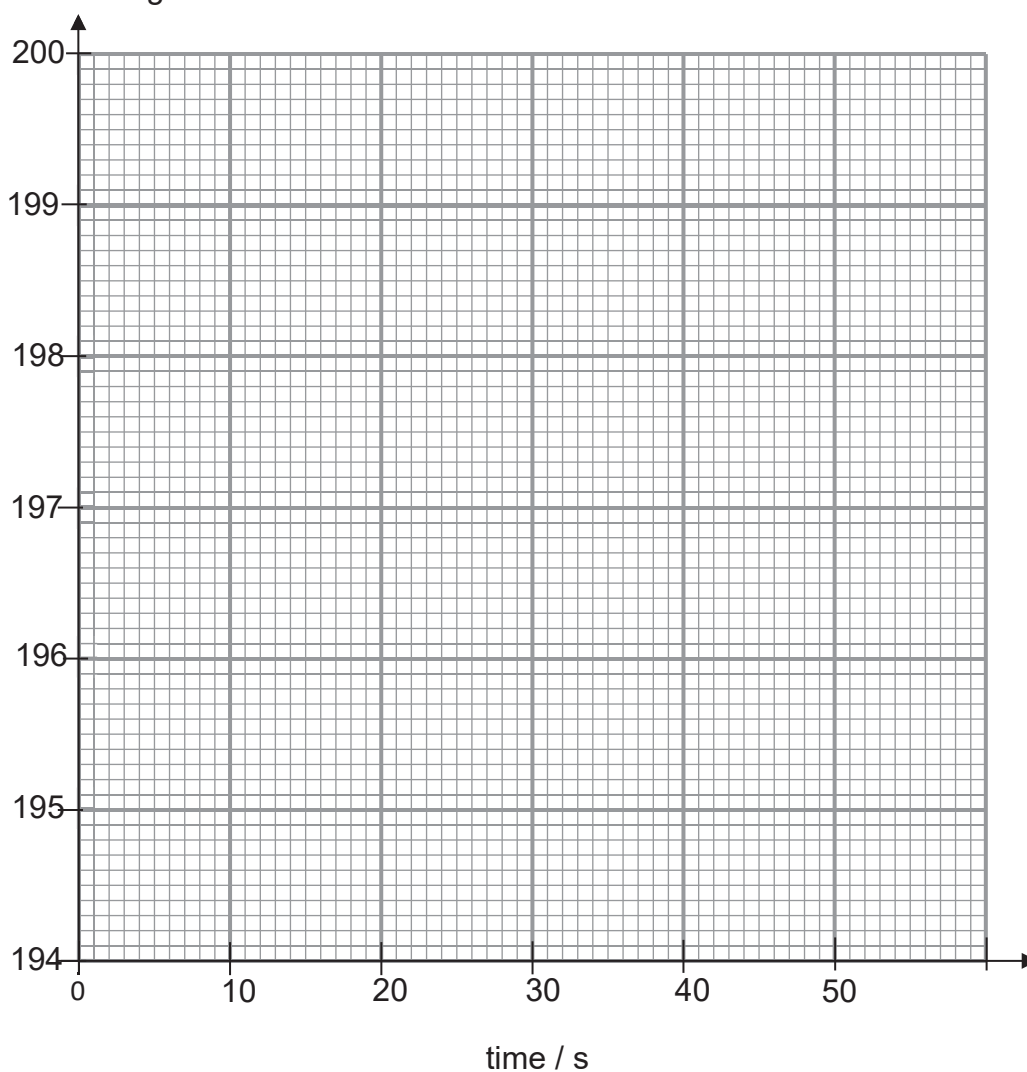
..... [2]

- (b) Emily measured the decrease in mass of the reaction mixture with time and recorded the readings obtained in the table.

time / s	0	10	20	30	40	50
mass of reaction mixture / g	200	198.5	196.5	196.2	196	196

- (i) Plot a graph of mass of the reaction mixture against the time taken, marking each point with a cross (x). [1]
- (ii) Draw a curved line of best fit, taking into account all your plotted points. [1]

Mass of reaction mixture / g



- (iii) Use your graph to determine the time in which the reaction stopped.

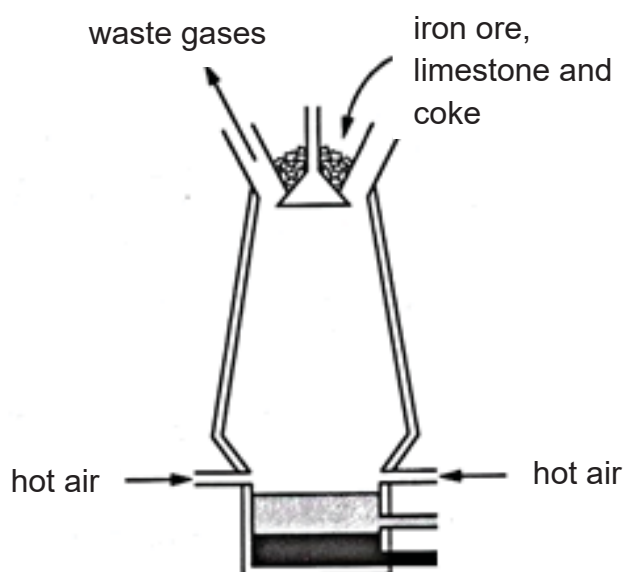
..... s [1]

- (c) At the start of the experiment there is 37.8 g of magnesium carbonate.

Calculate the amount of magnesium carbonate, in moles.  
[relative atomic masses, Ar: Mg, 24; C, 12; O, 16]

amount of magnesium carbonate = ..... mol [2]

- 6 (a) The diagram shows a blast furnace.



- (i) Suggest two gases likely to be present in the waste gases emitted from the blast furnace.

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

- (ii) Why is limestone used in the extraction of iron?

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

- (b) Cupronickel is an alloy of copper and nickel.

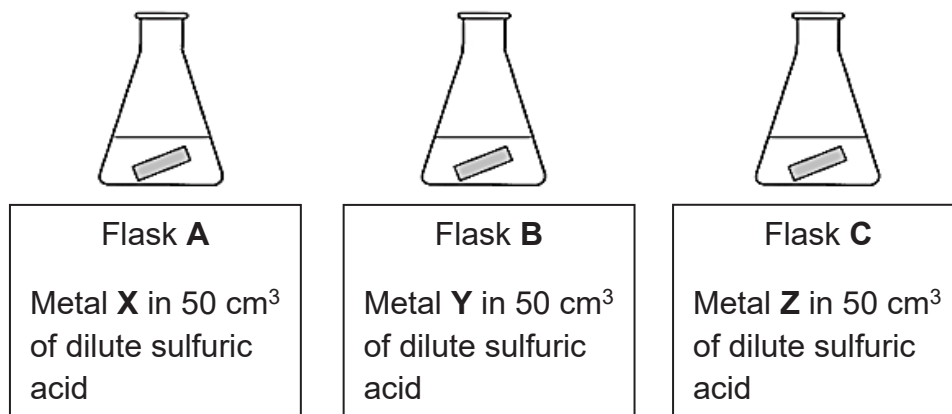
Explain why cupronickel is harder and stronger than pure copper.

.....  
 .....  
 .....  
 ..... [2]



- (c) Three conical flasks labelled **A**, **B** and **C** were each filled with 50 cm<sup>3</sup> of dilute sulfuric acid.

5.0 g of metals **X**, **Y** and **Z** were placed in the respective flasks as shown.



After 5 minutes, the metals were removed from the flasks. The metals were dried and weighed. The masses of the metals before and after placing in the flasks were recorded in the table below.

	mass of <b>X</b> / g	mass of <b>Y</b> / g	mass of <b>Z</b> / g
before	5.0	5.0	5.0
after	2.4	5.0	3.6

- (i) Place these metals in order of their reactivity.

most reactive  $\longrightarrow$  least reactive

--	--	--

[1]

- (ii) Suggest a possible identity for metal **Y**.

..... [1]

- (d) An element in Period 4 of the Periodic Table sinks when added to cold water. The element reacts slowly with water to produce hydrogen gas.

- (i) Identify the element.

..... [1]

- (ii) Write a balanced chemical equation for the reaction between cold water and the element named in (d) (i).

..... [1]

- 7 (a) Members of a homologous series show a gradation in physical properties with an increase in molecular size.

- (i) How does the boiling point of propane differ from the boiling point of ethane?

..... [1]

- (ii) Suggest a possible explanation for this difference.

.....  
 .....  
 .....  
 ..... [2]

- (b) Ethene, when added to hydrogen, will produce ethane.

- (i) Draw the full structural formula of ethene showing all the atoms and bonds present.

[1]

- (ii) State **two** conditions for the addition of hydrogen to ethene to take place.

1. ....  
 2. .... [1]

- (iii) Describe a test to distinguish between ethene and ethane.

test .....  
 .....  
 observation with ethene .....  
 .....  
 observation with ethane .....  
 ..... [3]

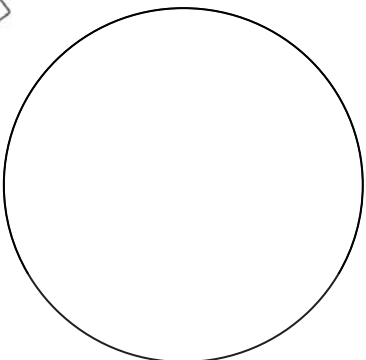
## 159

The volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).



2018 Secondary Four Normal Academic Science Chemistry  
Preliminary Examination Answer Scheme

1. B	2. A	3. A	4. C	5. C	6. D	7. A	8. C	9. B	10. C
11. A	12. D	13. B	14. B	15. A	16. C	17. D	18. A	19. C	20. B

1	(a)	H	1
	(b)	E	1
	(c)	D	1
2	(a)	A sodium atom loses one electron to become a sodium ion.	1
	(b)	Ionic bonding	1
	(c)		2
3	(a)	Diatomic means two atoms in a molecule	1
	(b)	In the presence of sunlight Heated to about 400°C	1 1
	(c)	The colourless potassium iodide solution turns brown.	1
4	(a)	It acts as a protective layer to prevent oxygen and water from getting into contact with the iron.	1
	(b)		2

5	(a) (i)	carbon dioxide; white precipitate is formed when carbon dioxide gas is present.	1
	(a) (ii)	Heat the solution to 1/3 of its original volume to form a saturated solution. Allow the solution to cool. Filter and wash the crystals with distilled water. Dry the crystals in between 2 sheets of filter paper.	1 1
	(b) (i) (b) (ii)		Plot all points correctly – 1 Shape of the graph – 1
	(b) (iii)	40	1
	(c)	$M_r = 84$ No of moles = $37.8 / 84 = 0.45 \text{ mol}$	1 1
6	(a) (i)	carbon monoxide, carbon dioxide and nitrogen (any two)	1
	(a) (ii)	Limestone is used to remove impurities.	1
	(b)	Cupronickel is an alloy containing atoms of different sizes. The <b>atoms of different sizes disrupts the orderly arrangement of atoms</b> . As a result, it is <b>difficult for the atoms to slide past</b> each other. But, for pure copper, it is made up of atoms of same size. This <b>ensures the orderly arrangement of atoms</b> and hence, it is <b>easier for the atoms to slide past</b> one another.	1 1

	(c) (i)	$X > Z > Y$	1
	(c) (ii)	Copper, silver, platinum (any one)	1
	(d) (i)	Calcium	1
	(d) (ii)	$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$	1
7	(a) (i)	The boiling point of propane is higher than the boiling point of ethane.	1
	(a) (ii)	From ethane to propane, the molecular size increases. As the molecular size increases, the <b><u>intermolecular forces of attraction between the molecules also increases</u></b> . Hence <b><u>more energy is needed to overcome the intermolecular forces of attraction between the molecules</u></b> .	1 1
	(b) (i)		1
	(b) (ii)	1. 200°C 2. Nickel catalyst	1
	(b) (iii)	Test: Add a few drops of aqueous bromine into a sample of ethene / ethane in the test tube.  Observation with ethene: Reddish brown aqueous bromine turns colourless.  Observation with ethane: Reddish brown aqueous bromine remains the same.	1  1  1





Name and Index Number:  (       )	Class:
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## SENG KANG SECONDARY SCHOOL PRELIMINARY EXAMINATION

**SCIENCE (CHEMISTRY)**

**5105/03**

**Secondary 4 Normal (Academic)**

**3 August 2018**

Paper 3 Multiple Choice

**Paper 3 & 4**

**1 hour 15 min**

Additional Materials: Multiple Choice Answer Sheet

### READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.  
You may use a soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **twenty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the Multiple Choice Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.  
Any rough working should be done in this question paper.  
The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page 8.

