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.

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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.

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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 In^{3+} ions and the sulfate ion has the formula SO_4^{2-}. What is the chemical formula of indium(III) sulfate?

A $In(SO_4)_2$
B $In_2(SO_4)_3$
C In_2SO_4
D $InSO_4$

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**
A	Red	Blue
B	Red	Yellow
C	Blue	Red
D	Yellow	Red

9 Which of the following shows the correct type of oxide for the element?

	Element	**Type of oxide**
A	Carbon	Amphoteric
B	Hydrogen	Neutral
C	Sulfur	Basic
D	Zinc	Acidic

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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^-
C Calcium ion, Ca^{2+}
D Potassium ion, K^+

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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

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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 *****

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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											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 –

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

The volume of one mole of any gas is 24 dm^3 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.

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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]

W: A black solid which is formed by strongly heating copper in oxygen. Element / Compound / Mixture	**X**: A gas that is required by green plants for photosynthesis. Element / Compound / Mixture
Y: 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	**Z**: 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]

_____

(b) Describe the steps that she must take to obtain a pure, dry sample of the salt. [2]

_____

_____

_____

_____

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3 Yitrium, Y is a period 5 element that can be manufactured from its oxide using carbon as shown in the following equation:

$$Y_2O_3\,(s) + 3C\,(s) \rightarrow 2Y\,(s) + 3CO\,(g)$$

(a) Calculate the relative molecular mass, M_r of Y_2O_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]

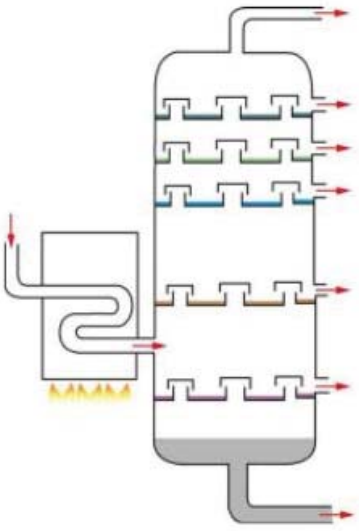
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(b) List the major source of the air pollutant below and its effect on human health. [1]

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	
7-14	
11-16	
16-20	
20-35	
more than 70	

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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.

Most reactive ⟶ **Least reactive**
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]

_____

_____

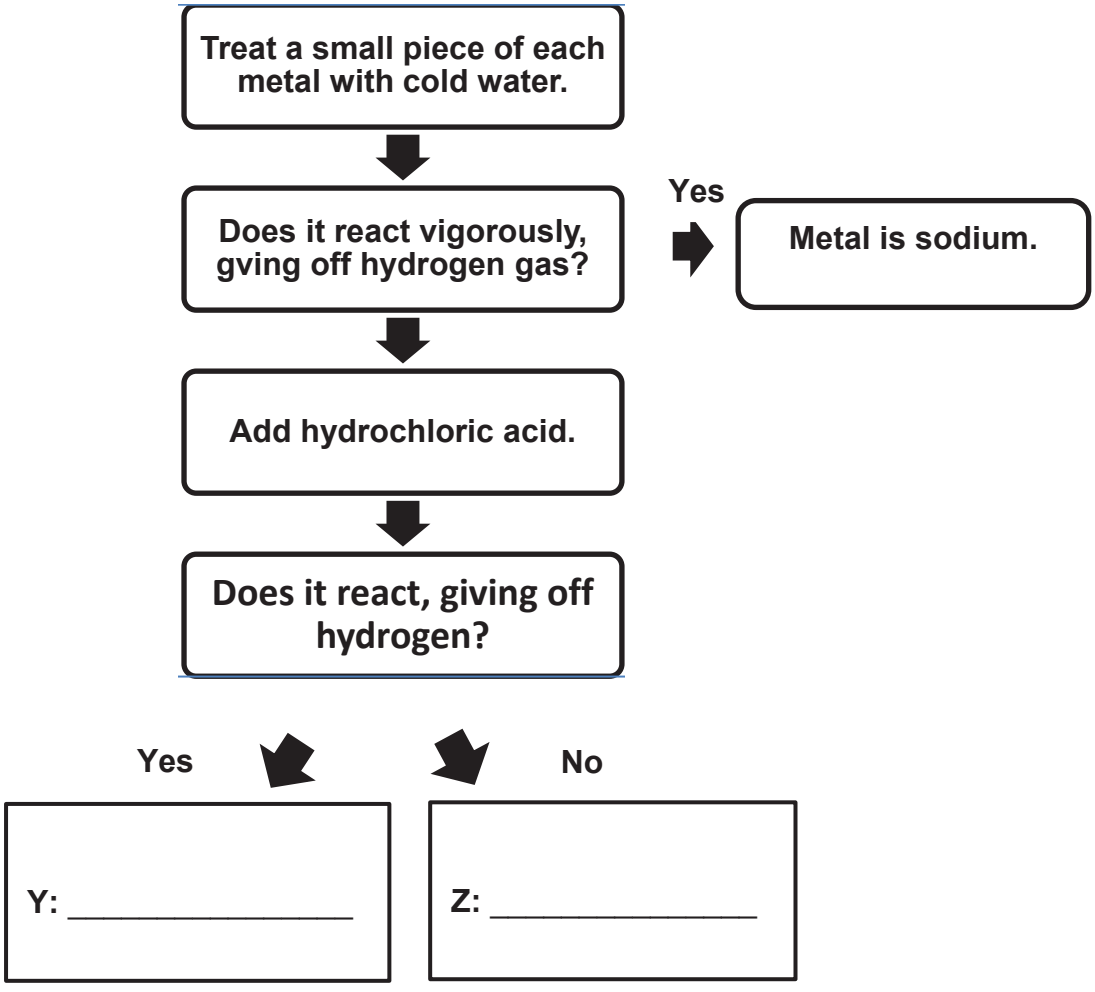
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(ii) Recycling metals can save money. [1]

