13 Oct 2021

70 marks

Papers 1 and 2: 1 hour 30 minutes



Name	Class	Register Number

SECONDARY 3 EXPRESS END OF YEAR EXAMINATION 2021

SCIENCE (CHEMISTRY)

Paper 1 Multiple Choice

Wednesday 0800 - 0930

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in. Write in dark blue or black pen.

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

There are **ten** 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 the boxes provided on page 4.

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 paper.

A copy of the Periodic Table is printed on page 12 of Paper 2.

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

You are advised to spend no more than **15 minutes** on Paper 1. You may proceed to answer Paper 2 as soon as you have completed Paper 1. At the end of the examination, submit your answers to Paper 1 and Paper 2 separately.

This document consists of 4 printed pages, including the cover page.

Setter: Ms Chua Wei Tian

[Turn over

- 1 Rock salt is a mixture of sand and sodium chloride. Sodium chloride is soluble in water but not in alcohol. Sand is insoluble in both water and alcohol. What is required to separate sand from the sodium chloride?
 - 1 alcohol
 - 2 filter paper
 - 3 fractionating column
 - 4 water

Α	1 and 3	В	1 and 4
С	2 and 3	D	2 and 4

2.00 g of powdered calcium carbonate is added to 49.00 cm³ of dilute hydrochloric acid. Which apparatus is best used to measure the calcium carbonate and dilute hydrochloric acid?
 calcium carbonate hydrochloric acid

OA	calcium carbonate	hydrochloric acid
A	beaker	burette
в	beaker	pipette
С	mass balance	burette
D	mass balance	pipette

3 Four coloured dyes are separated using chromatography. Which chromatogram shows a dye which contains an insoluble component?



4 Period 3 of the Periodic Table is shown.

Na	Mg	Al	Si	Р	S	Cl	Ar
----	----	----	----	---	---	----	----

Which characteristic of the elements increases from Na to Ar across Period 3?

Α	density	В	melting point
С	non-metallic character	D	number of electron shells

5 An element **Y** reacts with oxygen to form an ionic compound with the formula **Y**₂O₃. Which group of the Periodic Table is element **Y** found in?

Α	Group II	в	Group III
С	Group V	D	Group VII

- 6 Lead(II) oxide is an amphoteric oxide. Which statement about lead(II) oxide is correct?
 - A It will not react with hydrochloric acid but will react with sodium hydroxide.
 - **B** It will not react with hydrochloric acid or sodium hydroxide.
 - **C** It will react with hydrochloric acid and sodium hydroxide.
 - D It will react with hydrochloric acid but not sodium hydroxide.
- 7 Four different solutions, J, K, L and M, are tested with Universal Indicator.

solution	J	К	LE	M
colour with Universal Indicator	green	red	purple	orange

В

D

Which solutions are acidic?

- A J and M
- C K only

K and M L only

8 What is the ionic equation for the reaction between dilute nitric acid and dilute sodium hydroxide?

В

- $\mathbf{A} \qquad \mathsf{H}^+(\mathsf{aq}) + \mathsf{NO}_3^-(\mathsf{aq}) \to \mathsf{HNO}_3(\mathsf{aq})$
- **C** Na⁺(aq) + NO₃⁻(aq) \rightarrow NaNO₃(aq)
- $H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$
- D Na⁺(aq) + OH⁻(aq) → NaOH(aq)
- 9 Which statement about evaporation is false?

A It occurs only at the boiling point.

- B It occurs only at the surface of the liquid.
- C It occurs slowly.
- D It occurs when a substance converts from the liquid to the gaseous state.

10 Which technique can be used to obtain a pure sample of water from sodium chloride solution?





Answers for Paper 1

1	2	3	4	5	6	7	8	9	10

End of Paper 1



 Name
 Class
 Register Number

 SECONDARY 3 EXPRESS END OF YEAR EXAMINATION 2021
 13 Oct 2021

 SCIENCE (CHEMISTRY) Paper 2 Chemistry Wednesday 0800 – 0930
 13 Oct 2021 Papers 1 and 2: 1 hour 30 minutes 70 marks

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

 READ THESE INSTRUCTIONS FIRST Write your class, register number and name on all the work you hand in.

Write in dark blue or black pen only.

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 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 15 minutes on Paper 1.

You may proceed to answer Paper 2 as soon as you have completed Paper 1.