Parent's / Guardian's Signature: .....

This document consists of **8** printed pages and **0** blank page.

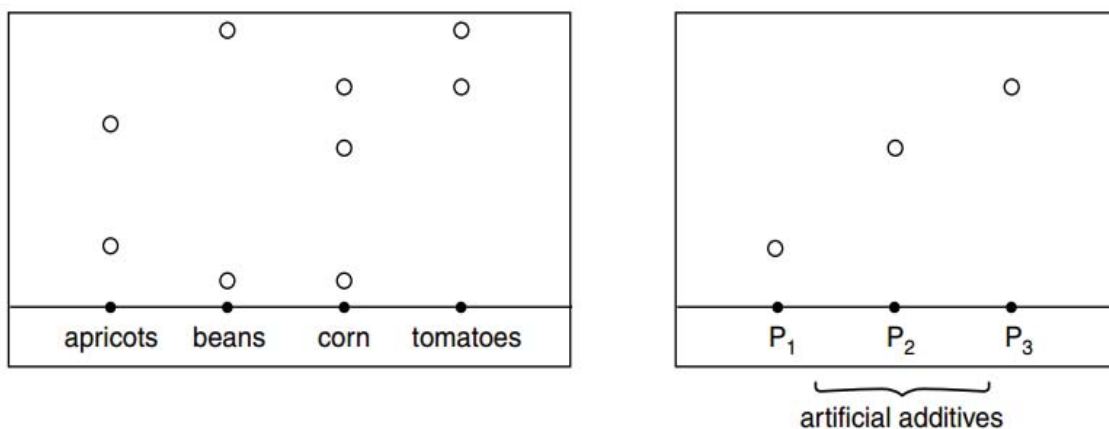
***Do not turn over the page until you are told to do so.***

- 1 Which apparatus would be most suitable to measure out  $25.50 \text{ cm}^3$  of solution?
- A beaker  
B burette  
C measuring cylinder  
D pipette
- 2 Which of the following statements correctly describes the states of substances I to IV at room temperature?

substance	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$
I	-30	69
II	-101	-35
III	-11	12
IV	98	890

- A Substance I is a gas.  
B Substance II is a solid.  
C Substance III is a gas.  
D Substance IV is a liquid.
- 3 Four samples of canned food, apricots, beans, corns and tomatoes, were tested for additives using chromatography. The chromatograms were compared with three artificial additives,  $P_1$ ,  $P_2$  and  $P_3$ .

The results were as follow.



Which canned food does **not** contain any artificial additives?

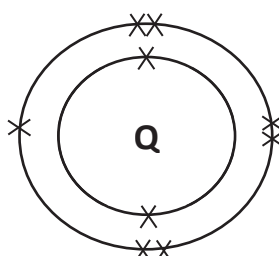
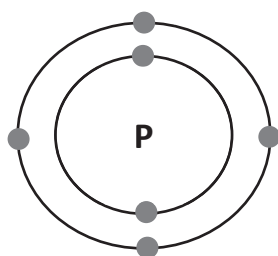
- A apricots      B beans      C corn      D tomatoes

- 4 An atom of element X has 5 neutrons and 4 protons.

Which of the particle is an isotope of element X?

particle	nucleon number	proton number
<b>A</b>	10	4
<b>B</b>	11	5
<b>C</b>	9	5
<b>D</b>	9	4

- 5 The electronic structures of atoms P and Q are shown.



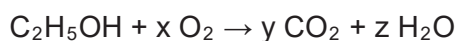
key

● = electron from P  
X = electron from Q

P and Q react to form a covalent compound. What is its formula?

- A** PQ<sub>2</sub>                      **B** PQ<sub>4</sub>                      **C** P<sub>2</sub>Q                      **D** P<sub>2</sub>Q<sub>5</sub>
- 6 How does molten sodium chloride conduct electricity?
- A** The movement of positive ions only.  
**B** The flow of mobile electrons.  
**C** The movement of sodium chloride molecules.  
**D** The movement of both negative and positive ions.

- 7 The equation shows the reaction that occurs when ethanol burns in air.



What values of x, y and z would balance the equation?

	x	y	z
<b>A</b>	2	2	2
<b>B</b>	3	2	3
<b>C</b>	3	2	2
<b>D</b>	3	3	2



- 10** A coal-burning heater is inefficient and badly sealed. The limestone walls near the heater are being gradually worn away.

Which gas, when escapes from the heater, causes the walls to be worn away?

- 11** Caesium is a Group I element.

What is the ionic equation for the reaction between caesium hydroxide and nitric acid?

- A**  $\text{Cs}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{CsNO}_3(\text{aq})$
- B**  $\text{CsOH}(\text{aq}) + \text{HNO}_3(\text{aq}) \rightarrow \text{CsNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- C**  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- D**  $\text{HNO}_3(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$

**12** An element Z is in Group VI of the Periodic Table. It reacts with oxygen to form an oxide.

- 1 The oxide formed dissolves in water to form an acid.
- 2 The oxide formed has a high boiling point.
- 3 The oxide formed reacts with hydrochloric acid.
- 4 The oxide formed reacts with sodium hydroxide.

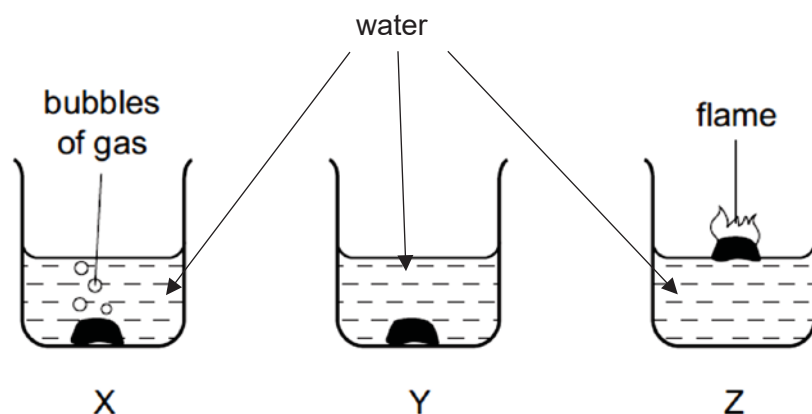
Which statement(s) is/are likely to be true of the oxide?

- A** 1 and 2 only  
**B** 1 and 4 only  
**C** 2 only  
**D** 2 and 3 only

**13** Which pair of substances could **not** be used in the preparation of copper(II) sulfate?

- A** copper and dilute sulfuric acid  
**B** copper(II) oxide and sulfuric acid  
**C** copper(II) carbonate and sulfuric acid  
**D** copper(II) hydroxide and sulfuric acid

**14** The results of adding samples of different metals to water are shown.



What could metals X, Y and Z be?

	X	Y	Z
<b>A</b>	calcium	copper	potassium
<b>B</b>	copper	calcium	potassium
<b>C</b>	potassium	calcium	copper
<b>D</b>	potassium	copper	calcium

- 15** Cars made of steel can be protected from rusting by painting.

How does paint prevent rusting?

- A** Paint reacts with the steel to form a stable compound.
- B** Paint reacts with the air to form a protective layer.
- C** Paint forms a barrier preventing the steel from reacting with oxygen and water.
- D** Oxygen reacts with the paint instead of with the steel.

- 16** Lithium and caesium are the first and fifth element in Group I of the Periodic Table.

Which of these statements is correct?

- A** They have the same number of electrons.
- B** Lithium has fewer electrons in the valence shell than caesium.
- C** Lithium has a higher melting point than caesium.
- D** Lithium reacts more vigorously with water than caesium.

- 17** The table shows the composition of exhaust gases from an internal combustion engine.

gas	% of the gas in the exhaust fumes
gas Y	71
carbon dioxide	14
water vapour	13
carbon monoxide	1
hydrocarbons	0.3
nitrogen oxides	0.2
sulfur dioxide	less than 0.003

What is gas Y most likely to be?

- A** ammonia
- B** argon
- C** chlorine
- D** nitrogen

- 18** How do the properties of alkanes change as their molecular masses increase?

- A** Their boiling points decrease.
- B** Their flammability decreases.
- C** They become more soluble in water.
- D** They evaporate more easily.

- 19 Some food are described as polyunsaturated.

What does polyunsaturated mean?

- A The molecules in the food are edible.
- B The molecules in the food contain many hydrogen atoms.
- C The molecules in the food contain many double bonds.
- D The molecules in the food contain many single bonds.

- 20 Hydrocarbons obtained by fractional distillation of petroleum can be cracked to make useful products.

Which substance could **not** be obtained by cracking propane?

- A  $C_2H_4$                       B  $C_3H_6$                       C  $C_4H_8$                       D  $H_2$

**END OF PAPER**

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	euporium	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
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	—

Volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).



Name and Index Number:  (            )	Class:
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## SENG KANG SECONDARY SCHOOL PRELIMINARY EXAMINATION

### SCIENCE (CHEMISTRY) Secondary 4 Normal (Academic)

**5105/04**

**3 August 2018**

Paper 4 Theory

**Paper 3 & 4**

**1 hour 15 min**

Candidates answer on the Question Paper.

No Additional Materials are required.

#### 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 in the spaces provided.

#### Section B

Answer any **two** questions.

Write your answers in the spaces provided.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [    ] at the end of each question or part question.

A copy of the Periodic Table is printed on page 12.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's use	
Section A	/ 14
1	/ 2
2	/ 3
3	/ 4
4	/ 5
Section B	/ 16
5	/ 8
6	/ 8
7	/ 8
Total	/ 30
Total %	/ 100

Parent's / Guardian's Signature: .....

This document consists of **12** printed pages and **0** blank page.

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

**[Turn over**

## Section A

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

- 1 Fig. 1.1 shows the apparatus used to separate a mixture of acetone, ethanol and water.

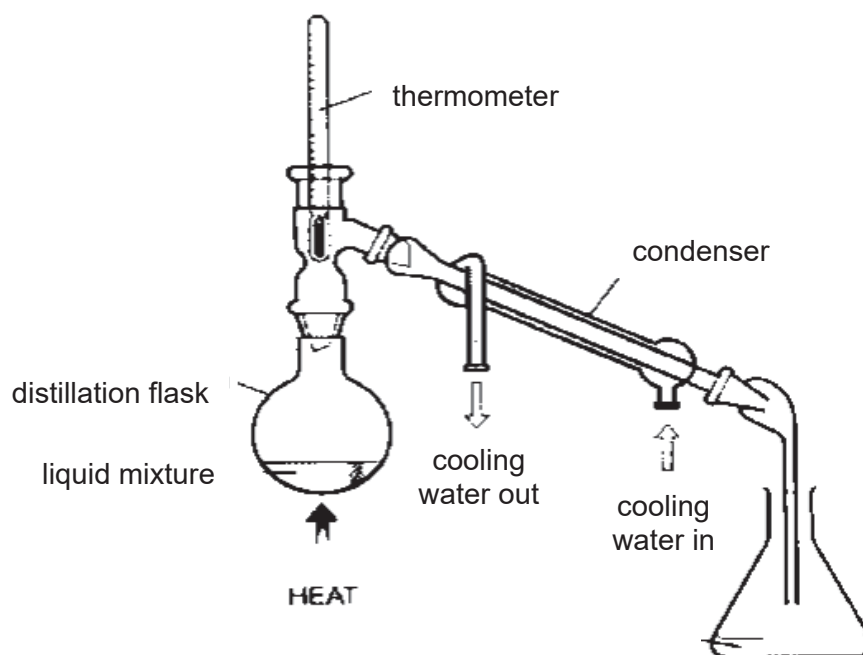


Fig. 1.1

The boiling point of the different liquids is given in Table 1.1.

