N

GAN ENG SENG SCHOOL
Mid-Year Examination 2018

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

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.

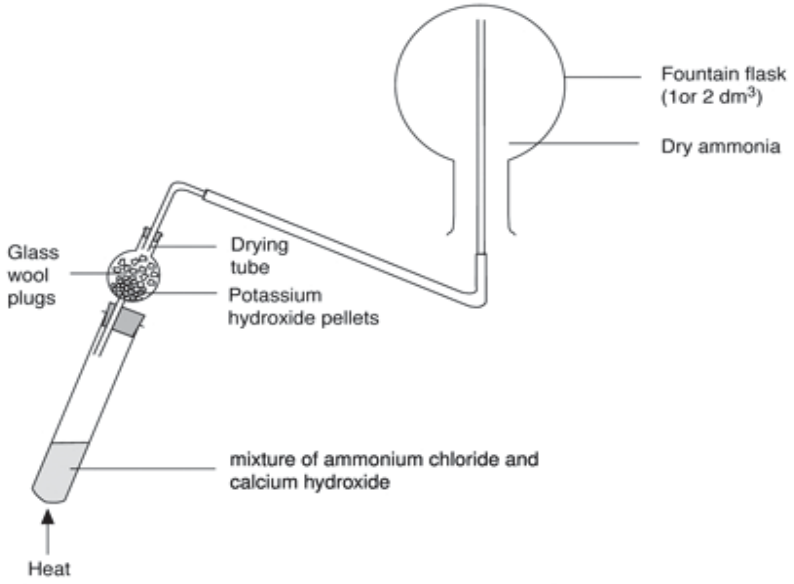
There are **twenty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate OTAS.
Each correct answer will score one mark. A mark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

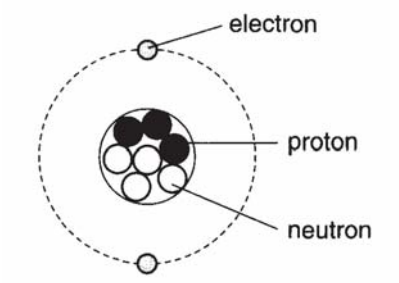
Total Marks
20

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.

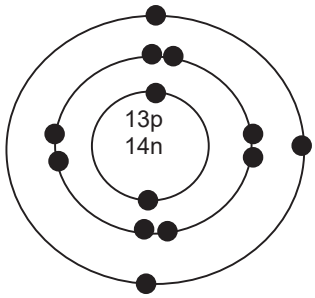
2 The diagram shows the structure of a particle.



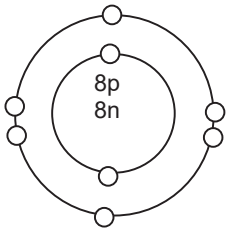
Which of these best describes the above structure accurately?

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**.



M

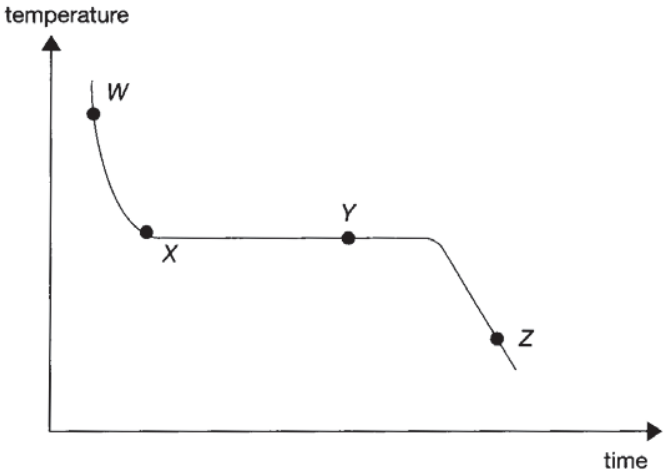


N

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

	formula	mass of one mole (g)
A	MN	43
B	M_3N_2	113
C	MN_2	70
D	M_2N_3	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

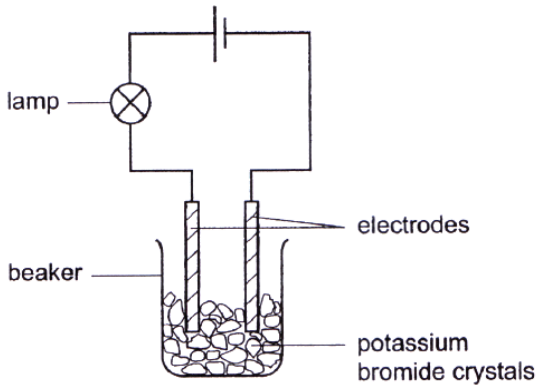
5 Titan is the largest moon of the planet Saturn and it is the only moon in the Solar System with an atmosphere. The following substances are present:

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.