A copy of the Periodic Table is printed on page 12 of Paper 2.

At the end of the examination hand in your answers to Paper 1 and Paper 2 separately.

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

	For Examiner's Use
Section A	
Section B	
Total	

This document consists of 12 printed pages, including the cover page.

Setter: Ms Chua Wei Tian

[Turn over

Section A [40 marks]

Answer **all** the questions in this section. Write your answers in the spaces provided on the question paper.

1 Table 1.1 shows the melting and boiling points of four substances, W, X, Y and Z.

	Table 1.1	
substance	melting point / °C	boiling point / °C
w	-182	-161
x	115	445
YAY	-7	59
Z	-169	-85

(a) Identify the substance that exists as a liquid at room temperature and pressure.

- (b) Identify the substance that exists as a gas at -100°C.
- (c) Draw, in the box provided in Fig. 1.1, the arrangement of particles in substance X at −10°C. You may use circles to represent the particles.





Fig. 1.1

DANYAL

Explain, in terms of kinetic particle theory, the change in the arrangement and movement of the particles in substance Y as it is heated from -10°C to 10°C.

2

- 2 An atom is the smallest particle of an element and can be described as an electrically neutral particle.
 - (a) Explain why an atom is *electrically neutral*.

(b) (i) Complete Table 2.1 to show the number of protons, neutrons and electrons present in atoms of ²³/₁₁Na and ²⁴/₁₁Na.

		Та	able 2.1	
No.	atom	number of protons	number of neutrons	number of electrons
	²³ ₁₁ Na			EDU
	²⁴ ₁₁ Na			

[2]

- (ii) What is the name given to describe atoms of the same element, such as ${}^{23}_{11}$ Na and ${}^{24}_{11}$ Na?
- (iii) Explain why the chemical properties of ²³/₁₁Na and ²⁴/₁₁Na are the same.
- (iv) Predict one difference in the physical properties of ²³/₁₁Na and ²⁴/₁₁Na.
- (c) Complete Table 2.2 to identify the charges of particles that have the following numbers of protons, neutrons and electrons.

Та	b	le	2.2	
	-	-		

charge of particle	number of protons	number of neutrons	number of electrons
2+	12	12	10
	4	5	4
	17	20	18

[2]

- 3 (a) Magnesium chloride has a high melting point and is a conductor of electricity when molten.
 - (i) Name the type of chemical bonding present in magnesium chloride.

(ii) Draw a 'dot and cross' diagram to show the arrangement of the outer shell electrons in magnesium chloride in the space provided. [Proton numbers: Mg, 12; Cl, 17]

[2] (iii) Explain why magnesium chloride is a conductor of electricity when molten but not in the solid state. , set b (b) Chlorine, Cl₂, has a much lower boiling point than magnesium chloride. Use your knowledge of the bonding in chlorine and magnesium chloride to explain the difference in their boiling points.

4 In each of these redox equations, identify the oxidising agent and the reducing agent.

(a)	$Zn + Fe^{2+} \rightarrow Zn^{2+} + Fe$		
	oxidising agent	reducing agent	[1]
(b)	$2Cu_2O + C \rightarrow 4Cu + CO_2$		
	oxidising agent	reducing agent	[1]

5 Fig. 5.1 shows the arrangement of particles in six different substances, A, B, C, D, E and F.





Which substance best represents

(a)	oxygen gas,	
(b)	water vapour,	
(c)	a mixture of two elements,	[1]
(d)	a mixture of two compounds,	[1]
(e)	a mixture of an element and a compound.	[1]



6 Fig. 6.1 shows the apparatus a student used to prepare a dry sample of chlorine gas. Chlorine gas is denser than air.



7 Mixture X contains iron(II) nitrate and zinc carbonate. The mixture was first added with water and stirred. Then it was filtered into two portions – the filtrate and the residue. A series of tests was performed as shown in Fig. 7.1.



PRSS_2021_EOY_S3E_SCI(CHEM)_P2

Section B [20 marks]

Answer any **two** questions in this section.

Write your answers in the spaces provided on the question paper.

- 8 (a) A student prepares crystals of copper(II) chloride by adding an excess of copper(II) carbonate to 50.0 cm³ of 2.00 mol/dm³ hydrochloric acid.
 - (i) Write a balanced chemical equation, including state symbols, to represent the reaction.