Table 1.1

liquid	boiling point / °C
acetone	56
ethanol	78
water	100

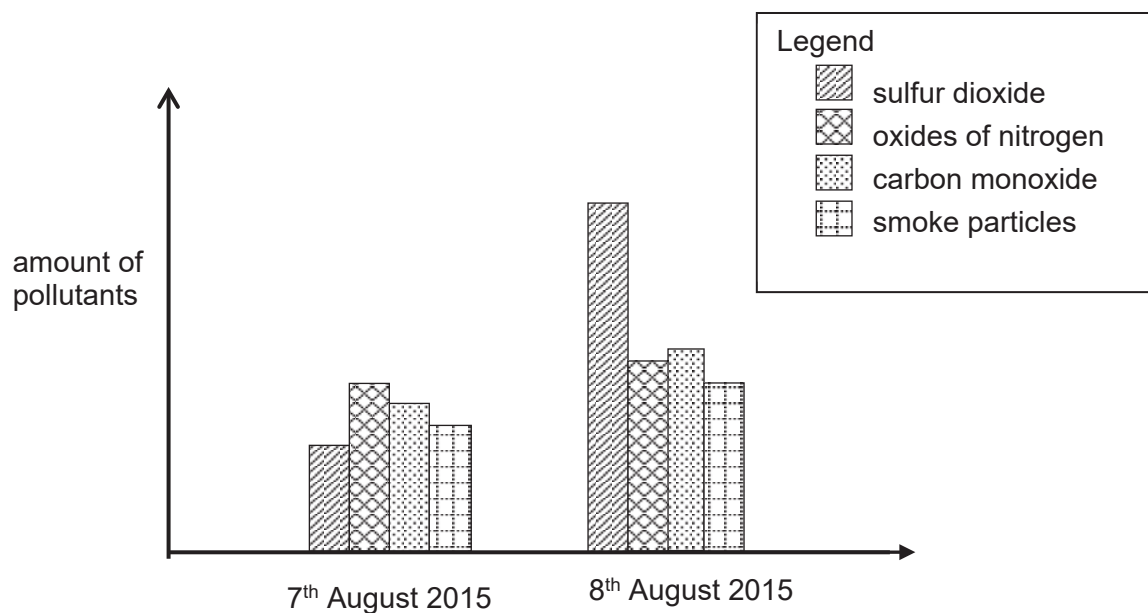
- (a) State the physical property which makes the separation process possible.

..... [1]

- (b) When the thermometer reading is constant at 56°C, what is the liquid being collected in the conical flask?

..... [1]

- 2 Figure 2.1 shows the composition of air samples collected on island **A** on 7<sup>th</sup> August 2015 and 8<sup>th</sup> August 2015.



**Fig. 2.1**

- (a) The residents on island **A** were worried about the possibility of experiencing acid rain. Identify **two** air pollutants from the air samples that cause acid rain.

..... [1]

- (b) Explain **two** harmful effects of acid rain on the environment.

.....

..... [2]

- 3 All the elements in Group VII of the Periodic Table react with sodium.

Fluorine reacts violently with sodium at room temperature.

Chlorine reacts very vigorously when in contact with hot sodium.

Iodine reacts slowly with hot sodium.

- (a) Based on the reactions with sodium metal, state the trend in reactivity of the halogen.

..... [1]

- (b) Suggest one condition needed for bromine to react with sodium.

..... [1]

- (c) Methane gas is bubbled through aqueous bromine under sunlight. The reaction is similar to that of methane with chlorine.

- (i) What is the name given to this type of reaction?

..... [1]

- (ii) Write the chemical equation for the reaction when one mole of aqueous bromine reacts with one mole of methane gas.

..... [1]

- 4 When solid iodine crystals are heated, they form dense, purple vapour.

- (a) Describe the change in the movement and arrangement of the particles in solid iodine crystals during sublimation.

.....

..... [2]

- (b) Iodine is in the same Group as fluorine and chlorine. Each element consists of molecules which are **diatomic**.

- (i) Explain the meaning of **diatomic**.

..... [1]

- (ii) Showing only the valence electrons, draw a diagram to show the arrangement of electrons in a molecule of iodine.

[1]

- (iii) Explain why the boiling point of iodine is very low.

.....

.....

[1]

## Section B

Answer any **two** questions in this section in the spaces provided.

- 5 Julian wishes to prepare sodium sulfate solution in the laboratory. He found an old practical note which describes the preparation of sodium sulfate solution as shown in Fig. 5.1. However, some words were left out.

- (a) Complete the following description by writing in the missing words and/or formulae in Fig. 5.1.

A fixed volume of dilute sulfuric acid is placed in a conical flask. The formula for the ion present in all acid is .....

A few drops of a suitable indicator is added to the solution. Slowly, with swirling, dilute sodium hydroxide is added from a burette into the flask until the solution just changes colour. This method of preparing a salt by adding a solution from a burette is called .....

The resulting solution will now have a pH of ..... This type of reaction is called .....

Fig. 5.1

[2]

- (b) Write a balanced chemical equation for the reaction between dilute sulfuric acid,  $\text{H}_2\text{SO}_4$ , and sodium hydroxide,  $\text{NaOH}$ . State symbols are **not** required.

..... [1]

- (c) When excess sodium hydroxide is added to sulfuric acid, the solution changes from acidic to alkaline.

Samples of the solution are taken before and after the addition of excess sodium hydroxide.

Describe a test that could be carried out on each sample, to show that the solution had changed from acidic to alkaline.

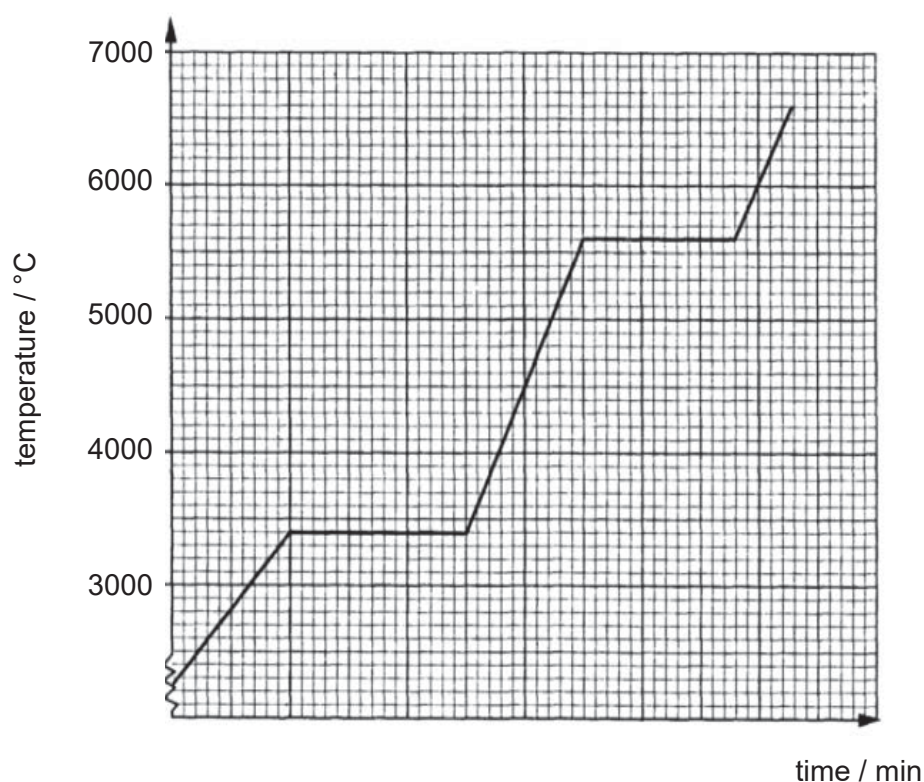
test .....

observation when solution is acidic .....

observation when solution is alkaline ..... [2]

[Turn over

(d) Fig. 5.2 shows the heating curve of sodium sulfate.



**Fig. 5.2**

(i) Using Fig. 5.2, determine the melting point of sodium sulfate.

..... [1]

(ii) Explain why the temperature remains constant during the melting of sodium sulfate.

.....

..... [2]

- 6 (a) The boiling points of five hydrocarbons are shown in Table 6.1.

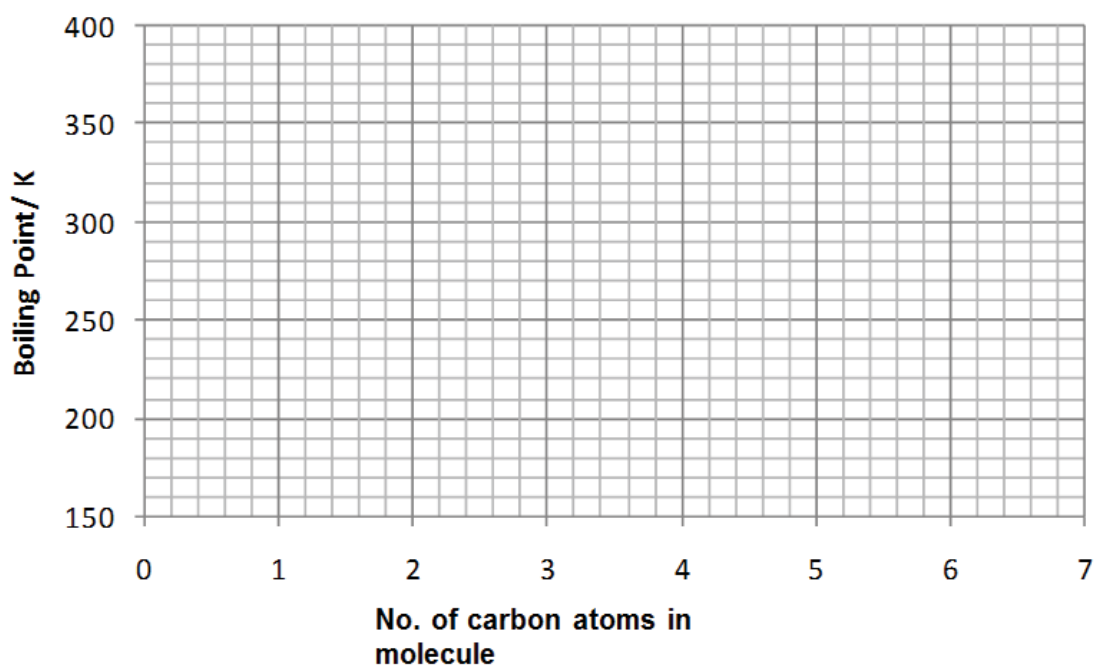
Four of the hydrocarbons are alkanes and the remaining hydrocarbon is an alkene.

**Table 6.1**

hydrocarbon	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
number of carbon atoms per molecule	2	3	4	5	6
boiling point / K	170	235	250	290	330

- (i) Plot a graph of boiling point against number of carbon atoms for these hydrocarbons.

Mark each point with a cross (X). Draw a straight line of best fit.



[2]

- (ii) Using the plotted graph in (a)(i), deduce which hydrocarbon is **not** an alkane?

..... [1]

- (iii) Give the chemical name of the hydrocarbon in (a)(ii).

..... [1]



- (b) Dodecane,  $C_{12}H_{26}$  is a large molecule that can be broken down into **X** and ethene in the laboratory using the setup, shown in Fig. 6.1.

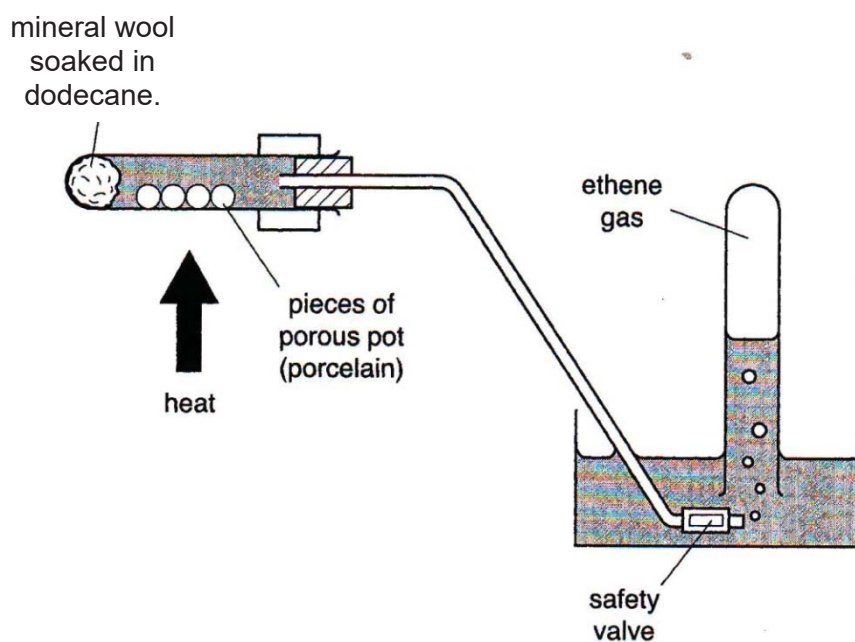


Fig. 6.1

- (i) Give the chemical formula of **X**.