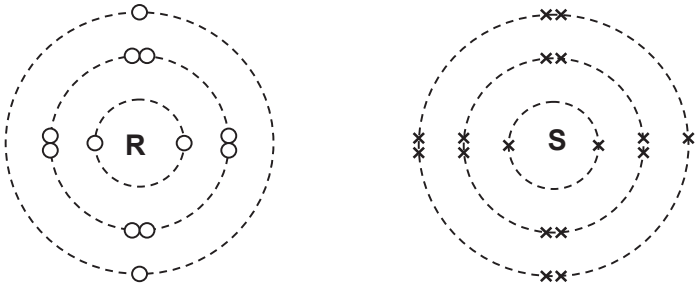


The lamp does not light up.
Distilled water is then added to the beaker and the lamp lights up.

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?

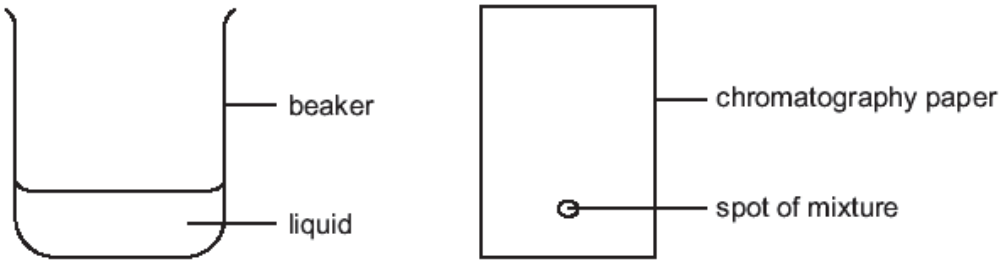
A R_2S ; covalent

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

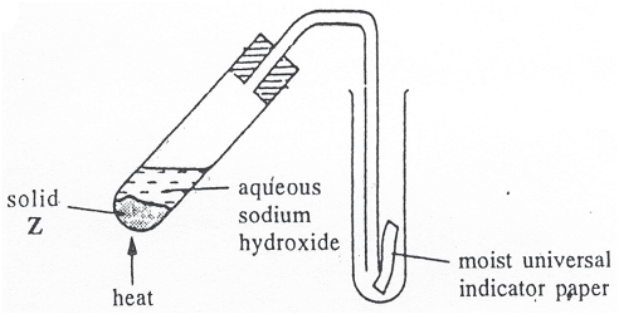
B 3, 1, 2 (omit 4)

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 ?

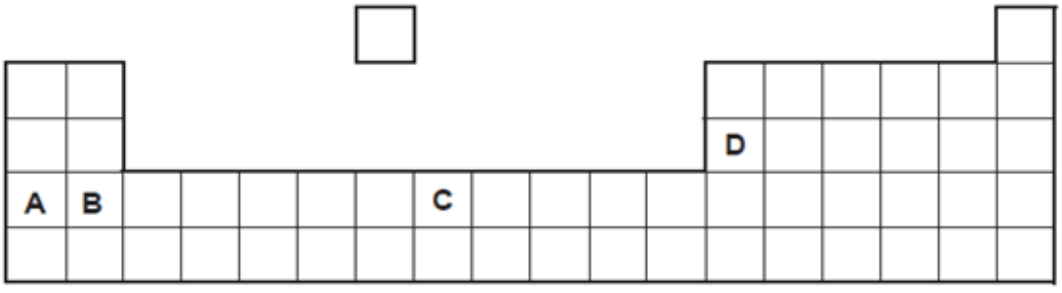
A Apple and Celery
B Orange and Spinach
C Lemon and Banana
D Celery and Carrot

12 Which statement about the Periodic Table is correct?

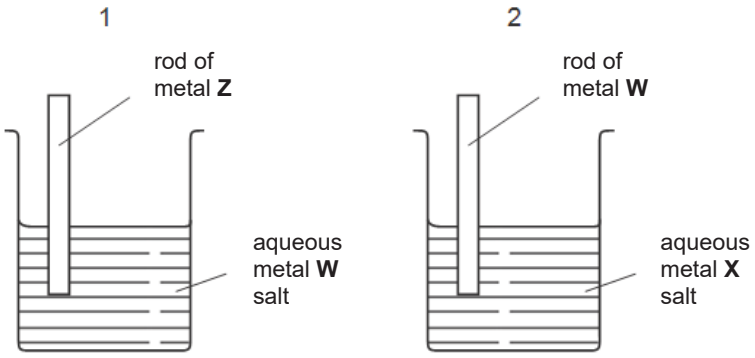
A Atoms of all elements in the same Group have the same total number of electrons.
B All Groups contain both metallic elements and non-metallic elements.
C There are more non-metallic than metallic elements.
D In Group VII, the melting and boiling points increase with increasing proton number.