(ii) Why does the student add an excess of copper(II) carbonate?

(iii) Describe how the student would obtain **pure** and **dry** crystals of copper(II) chloride from the filtrate. You may assume that copper(II) chloride decomposes under strong heating.

EDUCATION [3]

(b) (i) Calculate the number of moles of copper(II) chloride that can be made from 50.0 cm³ of 2.00 mol/dm³ hydrochloric acid. [Relative atomic masses: A_r: H, 1; C*l*, 35.5; Cu, 64]

[2]

(ii) Hence, calculate the maximum mass of copper(II) chloride that can be obtained. [Relative atomic masses: A_r: H, 1; C*l*, 35.5; Cu, 64]

PRSS_2021_EOY_S3E_SCI(CHEM)_P2

Silver chloride, AgCl, is insoluble. It can be made by a precipitation reaction between 9 (a) aqueous barium chloride and a suitable aqueous reactant X. What is meant by the term precipitate? (i) Write a balanced ionic equation, including state symbols, to represent the formation of (ii) silver chloride. Name a suitable aqueous reactant X that can be used to prepare silver chloride. (iii)[1] Describe how you would obtain a pure and dry sample of the precipitate from the reaction (b) mixture. QP-1-105 - V⁻ Suggest one reactant, other than aqueous barium chloride, that can react with aqueous (c) reactant X to obtain silver chloride. reactant A to obtain sliver chloride. Explain why titration is not a suitable method to prepare silver chloride. (d)[2]

10 Phosphine, PH₃, is a gas which has a smell of garlic. It is formed when white solid phosphorus is warmed with aqueous sodium hydroxide.

$$4P + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

(a) (i) Draw a 'dot and cross' diagram to show the arrangement of the outer shell electrons in one molecule of phosphine. [Proton numbers: P, 15; H, 1]

(ii)

Predict one physical property of phosphine besides its low boiling point.

[2]

-[1]
- (b) (i) Calculate the maximum mass of phosphine formed when 1.86 g of phosphorus reacts with excess aqueous sodium hydroxide.

[2]

(ii) Calculate the volume of phosphine formed from 1.86 g of phosphorus at room temperature and pressure.

[1]

(c) Phosphine decomposes into its elements on warming. Write a balanced chemical equation, including state symbols, for this reaction.

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PRSS_2021_EOY_S3E_SCI(CHEM)_P2

- (d) Phosphine reacts with hydrogen iodide to form the salt phosphonium iodide, PH₄I. Phosphonium salts react in a similar way to ammonium salts when warmed with aqueous sodium hydroxide.
 - (i) Identify the products, other than water, formed during the reaction of phosphonium iodide with aqueous sodium hydroxide.

(ii) State the observation that could be made when sodium hydroxide is warmed with phosphonium iodide.

End of Paper EDUCATION

Pasir Ris Secondary School End of Year Examination (Oct 2021) Sec 3E Science(Chemistry) 5076/5078

Marking Scheme

Paper 1

	2	3	4	5	6	7	8	9	10
D	С	D	С	в	С	В	В	Α	D

Paper 2

Que	estior	1	Marking Scheme	Marks	Remarks
Sec	tion	A			
1	(a)	Ter.	Y DI	CASI	
74	(b)		W	1	
	(c)		Barren and Alexandre	1	0.5m – at least 3 rows of particles particles 0.5m – particles touching each other and same size
	(d)	ANY DUCA	From -10°C to -7°C, the particles in solid state are <u>packed</u> <u>very closely together in an orderly manner*</u> and <u>vibrate</u> <u>about their fixed positions</u> [#] . At -7°C, a mixture of liquid and solid states are present. The particles gain energy and move further apart as they overcome the forces of attraction. From -7°C to 10°C, the particles are in the liquid state. The <u>particles</u> are <u>close together in a disorderly manner*</u> and <u>move freely throughout the liquid volume</u> [#] .	2 ANYA DUCAT	1m – comparison between arrangement of particles* 1m – comparison between movement of particles#
2	(a)		The <u>total number of positive charges from the protons</u> is <u>equal to</u> the <u>total number of negative charges from the</u> <u>electrons</u> . Hence, net charge is zero. <i>Reject: "number of protons is equal to number of electrons."</i>	1	