..... [1]

- (ii) Ethene can undergo further reactions, as shown in Fig. 6.2.

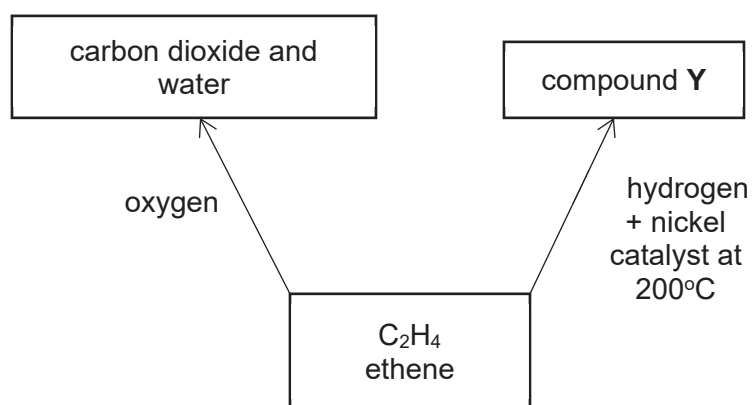


Fig. 6.2

Draw the full structural formula of compound **Y**.

[1]

[Turn over

- (iii) Describe one test that could be used to distinguish between a sample of ethane and ethene.

Name the reagent used and state the results obtained.

reagent .....

result with ethane .....

result with ethene ..... [2]

- 7 Four different metals of the same surface area were separately added to equal volumes of excess dilute hydrochloric acid.

Fig. 7.1 shows the volume of gas collected in the first 30 seconds in each experiment.

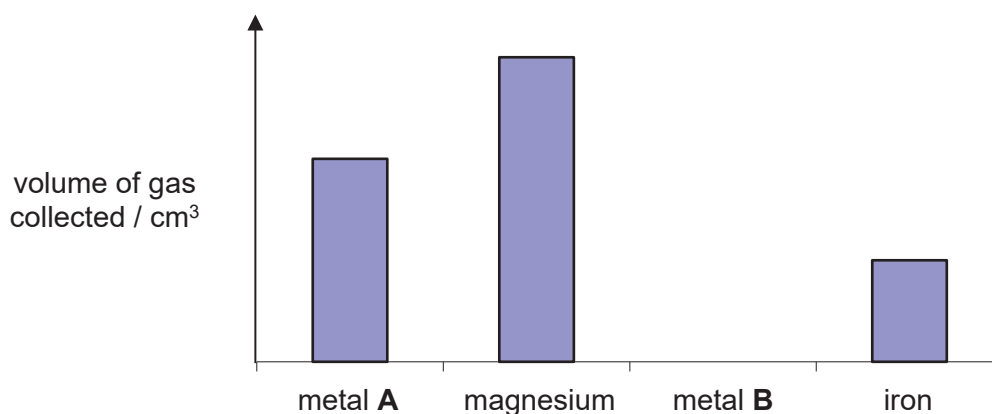


Fig. 7.1

- (a) Name the laboratory apparatus that should be used to measure the volume of gas produced at the end of each reaction.

..... [1]

- (b) Place the metals in order of increasing reactivity.

..... [1]

- (c) Suggest the possible identity of metal A.

..... [1]

- (d) (i) Write a balanced chemical equation, with state symbols, for the reaction between magnesium metal with hydrochloric acid.

..... [2]

- (ii) Given that 28.5g of magnesium chloride crystals were produced, calculate the number of moles of magnesium chloride crystals.

[2]

- (e) Some calcium metal was added into a solution of metal **B** nitrate.

Explain, using the reactivity series of metals, whether any displacement reaction will take place.

.....

..... [1]

END OF PAPER

# The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		Key															
		proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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 -
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 -	118 Og oganesson -	120 Uue ununium -	121 Uut ununium -

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
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 -

actinoids

lume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

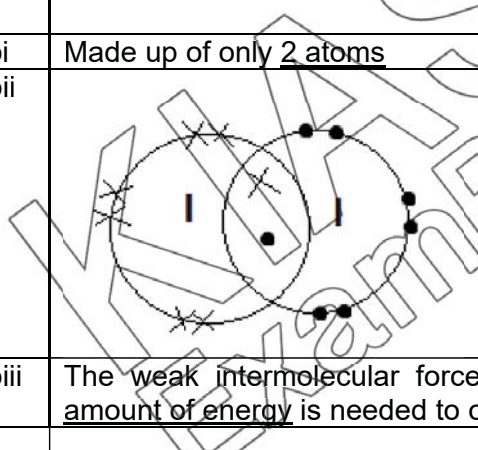


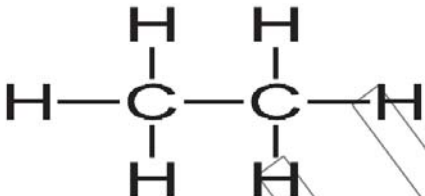
**PRELIM  
SECONDARY 4 NORMAL ACADEMIC  
SCIENCE CHEMISTRY 5105**

**Paper 3**

1	B	2	C	3	B	4	A	5	B
6	D	7	B	8	A	9	C	10	A
11	C	12	B	13	A	14	A	15	C
16	C	17	D	18	B	19	C	20	C

**Section A and B (Paper 4)**

Qn	Answer	Marks
1a	Difference in Boiling points	[1]
1b	acetone	[1]
2a	Sulfur dioxide and oxides of nitrogen	[1]
2b	Acids rain: corrode limestone building Kill marine life Kill plant	[1] [1] [1]
3a	Reactivity decreases down the group.	[1]
3b	Hot sodium needed	[1]
3ci	Substitution reaction	[1]
3cii	$\text{CH}_4 + \text{Br}_2 \rightarrow \text{CH}_3\text{Br} + \text{HBr}$	[1]
4a	During sublimation, the particles move further apart. <u>From vibrating at fixed position to moving freely in all directions at high speed.</u> (if students only state move further apart, give 1 mark)	[2]
4bi	Made up of only 2 atoms	[1]
4bii		[1]
4biii	The weak intermolecular forces between iodine molecules thus <u>small amount of energy</u> is needed to overcome these forces.	[1]
5a	H <sup>+</sup> titration seven / 7 neutralisation	2 correct answers – [1] 4 correct answers – [2]
5b	$\text{H}_2\text{SO}_4 + 2 \text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O}$	[1]
5c	test: addition of methyl orange / litmus / universal indicator observation when acidic: red / red / red observation when alkaline: yellow / blue / blue	[1] [1] for both observations
5di	3400 °C	[1]
5dii	<u>Heat energy is absorbed to overcome the attractive forces</u> between the solid particles so that the solid can be change to liquid state. Thus temperature remains constant.	[2]
6ai	All points plotted correctly. Best fit straight line	[1] [1]

6aii	Hydrocarbon B	[1]
6aiii	Propene	[1]
6bi	C <sub>10</sub> H <sub>22</sub>	[1]
6bii		[1]
6biii	reagent: bromine solution result with ethane: remain reddish brown result with ethene: bromine decolourised	[1] [1] for both observation
7a	Gas syringe	[1]
7b	metal B, iron, metal A, magnesium	[1]
7c	Zinc / Aluminium	[1]
7di	$\text{Mg (s)} + 2 \text{HCl (aq)} \rightarrow \text{MgCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$ 1m for balanced chemical equation 1m for correct state symbols	[2]
7dii	number of moles = $\frac{28.5}{24 + 35.5 \times 2}$ $= 0.3 \text{ mol}$ [1]	Calculation of Mr: [1] Answer: [1]
7e	Yes, calcium <u>will displace</u> metal B because <u>Calcium is more reactive</u> than metal B [1]	[1]





NAME		REG. NO.		CLASS	
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## SERANGOON GARDEN SECONDARY SCHOOL PRELIMINARY EXAMINATION 2018

SUBJECT: SCIENCE(CHEMISTRY) 5105/3; 5107/3  
 LEVEL: SECONDARY 4 NORMAL(ACADEMIC)  
 DATE: 14 AUGUST 2018 (TUESDAY)  
 TIME: 0815 – 0930 HOURS  
 DURATION: 1 HOUR 15 MINUTES (PAPERS 3 AND 4)

### READ THESE INSTRUCTIONS FIRST

Write in soft pencil.  
 Do not use staples, paper clips, glue or correction fluid.  
 Write your name, class register number and class on the Answer Sheet in the spaces provided unless this has been done for you.  
 DO **NOT** WRITE IN ANY BARCODES.

There are **twenty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Answers to Paper 3 and Paper 4 must be handed in separately.  
 Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

You are advised to spend no more than **30 minutes** on **Paper 3**.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

Any rough working should be done in this paper.

A copy of the Periodic Table is printed on page 10.

The use of an approved scientific calculator is expected, where appropriate.

<div style="display: flex; justify-content: space-between; border-top: 1px solid black; padding-top: 5px;"> <span>Name/Signature of Parent/Guardian</span> <span>Date</span> </div>	<div style="border: 1px solid black; padding: 5px;"> <b>FOR MARKER'S USE</b>   <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <div style="position: absolute; top: 0; right: 0; font-size: 2em; font-weight: bold;">20</div> </div> </div>
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This question paper consists of **9** printed pages and **1** blank page.

Setter: Mrs Erica Tay

Vetter: Ms Koh Li Min

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- 1 In an experiment, a student needs to measure  $29.7 \text{ cm}^3$  of sodium nitrate solution.

Which piece of apparatus would help him to measure this volume most accurately?

- A beaker
- B burette
- C measuring cylinder
- D pipette

- 2 Aspirin is often used to treat pain, fever, and inflammation.

What is the best method to test whether a sample of aspirin is pure?

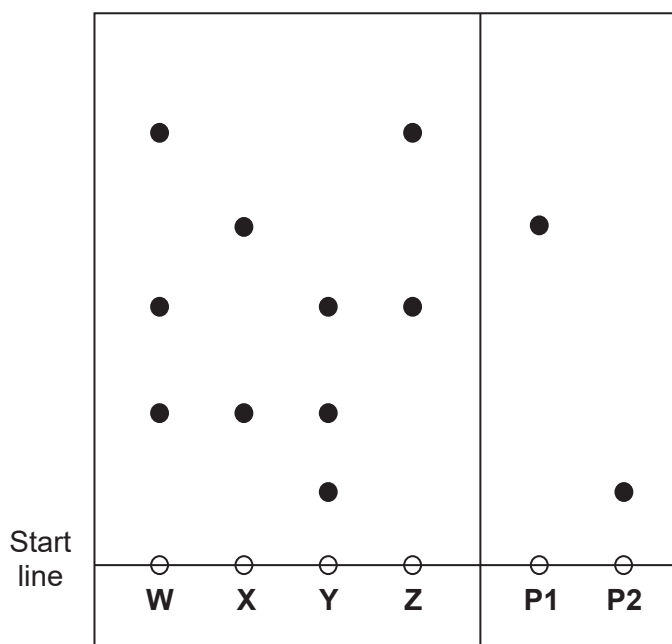
- A Check whether it melts at a single temperature.
- B Filter its solution and check whether the solution can pass through the filter paper.
- C Heat it to see whether it melts.
- D Test whether it is soluble in water.

- 3 The table below shows the melting points and boiling points of four pure substances.

Which substance is a solid at room temperature?

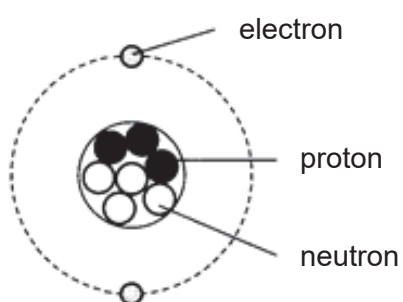
	melting point / °C	boiling point / °C
A	-100	-35
B	-7	58
C	6	215
D	44	280

- 4 The chromatogram below shows the substances contained in four different cups of bubble tea labelled **W**, **X**, **Y** and **Z**. Substances **P1** and **P2** are plasticisers which are harmful.



