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Pasir Ris Secondary School

Name	Class	Register Number
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SECONDARY 3 EXPRESS END OF YEAR EXAMINATION 2021

SCIENCE (CHEMISTRY)

13 Oct 2021

Paper 1 Multiple Choice

Papers 1 and 2: 1 hour 30 minutes

70 marks

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 alcohol
- 2 filter paper
- 3 fractionating column
- 4 water

B 1 and 4

D 2 and 4

- | | calcium carbonate | hydrochloric acid |
|----------|-------------------|-------------------|
| A | beaker | burette |
| B | beaker | pipette |
| C | mass balance | burette |
| D | mass balance | pipette |

-

- | | | | | | | | |
|----|----|----|----|---|---|----|----|
| Na | Mg | Al | Si | P | S | Cl | Ar |
|----|----|----|----|---|---|----|----|

B melting point

D number of electron shells

- A** Group II **B** Group III
C Group V **D** Group VII

- 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.

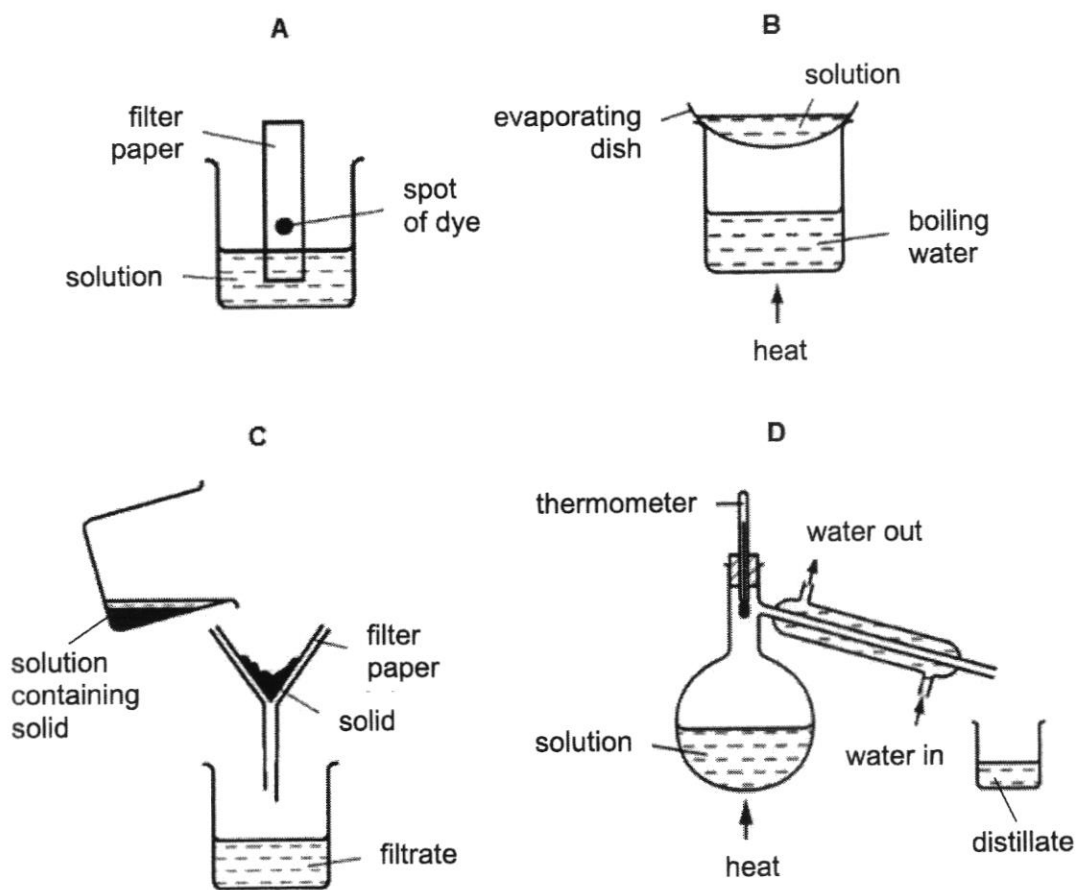
- | solution | J | K | L | M |
|---------------------------------|-------|-----|--------|--------|
| colour with Universal Indicator | green | red | purple | orange |