BP~167

 (b)	(i)							2	Minus 0.5m
			number of protons	number of neutrons	numb electr	er of ons			for every incorrect
		²³ ₁₁ Na	<u>11</u>	<u>12</u>	11	L			answer.
		²⁴ 11Na	<u>11</u>	<u>13</u>	11	L			
	(ii)	Isotopes.						1	
	(iii)	They have	e the <u>same n</u>	umber of va	lence ele	ectrons.		1	
DA	(iv)	²⁴ Na has a <u>than</u> ²³ ₁₁ Na <i>Reject:</i> "	a <u>higher den</u> .hiaher mass	sity / boiling	point /	melting r	DAN DAN	CATION	Comparison must be made.
 (c)	000	charge	of numbe	or of numb	orof	umbor of	7	2	1m each
		particl	e proto	ns neuti	ons (electrons			
		2+	12	1:	2	10			
		<u>0</u>	4	5		4	_		
		1-	17	20	N.	18			
				R	102		0		
(a)	(i)	lonic bon	ding.	ED				1	
D	(ii)			8 Mg	2+ ()			2 ANY EDUCA	1m – correct charges for both ions 1m – correct valence electron Minus 0.5m for missing
		Key: x – electro o – electro	ons from chlo	rine Inesium					кеу
	(iii)	Mobile io which ena	ns in the mo able the cond	olten state uction of elec	an <u>act as</u> ctricity.	charge	carriers	2	1m – presence of mobile ions
		However positions the solid s	in solid st and are not state is unable	tate, ions a mobile. Her e to conduct	are held ace magn electricity	l in thei nesium ch /.	i r fixed loride in		1m – fixed position of ions in solid state

	(b)	<u>Chlorine molecules</u> are <u>held together by weak</u> <u>intermolecular forces of attraction</u> which <u>require little</u> <u>amount of energy to overcome them</u> .	2	1m – little vs large amount of energy
		Magnesium chloride consists of oppositely charged ions held together by strong electrostatic forces of attraction which require large amount of energy to overcome them.		1m – compare forces of attraction involved
		Hence, chlorine has a much lower boiling point than magnesium chloride.		
4	(a)	Oxidising agent: <u>Fe²⁺</u> Reducing agent: <u>Zn</u>	YAL	Both must be correct
	(b)	Oxidising agent: <u>Cu₂O</u> Reducing agent: <u>C</u>	CATO	Both must be correct
	1 SOL			
5	(a)	E	1	
	(b)	D	1	
	(c)	<u>C</u>	1	
	(d)	E	1	
	(e)	A EDUCAT	1	
			2	and the second
6	(a)	Box on the left: <u>conical flask</u> – 1m	2	
		Box on the right: gas jar – 1m Also accept: measuring cylinder	Y.	L
		N.		405
	(b)	1. The <u>second conical flask should be stoppered /</u> <u>should not be left opened</u> . – 1m	DUCA	
	ED	 <u>Gas jar should be inverted</u> (i.e. downward delivery of gas) as chlorine is denser than air. – 1m 		
	(c)	<u>Neutral / acidic</u>	1	
		Accept any one of the answers.		
	(d)	Blue litmus paper will <u>turn red</u> (0.5m), <u>then bleached /</u> <u>white</u> (0.5m).	1	

3

7	(a)	(i)	iron(II) nitrate	1	
		(ii)	ammonia	1	
		(iii)	thermal decomposition	1	reject: heating
	(b)		Add any named dilute acid (e.g. nitric acid) to the white residue. <u>Effervescence</u> can be observed / <u>white residue dissolves</u> <u>in the acid</u> to form a colourless solution.	2	
	(c)	ATY DCA?	$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$ 1m – balanced equation 1m – correct chemical formulae for reactants and products	CATION	State symbols not insisted for chemical equation
Sec	tion	B			
8	(a)	(i)	<u>CuCO₃(s) + 2HC<i>l</i>(aq) → CuC<i>l</i>₂(aq) + CO₂(g) + H₂O(<i>l</i>) 1m – formulae are correctly written and the equation is balanced 1m – state symbols are all correct</u>	2	
		(ii)	To ensure that <u>all acids are completely used up</u> . If not, the presence of acid will contaminate the salt formed.	1	
		(iii)	<u>Heat the filtrate until a saturated solution</u> is obtained. <u>Leave the saturated solution to cool</u> so that <u>crystals can</u> <u>form</u> .	3	1m each
		5	Filter the mixture to obtain the crystals. Dry the crystals between sheets of filter paper.	MAN	AL NON
	(b)	(i)	Number of moles of hydrochloric acid = (50 / 1000) x 20 = <u>1.00 mol</u> [1] Molar ratio of hydrochloric acid : copper(II) chloride = 2 : 1 Number of moles of copper(II) chloride = 1.00 / 2 = <u>0.500 mol</u> [1]	2	Allow ecf of molar ratio based on 8(a)(i)
		(ii)	Relative molecular mass of copper(II) chloride = $(64 + 35.5 + 35.5) = 135$ [1] Maximum mass of copper(II) chloride = $0.500 \times (64 + 35.5 + 35.5) = 67.5 \text{ g}$ [1]	2	