Which cups of bubble tea are safe for consumption?

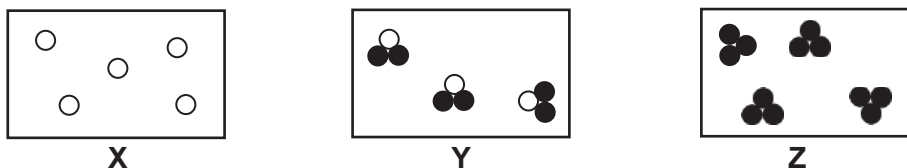
- A **W** and **Y**  
 B **W** and **Z**  
 C **X** and **Y**  
 D **X** and **Z**
- 5 The diagram shows the structure of a particle.



Which option describes the above structure accurately?

- A a negative ion  
 B a positive ion  
 C an atom  
 D an isotope

- 6 The diagrams show the arrangement of particles in three substances, **X**, **Y** and **Z**.  
● and ○ represent atoms of different elements.



Which row correctly describes these three substances?

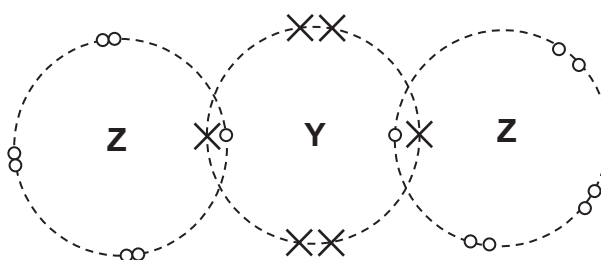
	<b>X</b>	<b>Y</b>	<b>Z</b>
<b>A</b>	compound	element	mixture
<b>B</b>	element	compound	compound
<b>C</b>	element	compound	element
<b>D</b>	element	mixture	element

- 7 The atoms of element **Y** have the electronic configuration 2.8.6.

Which statement about element **Y** is correct?

- A** It forms an ionic compound with potassium.  
**B** It only reacts with non-metals.  
**C** It forms an ion of charge +2.  
**D** In an atom of **Y**, there are 6 protons in the valence shell.

- 8 The diagram shows the electron arrangement in a molecule of compound **YZ<sub>2</sub>**.



Which elements could **Y** and **Z** be?

	<b>Y</b>	<b>Z</b>
<b>A</b>	calcium	chlorine
<b>B</b>	carbon	oxygen
<b>C</b>	oxygen	chlorine
<b>D</b>	sulfur	oxygen

- 9 Ethanoic acid is an active ingredient in vinegar. Its chemical formula is  $\text{CH}_3\text{COOH}$ .

How many elements is it made up of?

- A 3
- B 6
- C 8
- D 60

- 10 Which of the following is a property of all acidic solutions?

- A They react with bases.
- B They react with copper to give hydrogen.
- C They are solids at room temperature.
- D Their aqueous solutions have a pH greater than 7.

- 11 A student was asked to prepare a sample of zinc nitrate. He added a solid to dilute nitric acid. The experiment failed.

Which solid did he choose?

- A zinc carbonate
- B zinc chloride
- C zinc metal
- D zinc oxide

- 12 Why are lithium and fluorine placed in the same period of the Periodic Table?

- A Lithium and fluorine combine together to form a compound of formula  $\text{LiF}$ .
- B Lithium is a reactive metal and fluorine is a reactive non-metal.
- C The atoms of both elements have eight electrons in their outer electron shell.
- D The atoms of both elements have only two electron shells containing electrons.

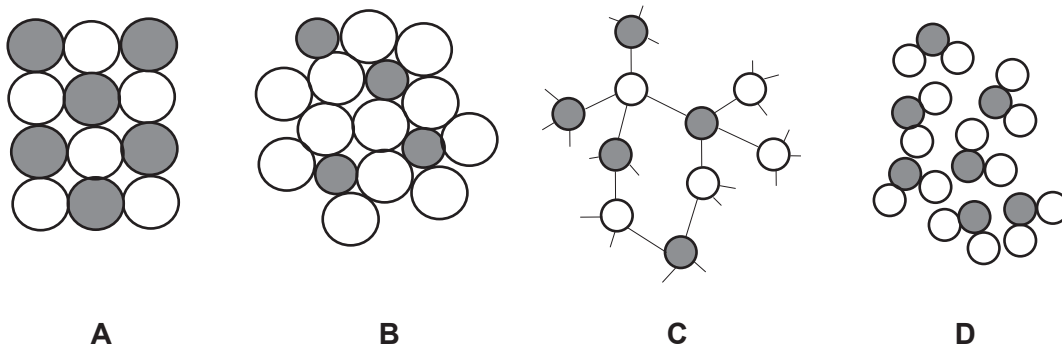
- 13 Helium is the second most abundant element in the world. It is very unreactive and is used to provide an inert protective atmosphere for making fibre optics and semiconductors.

Which of the following explains why helium is a chemically unreactive gas?

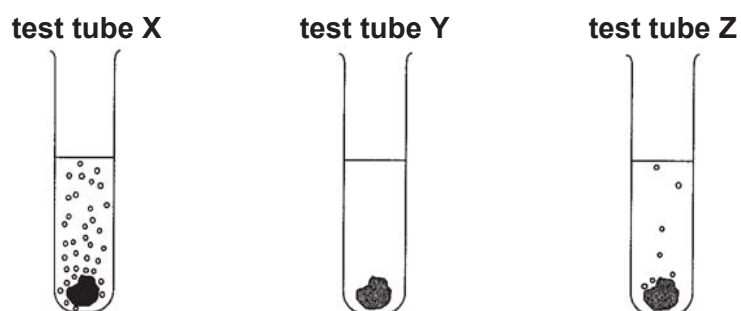
- A Its outermost electron shell is completely filled.
- B It has the same number of protons and electrons.
- C There are eight electrons in the valence shell.
- D There is an equal number of protons and neutrons in the nucleus.

- 14** Stainless steel is commonly used for food processing equipment as it has excellent resistance to stains or rust.

Which of the following most likely shows the arrangement of atoms in stainless steel?



- 15** The results of placing three metals separately in dilute hydrochloric acid are shown in the diagram below.



What could the metals in the three test tubes be?

	<b>test tube X</b>	<b>test tube Y</b>	<b>test tube Z</b>
<b>A</b>	zinc	copper	magnesium
<b>B</b>	copper	magnesium	iron
<b>C</b>	magnesium	copper	iron
<b>D</b>	magnesium	zinc	iron

- 16** Which metal(s) can be extracted by heating an ore containing its oxide with carbon?

	calcium	magnesium	lead	sodium
<b>A</b>	✓	✓	✓	✓
<b>B</b>	✓	✓	✓	✗
<b>C</b>	✗	✗	✓	✗
<b>D</b>	✗	✗	✗	✗

Key  
 ✓ = reacts  
 ✗ = does not react

**17** Which statement(s) about why metals should be recycled is/are correct?

- 1 There is a finite supply of metals.
- 2 Recycling metals produces more waste products compared to extraction of metals from their ores.
- 3 Recycling metals reduces the amount of space used up in landfill sites.
- 4 It is cheaper to recycle certain metals than to extract them from their ores.

- A** 1 and 4
- B** 2 and 3
- C** 1, 3 and 4
- D** All of the above

**18** Which property/properties of the alkanes do(es) **not** increase as their relative molecular masses increase?

- I** boiling point
- II** flammability
- III** viscosity

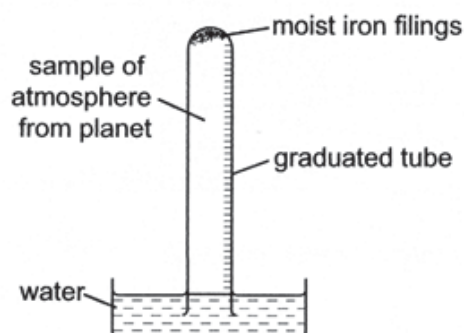
- A** I only
- B** II only
- C** I and II
- D** All of the above



- 19 The air taken from a newly discovered planet contains the following gases.

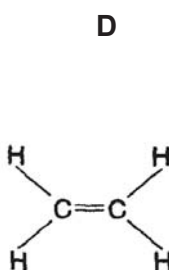
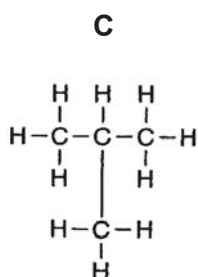
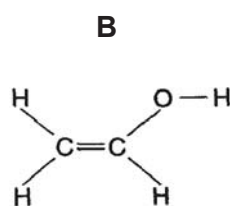
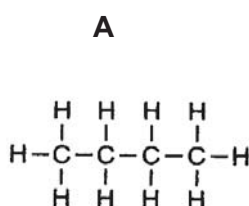
gas	concentration (%)
carbon dioxide	20
hydrogen	40
ammonia	10
oxygen	30

The apparatus below was set up with a 100 cm<sup>3</sup> sample of the air taken from the planet in the graduated tube. The volume of the sample was measured at regular time intervals until no further change in volume took place.



What volume of the sample would remain?

- A 20 cm<sup>3</sup>  
 B 30 cm<sup>3</sup>  
 C 70 cm<sup>3</sup>  
 D 80 cm<sup>3</sup>
- 20 Which diagram represents an unsaturated hydrocarbon?



**- END OF PAPER -**

## The Periodic Table of Elements

Group																							
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0						
		<div>Key</div> <div>proton (atomic) number atomic symbol name relative atomic mass</div>																					
3 Li lithium 7	4 Be beryllium 9																	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																	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 Lv livermorium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganesson -						

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
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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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The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

NAME		REG. NO.		CLASS	
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## SERANGOON GARDEN SECONDARY SCHOOL PRELIMINARY EXAMINATION 2018

SUBJECT: SCIENCE(CHEMISTRY) 5105/4; 5107/4  
 LEVEL: SECONDARY 4 NORMAL(ACADEMIC)  
 DATE: 14 AUGUST 2018 (TUESDAY)  
 TIME: 0815 – 0930 HOURS  
 DURATION: 1 HOUR 15 MINUTES (PAPERS 3 AND 4)

### READ THESE INSTRUCTIONS FIRST

Write your name, class register 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.

Answer **all** questions in Section A and any **two** questions 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.  
 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 13.

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.

<div style="display: flex; justify-content: space-between; border-top: 1px solid black; padding-top: 5px;"> <span>Name/Signature of Parent/Guardian</span> <span>Date</span> </div>	<div style="border: 1px solid black; padding: 5px;"> <b>FOR MARKER'S USE</b>   <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <div style="position: absolute; top: 0; right: 0; font-size: 2em; font-weight: bold;">30</div> </div> </div>
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This question paper consists of 12 printed pages and 2 blank pages.

Setter: Mrs Erica Tay

Vetter: Ms Koh Li Min

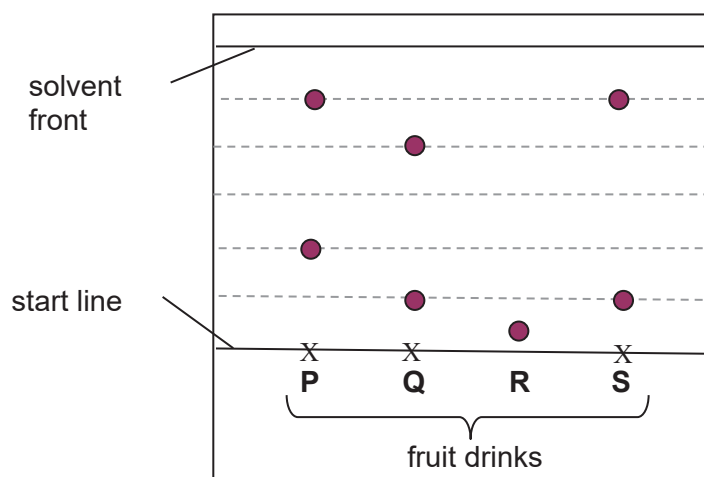
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### Section A

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

- 1** The diagram shows the chromatogram obtained with water-soluble dyes used in fruit drinks labelled **P**, **Q**, **R** and **S**.