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 XCl_2 and XCl_3.

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



14 Two different beakers are set up as shown.



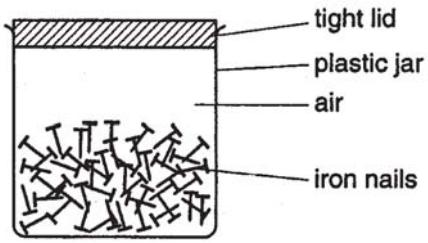
In beaker 1, metal **W** is displaced from the solution.
In beaker 2, metal **X** is displaced from the solution.

What is the order of decreasing reactivity of the metals?

most reactive ----------> least reactive

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

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?

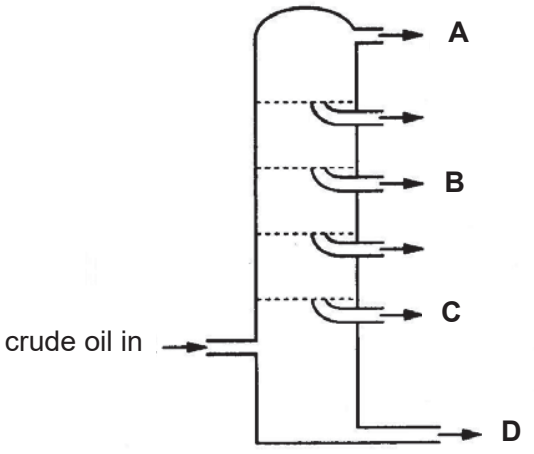
	sulfur dioxide	nitrogen dioxide	carbon monoxide
A	17	46	23
B	32	33	30
C	38	40	11
D	45	14	21

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

A carbon dioxide
B neon
C oxygen
D methane

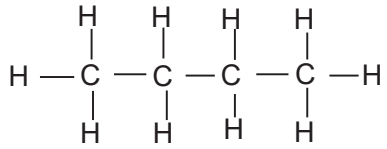
18 The diagram shows levels in a fractionating tower used for the fractional distillation of crude oil.

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

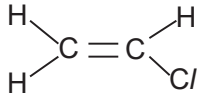


19 Which of the following shows an unsaturated hydrocarbon?

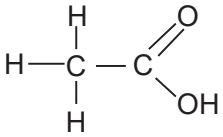
A



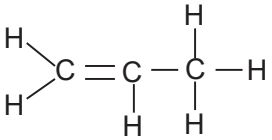
B



C



D



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

A $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

B $4CH_4 + 7O_2 \rightarrow 2CO_2 + 8H_2O + 2CO$

C $CH_4 + O_2 \rightarrow C + 2H_2O$

D $CH_4 + O_2 \rightarrow C + 2H_2 + O_2$

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
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number / atomic symbol / name / relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

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

N

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CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

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.

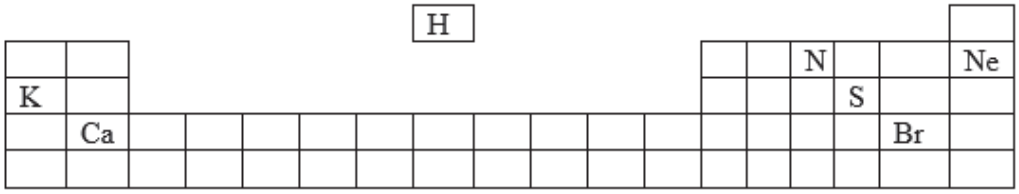
	For Examiner's Use	
Section A		
Section B	.....	
	.....	
Total		**30**

For Examiner's use

Section A [14 marks]

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

1 The diagram below shows some elements in the Periodic Table.



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]

a) salt from seawater ……

b) petrol from crude oil ……

c) water from a mixture of dyes ……

d) 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	
Asatine		Solid

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

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

For Examiner's use

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]

.....

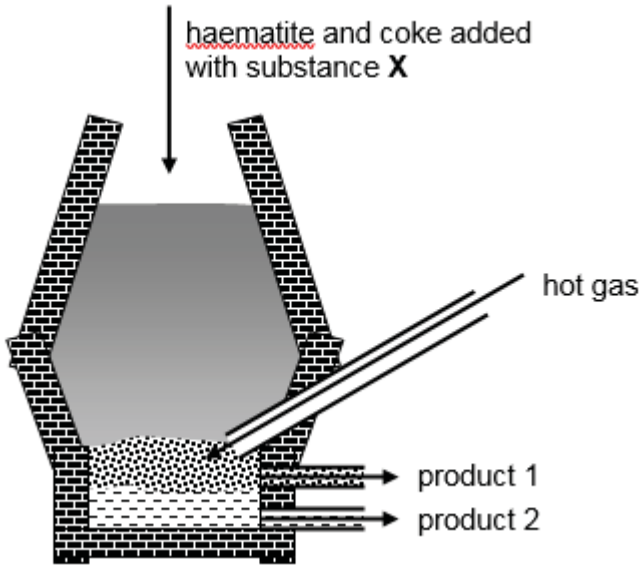
.....