_____

_____

(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]

_____

(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:

_____

_____

Observation:

_____

_____

(c) Write a balanced chemical equation to show the reaction between rubidium and water. [1]

_____

(d) Predict the colour of the Universal Indicator in a solution formed from the reaction of rubidium and water. [1]

_____

(e) Suggest an element in Group I that reacts **more** violently than rubidium does. [1]

_____

(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]

_____

_____

_____

(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

_____

(ii) A non-conductor of electricity in any physical state

_____

(iii) Most likely to be soluble in water, but insoluble in organic solvent

_____

***** END OF PAPER *****

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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											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 –		

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
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.).

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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	Mix sodium chloride solution and silver nitrate solution together in a test-tube. A white precipitate of silver chloride is formed. Filter the mixture. The residue/precipitate is silver chloride and filtrate sodium nitrate. Wash the precipitate with a little distilled water. Dry 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	Mr of Y_2O_3 = 2(89) + 3(16) = 226	1	
	b	No of moles of C = 18,000,000 / 12 = 1500,000mol [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 mol x 89 = 89000,000g 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	**Air pollutant** / **Major source** / **Effect on human health** Sulfur dioxide / Combustion of sulfur-containing fuels/fossil fuels / Eye and lung irritation /	1	1m for each pollutant (entire row to be correct to be awarded)

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				OR Volcanic activity	breathing difficulties/ form acid rain and damages skin		
5			**Number of carbon atoms per molecule**	**Fraction**		2	Every 4 correct boxes – 1m
			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			
		In picture: Fractionating tower					
6	a	Propane: Propene:				1	1m – Both are correct
	b	Propene is unsaturated but not propane				1	

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		Acceptable answers – Unsaturation in propene / carbon-carbon double bond present in propene/ C=C bond in propene		

SECTION B

Qn		Ans	M	Remarks
7	a(i)	Gold is unreactive but potassium is reactive.	1	
	(ii)	1. Electrolysis 2. Reduction by carbon/using carbon or hydrogen	2	1m each
	(iil)	Tin is an unreactive metal. It acts as a protective layer to protect/prevent the iron/steel from rusting/ rust/react instead of steel/iron	1	
	b(i)	There is lesser oxygen in deep seawater to react with iron to form rust.	1	
	(ii)	Recycling **reduces** the amount of **money** spent on **extracting and purifying of metals** from ores. OR It also **saves the cost of building landfill sites** for metal disposal.	1	Accept any other logical answer.
	c(i)	Y: Zinc Z: Copper	1	Both correct to get 1m
	(ii)	Sodium would explode if it were added to hydrochloric acid / catch fire / very vigorous reaction	1	
8	a	Tin	1	
	b	Chemical test: Place a lighted splint at the mouth of the test-tube. Observation: The lighted splint is extinguished with a 'pop' sound.	2	1m – chemical test 1m- observation
	c	$2Rb + 2H_2O \rightarrow 2RbOH + H_2$	1	
	d	Purple/Blue	1	
	e	Caesium / Francium	1	
	f	Soft; cut easily with a knife Low density / float on water	2	
9	a(i)	***Sodium chloride:***	2	1m for each correct ion
	(ii)	It has a high melting and boiling point. [1] A large amount of heat energy is needed to	2	

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		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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