- (a) Name a suitable solvent to produce this chromatogram. [1]

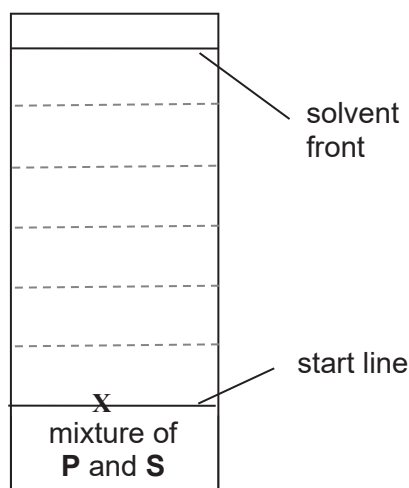
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- (b) Identify the drink(s) that is/are mixture(s). Explain your answer. [1]

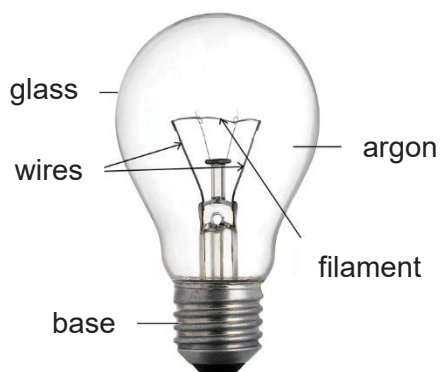
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- (c) In another experiment, drinks **P** and **S** were mixed together and chromatography was carried out using the same solvent. Draw on the diagram below the chromatogram you would expect to obtain. [1]



- 2** The diagram shows a light bulb. The wires and the filament are housed in a glass bulb, which is filled with an inert gas, such as argon.



Credits to <https://corrion.weebly.com/day-4-study-guide.html>

- (a)** Describe using the Kinetic Particle Theory, how argon fills the interior of the light bulb. [1]

.....  
 .....

- (b)** The most common isotope of argon in the air has the chemical symbol  $^{40}_{18}\text{Ar}$ .

- (i)** Determine the number of electrons and neutrons in one atom of this isotope. [1]

number of electrons = .....

number of neutrons = .....

- (ii)** Suggest the chemical symbol for another isotope of argon. [1]

.....

- 3** The table shows information about some gases.

gas	formula	relative molecular mass, $M_r$	pH of aqueous solution of the gas
ammonia	$\text{NH}_3$		12
carbon dioxide	$\text{CO}_2$	44	6
sulfur dioxide		64	4
oxygen	$\text{O}_2$	32	7

[relative atomic masses,  $A_r$ : C, 12; H, 1; N, 14; O, 16; S, 32]

- (a) Complete the table by filling in the blank spaces. [2]
- (b) Which gas(es) will turn moist blue litmus paper red? [1]
- .....
- (c) Draw the 'dot-and-cross' diagram of an oxygen molecule. Show only the outer electrons. [1]
- (d) Calculate the number of moles of carbon dioxide molecules present in 33 g of carbon dioxide. Show your working clearly.

number of moles = ..... [1]

- (e) State one major natural source for sulfur dioxide. [1]
- .....

- 4 The diagram shows the Third Series Singapore coins.



*Credits to <https://www.channelnewsasia.com/news/singapore/feedback-wanted-on-proposed-limits-on-using-coins-for-payments-8575854>*

Explain why steel is used to make the core of the coins, instead of pure nickel or copper. [2]

.....

.....



### Section B

Answer any **two** questions from this section in the spaces provided.

- 5** A student added 0.1 g of magnesium ribbon to sulfuric acid at room temperature. The gas is collected in a syringe and the volume of gas is noted every 20 seconds in Table 5.1.

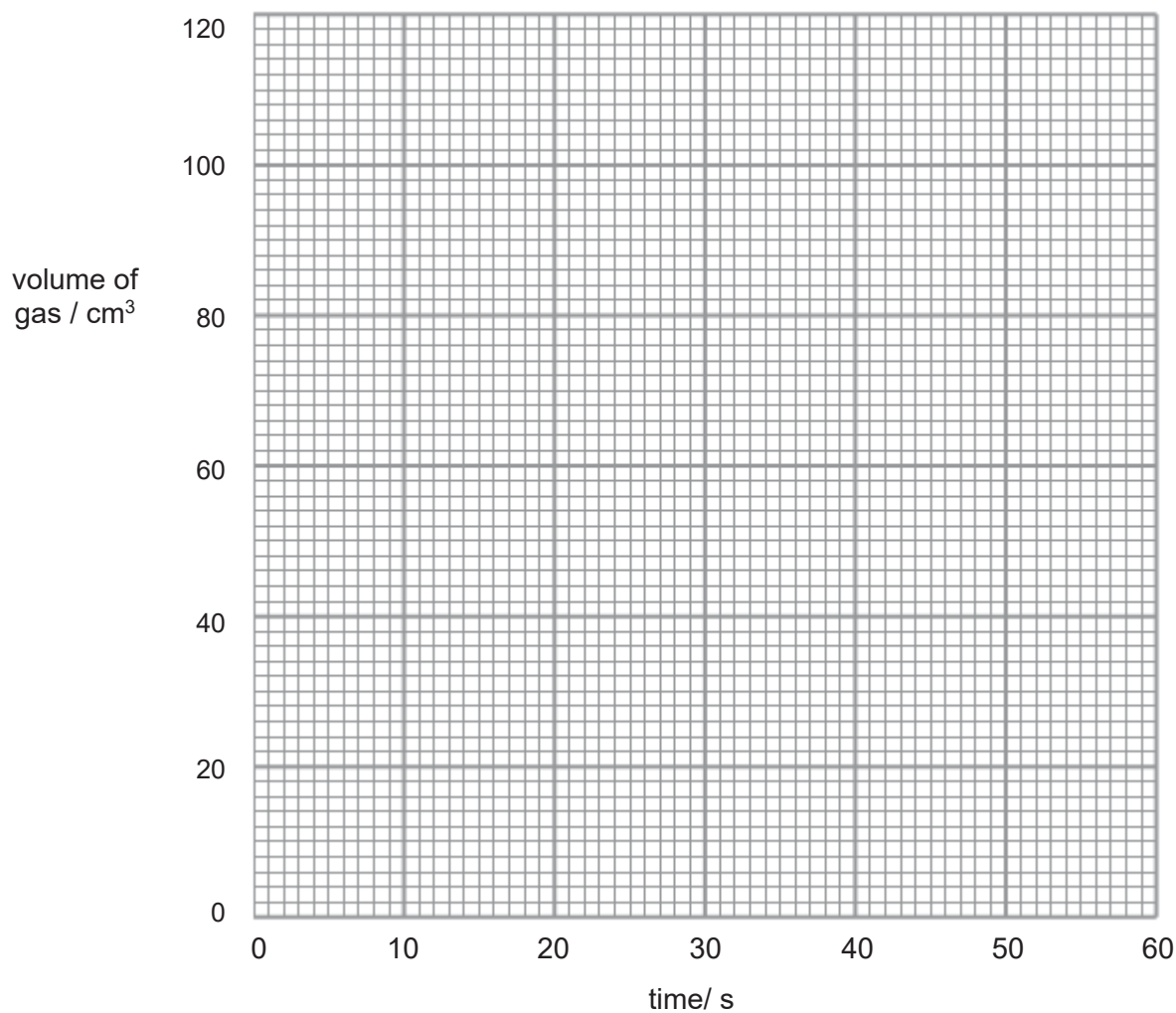
**Table 5.1**

time/s	0	10	20	30	40	50	60
volume of gas/cm <sup>3</sup>	0	30	60	80	90	100	100

- (a)** Plot a graph of these results, marking each point with a cross (x).

Draw a best-fit curve taking into account all the plotted points.

[2]



- (b) Predict the volume of gas collected if the experiment is allowed to proceed to 80 s. Explain why. [1]

.....

- (c) Describe a test for the gas produced in the above experiment and hence, state the results. [2]

Test: .....

Result: .....

.....

- (d) (i) Identify the salt formed in the reaction. [1]

.....

- (ii) Describe how pure and dry crystals can be obtained from the salt solution. [2]

.....

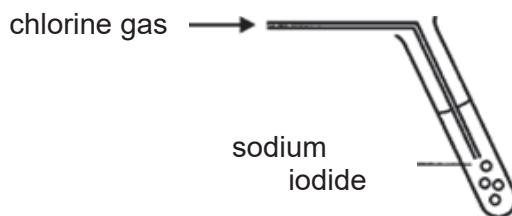
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- 6** Chlorine is commonly used as an antiseptic and is used to make drinking water safe and to treat the water in swimming pools.

- (a)** A student uses the apparatus in Fig 6.1 to bubble chlorine through a colourless sodium iodide solution in a fume cupboard.



**Fig. 6.1**

- (i)** Write a balanced chemical equation for the reaction that occurs between chlorine and sodium iodide solution. [2]

.....

- (ii)** Describe an observation that could be made during this chemical reaction. [1]

.....

- (b)** Bromine, another member of Group VII, is used to test for unsaturation in hydrocarbon molecules.

- (i)** What is the physical state of bromine used in this test? [1]

.....

- (ii)** Describe an observation which would prove that the sample being tested is an unsaturated hydrocarbon. [1]

.....

- (iii)** Name the type of reaction that occurs between bromine and the unsaturated hydrocarbon. [1]

.....

(c) Acidic aqueous chlorine was accidentally spilled on a plot of land during transportation.

(i) Suggest a suitable chemical that farmers can use to reduce the acidity of soil. [1]

.....

(ii) Explain how the chemical in **c(i)** can reduce the acidity of soil. [1]

.....

- 7 Fig. 7.1 shows the burning of methane gas using a Bunsen burner with the air hole open.

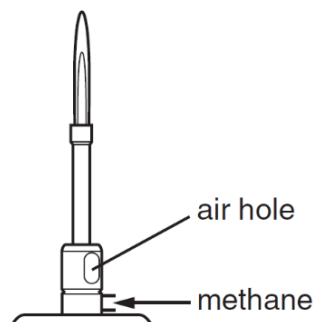


Fig. 7.1

- (a) Methane burns completely when the air hole is open. Write a balanced chemical equation for the complete combustion of methane. [1]
- .....
- (b) Methane burns incompletely when the air hole is closed. Name a pollutant that will be formed and explain why it is dangerous to use a Bunsen burner in a poorly ventilated room with the air hole closed. [2]
- .....
- .....
- (c) Organic compounds are grouped into families called homologous series. Describe two characteristics of a homologous series. [2]
- .....
- .....
- .....
- (d) Methane is the first member of a homologous series. Draw the full structural formula of the third member of the homologous series. [1]

- (e) Suggest one difference in physical property of the structure you have drawn in (d) as compared to methane. [1]

.....

- (f) Methane reacts with chlorine to form chloromethane. The equation for the reaction is shown below.



Name this type of reaction and state the condition needed for the reaction to occur. [1]

.....

.....