.....

.....

[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: .....

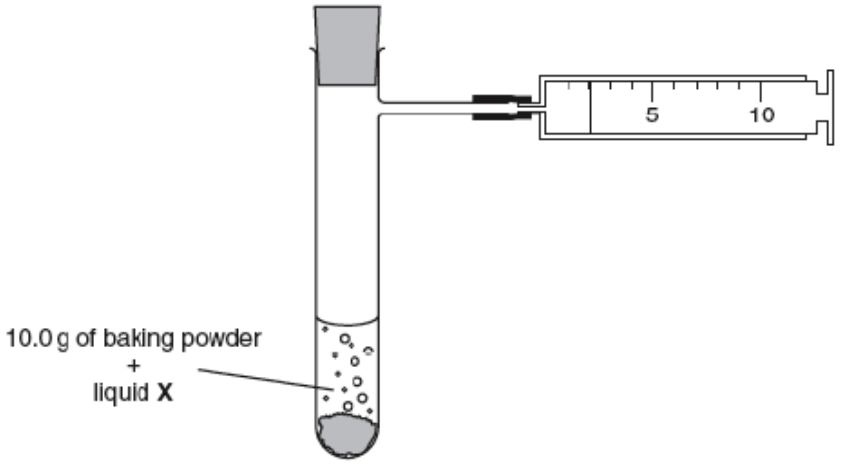
Product 2: .....

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^3
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 (^oC)
Methane	CH_4	-161
Ethane	C_2H_6	-89
?	?	?
Butane	C_4H_{10}	-0.5
Pentane	C_5H_{12}	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

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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

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

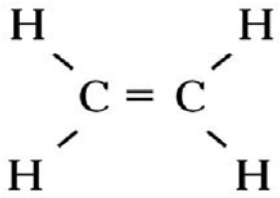
Answers for Secondary 4 Normal Academic Chemistry 5105/5107 MYE P3 2018

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

A1	a) K, Ca	[1]	**Markers' Comment** 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
A2	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
A3	a) Colour: black, State: solid	[2]	Many students wrote liquid as the physical state. To clear this misconception
	b) Cl_2 + 2NaAt → 2NaCl + At_2	[1]	Many students wrote At instead of 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
A4	(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
B5	a)It is a metal It loses 2 electrons to form a positive ion with charge 2+.	[1] [1]	Well-answered

	b) chemical formula : FaO  	Correct transfer of 2 electrons from Fa to O [1] Correct charge [1]	Some students did not show the full shell of Fa.
	c) other reactant : sulfuric acid Steps to obtain pure sample of Farallium sulfate - add excess Farallium carbonate to sulfuric acid and stir and filter to remove excess carbonate - evaporate filtrate till a saturated solution is formed - cool the solution for crystals to form, wash with distilled water and press dry between sheets of filter paper.	[1] [1] [1] [1]	Some students forgot to state the other reactant.
B6	(ai) Substance X is limestone. Substance X removes acidic impurities.	[1] [1]	Some students were not able to explain the reason for use of limestone
	(aii) Product 1 : Molten slag Product 2 : Molten iron	[1] [1]	Well-answered
	(aiii) Fe_2O_3 + 3CO → 2Fe + $3CO_2$	[1]	Poorly answered. Never study notes
	(bi) Carbon Dioxide	[1]	Some students wrote hydrogen which is wrong.
	(bii) Expt 2 is carried out at a higher temperature than expt 1	[1]	Most students able to infer that higher temperature leads to more gas formed
	(biii) Volume of gas produced after 5 minutes- $8dm^3$ No of moles = Volume of Gas / $24dm^3$ = 8 / 24 = 0.333 moles (3 s.f)	[1]	Well-answered
B7	(a)A hydrocarbon is a compound that contains only hydrogen and carbon atoms.	[1]	Well-answered. But some students did not write full definition and only wrote it contains hydrogen and carbon atoms only.
	(b) i) Propane & C_3H_8	[2]	Well-answered
	ii) -50°C to -30°C	[1]	Well-answered
	(ci)	[2] 1m for carbon double bond	Well-answered

	 (cii) Reddish-brown solution turns to colourless solution. (ciii) addition reaction	and 1m for correct structural formula [1] [1]	Some students forgot to write the colour change Bromination is also accepted