BP~170

4

3	(2)	(i)	Precipitate is the solid formed	2	
	(4)	(1)	when at least two aqueous solutions are mixed.		
		(il)	$\underline{Ag^{\pm}(aq) + Cl^{\pm}(aq) \rightarrow AgCl(s)}$	2	
			1m - formulae are correctly written and the equation is		
			balanced		
			1m – state symbols are all correct		
		(iii)	Silver nitrate solution	1	
			Any soluble silver salt solutions		
	(b)		Filter the reaction mixture to obtain silver chloride as the	VAN	
			Wash the residue with a little distilled water.	TON	
	PA		Dry the residue between sheets of filter paper.	<u>}</u> 1	
	(c)		Aqueous hydrochloric acid / sodium chloride / potassium	1	
			<u>chloride / any group I chloride</u>		
	(d)		Titration is used for preparation of soluble salt (1m) from	2	
			or ammonium ions. (1m)		
10	(a)	(i)		2	-0.5 m if
10	(a)	(i)	and another	2	-0.5 m if legend is missing
10	(a)	(i)	(HO P)H	2	-0.5 m if legend is missing
10	(a)	(i)	H P H	2	-0.5 m if legend is missing correct
10	(a)	(i)	H P H	2	-0.5 m if legend is missing correct electronic structure of
10	(a)	(i)	H P H	2	-0.5 m if legend is missing correct electronic structure of three bonding
10	(a)	(i)	H P H	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] end e long
10	(a)	(i)	H P H H	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i)	HPH H H Key: x - electron of H	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i)	HPH H H Key: X - electron of H • - electron of P		-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) 1000 (ii)	H P H H H H Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) 	H P H H H H Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) (ii)	HPHH HPHH HPHH Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density reject "poor conductor"	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) (ii)	HPHH HPHH HPHH Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density reject "poor conductor" reject "low melting point" as it is similar to "low boiling point"	2	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) (ii) (ii)	H P H Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density reject "poor conductor" reject "poor conductor" reject "low melting point" as it is similar to "low boiling point" as given in the question. Number of moles of phosphorus = 1.86/31 = 0.06 mol	2 1 0.5	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) (ii) (i)	H P H Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density reject "poor conductor" reject "low melting point" as it is similar to "low boiling point" as given in the question. Number of moles of phosphorus = 1.86/31 = 0.06 mol	2 1 0.5	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]
10	(a)	(i) (ii) (i)	H P H Key: X - electron of H • - electron of P insoluble in water / does not conduct electricity in any state / low density reject "poor conductor" reject "low melting point" as it is similar to "low boiling point" as given in the question. Number of moles of phosphorus = 1.86/31 = 0.06 mol Number of moles of phosphine = 0.06/4 = 0.015 mol	2 1 0.5 0.5	-0.5 m if legend is missing correct electronic structure of three bonding pairs [1] and a lone pair [1]

	(ii)	Volume of phosphine = 0.015 × 24 = <u>0.360 dm</u> ³	1	ecf allowed
		Also accept : 360 cm ³		
 (c)		$\underline{2PH_3(g)} \rightarrow 2P(s) + 3H_2(g)$	2	
		1m – formulae are correctly written and the equation is balanced 1m – state symbols are all correct		
(d)	(i)	phosphine / PH ₃ (0.5m)	1	accept both names and
		sodium iodide / NaI (0.5m)	.NU	formulae
	(ii)	smell of garlic / effervescence	TION	
 OP		10.	Ca	