**- END OF PAPER -**

## The Periodic Table of Elements

Group																	
I	II	<div>1<div>Hhydrogen1</div></div>										III	IV	V	VI	VII	0
		<div>Key<div>proton (atomic) number atomic symbol name relative atomic mass</div></div>															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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
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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

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The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

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SGS PRELIM 2018  
4NA SCIENCE(CHEMISTRY)  
MARK SCHEME

Paper 3

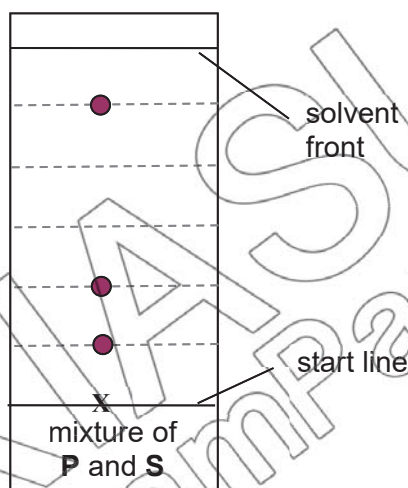
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	A	D	B	B	C	A	C	A	A
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	D	A	B	C	C	C	B	C	D

1

(a) water [1]

(b) P, Q and S, can be separated into two spots of dyes [1]

(c) [1]



2

(a) Particles move freely and randomly to occupy any available space [1]

(b) (i) number of electrons = 18  
number of neutrons = 22 Both correct [1]

(ii)  $^{39}_{18}\text{Ar}$  or  $^{41}_{18}\text{Ar}$  any feasible answer [1]

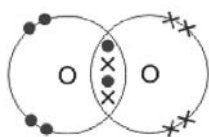
3 (a)

gas	formula	relative molecular mass, $M_r$	pH of aqueous solution of the gas
ammonia	$\text{NH}_3$	<u>17</u>	12
carbon dioxide	$\text{CO}_2$	44	6
sulfur dioxide	<u><math>\text{SO}_2</math></u>	64	4
oxygen	$\text{O}_2$	32	7

1 mark per correct answer [2]

(b) carbon dioxide and sulfur dioxide [1]

(c) [1]



(d) 0.75 [1]

(e) volcanic eruption [1]

4 Steel is harder/stronger than pure nickel or copper [1]

Atoms of different elements have different sizes, disrupts orderly layers of atoms, harder to slide over one another [1]

5 (a) All points plotted correctly [1]

Best-fit curve [1]

(b)  $100\text{cm}^3$ , reaction has stopped [1]

(c) (i) hydrogen [1]

(ii) Test: Insert lighted/burning splint into gas [1]

Result: Lighted/burning splint extinguished with 'pop' sound [1]

(d) (i) magnesium sulfate [1]

(ii) Heat solution until saturated [1]

Leave to cool and form crystals, filter and dry crystals [1]

6

(a) (i)  $\text{Cl}_2 + 2\text{NaI} \rightarrow 2\text{NaCl} + \text{I}_2$

Correct equation [1]

Correct balancing [1]

(ii) Colourless solution turns brown [1]

(b) (i) aqueous [1]

(ii) Reddish brown/orange aqueous bromine turns colourless [1]

(iii) Addition / bromination [1]

(c) (i) Calcium hydroxide / calcium oxide/ calcium carbonate [1]

(ii) Neutralise acidic soil [1]

7

(a)  $\text{CH}_4 + 3\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  [1]

(b) Carbon monoxide [1]

Prevents blood from transporting oxygen around the body, causing death [1]

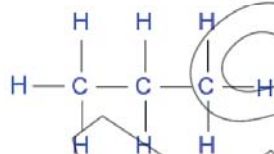
(c)

- Same general formula
- Similar chemical properties
- Each member differs from the next by  $-\text{CH}_2-$  group

Any two points

[2]

(d)



[1]

(e)

Higher boiling point/ more viscous/ less soluble than methane

[1]

(f)

Substitution, presence of light

[1]



Name	Class	Index Number

**UNITY SECONDARY SCHOOL**  
**PRELIMINARY EXAMINATION 2018**  
**SECONDARY FOUR NORMAL ACADEMIC**



**SCIENCE (CHEMISTRY) 5105/03**

**16 AUGUST 2018**

**PAPER 3**

**PAPER 3 AND 4 : 1 HOUR 15 MIN**

**Additional Materials : Optical Answer Sheet**

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name and index number on the Answer Sheet in the spaces provided.

There are **twenty** questions on this paper. Answer all questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 7.

The total marks for this paper is **20** marks.

This paper consists of **7** printed pages, including this cover page.

- 1 What happens to particles when heat energy is absorbed during melting?
- A The particles collide less frequently.
  - B The particles gain kinetic energy.
  - C The particles move more slowly.
  - D There are greater forces of attraction between the particles.
- 2 Sodium nitrate decomposes when heated. Which method is the best way to obtain crystals of sodium nitrate from aqueous sodium nitrate?
- A Filtration
  - B Distillation
  - C Crystallisation
  - D Evaporation to dryness
- 3 Which is the best method to test whether a solution is saturated?
- A Heat the solution quickly to see if crystals form.
  - B Filter the solution to see if crystals form in the filtrate.
  - C Evaporate the solution to dryness and see if crystals form.
  - D Dip a glass rod in the solution and remove it to see if crystals form on the rod.

- 4 An element **Y** has 13 protons, 14 neutrons and 13 electrons. What are the nucleon number and proton number of **Y**?

	Nucleon number	Proton number
A	13	13
B	14	14
C	27	13
D	40	14

- 5 Which statement is true about all the isotopes of an element?
- A They have the same number of neutrons.
  - B They have the same number of electrons and protons.
  - C They have the same number of neutrons and protons.
  - D They have the same number of electrons and neutrons.

- 6 Which statement is true about a particle that contains 20 protons, 20 neutrons and 18 electrons?

**A** It is a positive ion.  
**B** It is a negative ion.  
**C** It is an atom of a metal.  
**D** It is an atom of a noble gas.

- 7 Indium forms  $\text{In}^{3+}$  ions and the sulfate ion has the formula  $\text{SO}_4^{2-}$ . What is the chemical formula of indium(III) sulfate?

**A**  $\text{In}(\text{SO}_4)_2$   
**B**  $\text{In}_2(\text{SO}_4)_3$   
**C**  $\text{In}_2\text{SO}_4$   
**D**  $\text{InSO}_4$

- 8 The colour of the Universal Indicator at different pH values is given below.

pH	2	6	11
Colour	red	yellow	blue

What are the colours formed when a few drops of Universal Indicator are added separately to dilute sulfuric acid and aqueous ammonia solution?

	Dilute sulfuric acid	Aqueous ammonia solution
<b>A</b>	Red	Blue
<b>B</b>	Red	Yellow
<b>C</b>	Blue	Red
<b>D</b>	Yellow	Red

- 9 Which of the following shows the correct type of oxide for the element?

	Element	Type of oxide
<b>A</b>	Carbon	Amphoteric
<b>B</b>	Hydrogen	Neutral
<b>C</b>	Sulfur	Basic
<b>D</b>	Zinc	Acidic

- 10 What is formed when an acid reacts with a carbonate?
- A Salt and water only
  - B Carbon dioxide and salt only
  - C Carbon dioxide and water only
  - D Carbon dioxide, salt and water only
- 11 Which property do most metals have?
- A Low density
  - B High melting point
  - C Do not conduct heat
  - D Do not conduct electricity
- 12 What are the raw materials used in the blast furnace for extracting iron?
- A Haematite, slag and iron
  - B Haematite, slag and coke
  - C Haematite, limestone and coke
  - D Haematite, limestone and carbon dioxide
- 13 Which of the following methods is **not** used for preventing iron from rusting?
- A Greasing
  - B Painting
  - C Plastic coating
  - D Washing with water
- 14 Neon has a proton number of 10. Which of the following has the same number of electrons as a neon atom?
- A Argon atom, Ar
  - B Fluoride ion, F<sup>-</sup>
  - C Calcium ion, Ca<sup>2+</sup>
  - D Potassium ion, K<sup>+</sup>



- 15 Which statement about the Periodic Table is correct?
- A All elements in the same group of the Periodic Table have the same number of electrons.
  - B All elements in the same period of the Periodic Table have the same number of electron shells.
  - C The melting points of the elements in Group VII decrease down the group.
  - D When Group I metals react with water, they form acidic solutions.
- 16 Which of the following substances is **not** an atmospheric pollutant?
- A Argon
  - B Ozone
  - C Carbon monoxide
  - D Oxides of nitrogen
- 17 Which statements about a homologous series are correct?
- 1 All members have similar chemical reactions.
  - 2 All members have the same functional group.
  - 3 All members have the same physical properties.
- A 1 and 2 only
  - B 1 and 3 only
  - C 2 and 3 only
  - D 1, 2 and 3
- 18 Petroleum can be separated into petroleum fractions by fractional distillation because the fractions \_\_\_\_\_.
- A are miscible
  - B have different viscosities
  - C have different boiling points
  - D have similar chemical properties

- 19 Methane has four shared pairs of electrons. How many shared pairs of electrons are there in the ethane molecule?
- A 5  
B 6  
C 7  
D 8
- 20 When ethene reacts with hydrogen, the product obtained is \_\_\_\_\_.
- A an alkene  
B an alkane  
C a base  
D an organic acid

\*\*\* END OF PAPER \*\*\*

# The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
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		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	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84					51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131		
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55 Cs caesium 133	56 Ba barium 137	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -					114 Fl flerovium -	116 Lv livermorium -				
87 Fr francium -	88 Ra radium -		114 Fl flerovium -														

lanthanoids

actinoids

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The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

Name	Class	Index Number

**UNITY SECONDARY SCHOOL**  
**PRELIMINARY EXAMINATION 2018**  
**SECONDARY FOUR NORMAL ACADEMIC**



**SCIENCE (CHEMISTRY) 5105/04**

**16 AUGUST 2018**

**PAPER 4**

**PAPER 3 AND 4 : 1 HOUR 15 MIN**

**Additional Materials : Nil**

**READ THESE INSTRUCTIONS FIRST**

1. Write your name, class and register number in the space provided.
2. Answer **all** questions in Section A and any **two** questions in Section B.
3. In calculations, you should show all the steps in your working, giving your answer at each stage.
4. You are advised to spend no longer than 30 minutes on Paper 3.
5. You may proceed to answer Paper 4 as soon as you have completed Paper 3.
6. A copy of the Periodic Table is printed on last page of Paper 3.
7. At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
8. The number of marks is given in brackets [ ] at the end of each question or part question.
9. The total mark for this paper is **30** marks.

This paper consists of **11** printed pages, including this cover page.

### Section A (14 marks)

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

- 1** Information about four substances **W**, **X**, **Y** and **Z** is given below.

State whether each substance **W**, **X**, **Y** and **Z** is an element, compound or a mixture by circling the right option provided below the description of each substance. [2]

<b>W</b> : A black solid which is formed by strongly heating copper in oxygen.  Element / Compound / Mixture	<b>X</b> : A gas that is required by green plants for photosynthesis.  Element / Compound / Mixture
<b>Y</b> : A solid with black and white coloured particles that are distributed non-uniformly. The black particles dissolve in water but the white particles do not.  Element / Compound / Mixture	<b>Z</b> : A solid with a constant composition that produces two elements when heated strongly.  Element / Compound / Mixture

- 2** Rachel was tasked to prepare an insoluble salt in the school laboratory. She found that sodium chloride solution was able to react with silver nitrate solution to prepare an insoluble salt.

**(a)** Name the insoluble salt Rachel is supposed to make. [1]

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**(b)** Describe the steps that she must take to obtain a pure, dry sample of the salt. [2]

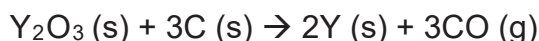
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- 3** Yttrium, Y is a period 5 element that can be manufactured from its oxide using carbon as shown in the following equation:



- (a)** Calculate the relative molecular mass,  $M_r$  of  $\text{Y}_2\text{O}_3$ . [1]

- (b)** What is the maximum mass of the element, Y that can be manufactured using 18 tonnes of carbon? Show all working clearly in the space provided. [2]

- 4** PSI, which stands for Pollutant Standards Index, is an indicator of pollution levels in the air. The air pollutants that contribute to the measurement of the PSI include sulfur dioxide, oxides of nitrogen, ozone, carbon monoxide and particulate matter, i.e. unburnt hydrocarbons called PM10 (particulate matter of 10 microns or smaller).

Singapore experienced its highest 3-hour PSI reading of 401 during the 2013 Southeast Asian haze which occurred in the middle of 2013, surpassing its previous record of 226 during the 1997 haze.

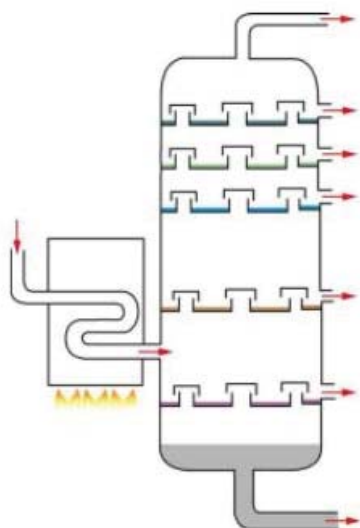
- (a)** What would have been the advice to Singaporeans during the period when the PSI was at the unhealthy level? [1]

- (b) List the major source of the air pollutant below and its effect on human health. [1]

Air pollutant	Major source	Effect on human health
Sulfur dioxide		

- 5 The diagram below represents a fractionating tower where crude oil, otherwise known as petroleum, is separated into its various fractions. Label the diagram with the following words: [2]

Bitumen	Kerosene	Petroleum gas
Petrol	Diesel oil	Lubricating oil
Naphtha		



Number of carbon atoms per molecule	Fraction
1-4	
5-10	
11-16	
16-20	
20-35	
more than 70	

**6** Propane and propene are hydrocarbons. They are also gases at room temperature.

**(a)** In the space below, draw the structural formula of propane and propene. [1]

Propane	Propene

**(b)** Reddish-brown aqueous bromine can be used to distinguish between the two hydrocarbons. It turns from reddish-brown to colourless when added to a test-tube containing propene but this is not observed for the test-tube containing propane. Explain the reason behind this observation. [1]

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### Section B (16 marks)

Answer any **two** questions in the spaces provided.

- 7 (a) The following list shows seven elements in order of reactivity.

<b>Most reactive</b>	—————→	<b>Least reactive</b>
Potassium > Magnesium > Carbon > Iron > Tin > Copper > Gold		

- (i) Why does gold occur mostly as pure gold in the Earth's crust while potassium only occurs as potassium compounds? [1]

\_\_\_\_\_

- (ii) Based on the position of the metals in the reactivity series, state the method that is most likely used to extract the metal from its compound. [2]

1. Magnesium from molten magnesium chloride

\_\_\_\_\_

2. Tin from tin(IV) oxide

\_\_\_\_\_

- (iii) Steel cans are usually coated with tin. Give a reason for this. [1]

\_\_\_\_\_

\_\_\_\_\_

- (b) Suggest an explanation for each of the following statements.

- (i) A piece of iron left near the sea rusts very quickly, but a similar piece of iron dropped into deep seawater rusts very slowly. [1]

\_\_\_\_\_

\_\_\_\_\_

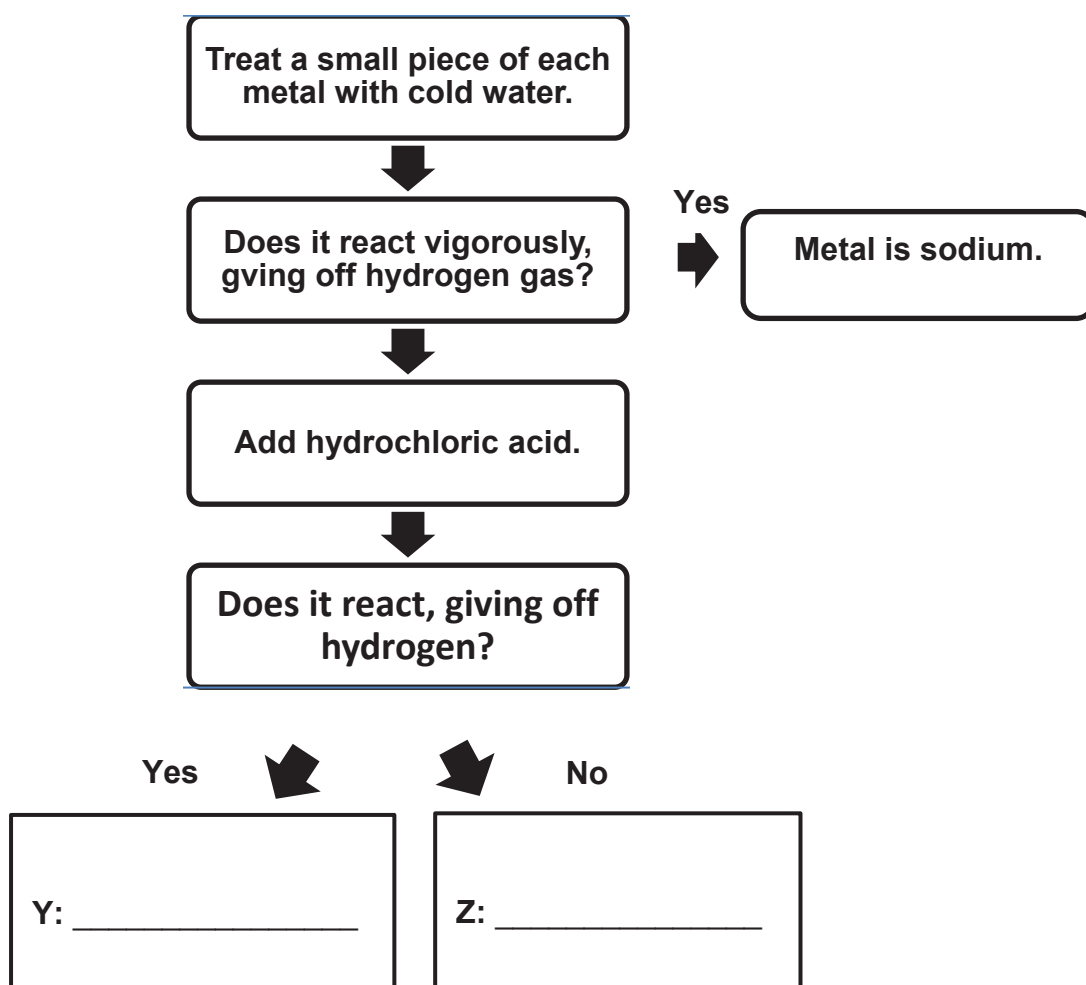
(ii) Recycling metals can save money.

[1]

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- (c) A chemist was given three metals labelled **X**, **Y** and **Z**. He had to identify which one was copper, sodium or zinc. To do so, he carried out a series of experiments. The flow chart below summarises what the chemist did.



- (i) Fill in the blanks for **Y** and **Z** in the flow chart.

[1]

- (ii) Why was it important for the chemist to identify sodium before identifying other metals?

[1]

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8 Rubidium is in Group I of the Periodic Table.

- (a) Give the chemical name of the element that is in the same period as Rubidium but is in Group IV. [1]

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- (b) The gas produced when rubidium is added to a beaker of water is hydrogen gas. Describe the chemical test carried out in the laboratory to confirm the identity of the gas and state all observations, if any. [2]

**Chemical test:**

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**Observation:**

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- (c) Write a balanced chemical equation to show the reaction between rubidium and water. [1]

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- (d) Predict the colour of the Universal Indicator in a solution formed from the reaction of rubidium and water. [1]

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- (e) Suggest an element in Group I that reacts **more** violently than rubidium does. [1]

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- (f) State **two** other physical properties of rubidium. [2]

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- 9 (a)** Sodium and chlorine are elements in the same period of the Periodic Table. When they react with each other, they form a neutral compound known as sodium chloride.

**(i)** Draw the “dot-and-cross” diagram for sodium chloride, showing **all** electrons. [2]

**(ii)** Predict whether the compound has a high or low melting and boiling point. Explain your answer. [2]

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**(iii)** Predict whether the compound can conduct electricity in its solid state. [1]

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- (b) Five unknown substances are investigated for three properties and the results are shown in the table below. Each substance is represented by a letter.

Substance	Melting Point / °C	Electrical conductivity in solid state	Electrical conductivity in liquid state
A	98	Good	Good
B	2027	Nil	Nil
C	-23	Nil	Nil
D	870	Nil	Good
E	1083	Good	Good

By using each letter once, more than once or not at all, determine the substance which is [3]

- (i) Composed of small covalent molecules

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- (ii) A non-conductor of electricity in any physical state

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- (iii) Most likely to be soluble in water, but insoluble in organic solvent

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\*\*\* END OF PAPER \*\*\*

# The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
3 Li lithium 7	4 Be beryllium 9	<div>Key</div> <div>proton (atomic) number atomic symbol name relative atomic mass</div>										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	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5
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
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 -

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



## Sec 4N Science Chemistry Preliminary Examinations 2018

1	B	6	A	11	B	16	A
2	C	7	B	12	C	17	A
3	D	8	A	13	D	18	C
4	C	9	B	14	B	19	C
5	B	10	D	15	B	20	B

### SECTION A

Qn	Ans				M	Remarks	
1		W-compound X- Compound Y-Mixture Z-Compound			2	2 correct 1m	
2	a	Silver chloride			1		
	b	<u>Mix</u> sodium chloride solution and silver nitrate solution together in a test-tube. A white precipitate of silver chloride is formed. <u>Filter the mixture.</u> The <u>residue/precipitate</u> is silver chloride and filtrate sodium nitrate. <u>Wash</u> the precipitate with a little distilled water. <u>Dry</u> between two pieces of filter paper. A pure, dry sample of silver chloride is obtained.			2	1m – mixing and filtering must be mentioned 1m- washing and drying must be mentioned	
3	a	$M_r \text{ of } Y_2O_3 = 2(89) + 3(16) = 226$			1		
	b	No of moles of C = $18,000,000 / 12 = 1500,000\text{mol}$ [1]  From equation, 3 moles of C produces 2 moles of Y. Hence, 1500,000 moles of C produces 1000,000 moles of Y. Mass of Y = no of moles of Y x $A_r$ of Y = $1000,000 \text{ mol} \times 89 = 89000,000\text{g}$ or 89 tonnes [1]  Accept ecf			2		
4	a	Stay indoors and minimise outdoor activities. Wear a face mask when they need to go outdoors.			1	Any logical answer	
	b		<b>Air pollutant</b>	<b>Major source</b>	<b>Effect on human health</b>	1	1m for each pollutant (entire row to be correct to be awarded)
			Sulfur dioxide	Combustion of sulfur-containing fuels/fossil fuels	Eye and lung irritation /		



				OR activity	Volcanic	breathing difficulties/ form acid rain and damages skin															
5			<table><tr><th>Number of carbon atoms per molecule</th><th>Fraction</th></tr><tr><td>1-4</td><td>Petroleum gas</td></tr><tr><td>5-10</td><td>Petrol</td></tr><tr><td>7-14</td><td>Naphtha</td></tr><tr><td>11-16</td><td>Kerosene</td></tr><tr><td>16-20</td><td>Diesel oil</td></tr><tr><td>20-35</td><td>Lubricating oil</td></tr><tr><td>more than 70</td><td>Bitumen</td></tr></table>	Number of carbon atoms per molecule	Fraction	1-4	Petroleum gas	5-10	Petrol	7-14	Naphtha	11-16	Kerosene	16-20	Diesel oil	20-35	Lubricating oil	more than 70	Bitumen	2	Every 4 correct boxes – 1m
Number of carbon atoms per molecule	Fraction																				
1-4	Petroleum gas																				
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11-16	Kerosene																				
16-20	Diesel oil																				
20-35	Lubricating oil																				
more than 70	Bitumen																				
		In picture: Fractionating tower																			
6	a	Propane:					1	1m – Both are correct													
	b	Propene is unsaturated but not propane					1														

		Acceptable answers – Unsaturation in propene / carbon-carbon double bond present in propene/ C=C bond in propene		
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## SECTION B

Qn		Ans	M	Remarks
7	a(i)	Gold is <u>unreactive</u> but potassium is <u>reactive</u> .	1	
	(ii)	1. <u>Electrolysis</u> 2. <u>Reduction by carbon/using carbon or hydrogen</u>	2	1m each
	(iii)	Tin is an <u>unreactive</u> metal. It acts as a protective layer to <u>protect/prevent the iron/steel</u> from rusting/ <u>rust/react instead of steel/iron</u>	1	
	b(i)	There is <u>lesser oxygen</u> in deep seawater to react with iron to form rust.	1	
	(ii)	Recycling <b>reduces</b> the amount of <b>money</b> spent on <b>extracting and purifying of metals</b> from ores.  OR It also <b>saves the cost of building landfill sites</b> for metal disposal.	1	Accept any other logical answer.
	c(i)	Y: Zinc Z: Copper	1	Both correct to get 1m
	(ii)	Sodium would <u>explode</u> if it were added to hydrochloric acid / <u>catch fire / very vigorous reaction</u>	1	
8	a	Tin	1	
	b	Chemical test: Place a <u>lighted splint</u> at the mouth of the test-tube. Observation: The <u>lighted splint is extinguished with a 'pop' sound</u> .	2	1m – chemical test 1m- observation
	c	$2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$	1	
	d	Purple/Blue	1	
	e	Caesium / Francium	1	
	f	<u>Soft; cut easily with a knife</u> <u>Low density / float on water</u>	2	
9	a(i)	<b>Sodium chloride:</b>	2	1m for each correct ion
	(ii)	It has a <u>high melting and boiling point</u> . [1] A large amount of heat energy is needed to	2	

		overcome the strong electrostatic forces of attraction /ionic bonds between the sodium and chloride ions. [1]		
	(iii)	It does not conduct.	1	
	b(i)	C	1	
	(ii)	C	1	
	(iii)	D	1	

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