A J and M **B** K and M
C K only **D** L only

- A** $\text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{HNO}_3(\text{aq})$ **B** $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
C $\text{Na}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq})$ **D** $\text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NaOH}(\text{aq})$

- 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



Pasir Ris Secondary School

Name	Class	Register Number
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SECONDARY 3 EXPRESS END OF YEAR EXAMINATION 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.

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
Y	-7	59
Z	-169	-85

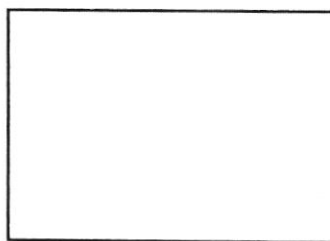
- (a) Identify the substance that exists as a liquid at room temperature and pressure.

..... [1]

- (b) Identify the substance that exists as a gas at -100°C.

..... [1]

- (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**

- (d) 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. [1]

.....

.....

..... [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*.

.....
 [1]

- (b) (i) Complete Table 2.1 to show the number of protons, neutrons and electrons present in atoms of $^{23}_{11}\text{Na}$ and $^{24}_{11}\text{Na}$.

Table 2.1

atom	number of protons	number of neutrons	number of electrons
$^{23}_{11}\text{Na}$			
$^{24}_{11}\text{Na}$			

[2]

- (ii) What is the name given to describe atoms of the same element, such as $^{23}_{11}\text{Na}$ and $^{24}_{11}\text{Na}$?

..... [1]

- (iii) Explain why the chemical properties of $^{23}_{11}\text{Na}$ and $^{24}_{11}\text{Na}$ are the same.

..... [1]

- (iv) Predict **one** difference in the physical properties of $^{23}_{11}\text{Na}$ and $^{24}_{11}\text{Na}$.

..... [1]

- (c) Complete Table 2.2 to identify the charges of particles that have the following numbers of protons, neutrons and electrons.

Table 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.

..... [1]

(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.

.....

.....

..... [2]

(b) Chlorine, Cl_2 , 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.

.....

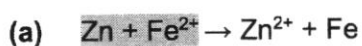
.....

.....

.....

..... [2]

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



oxidising agent reducing agent [1]



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.

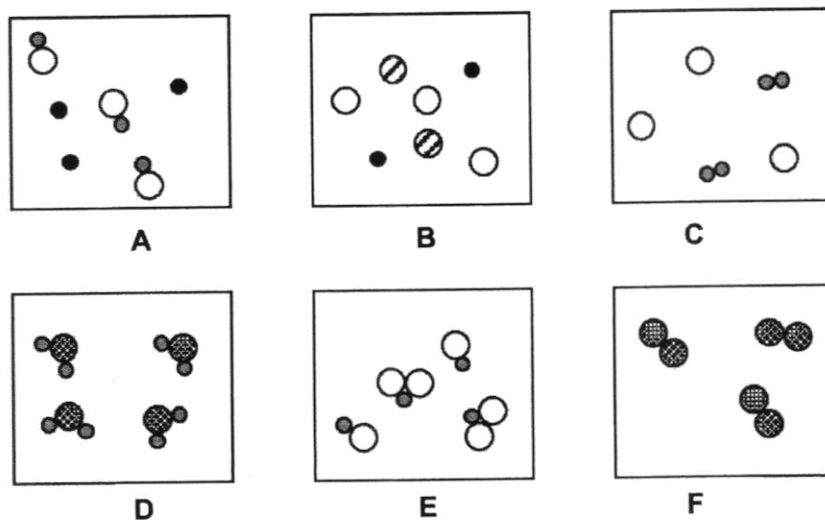


Fig. 5.1

Which substance best represents

- (a) oxygen gas, [1]
- (b) water vapour, [1]
- (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.

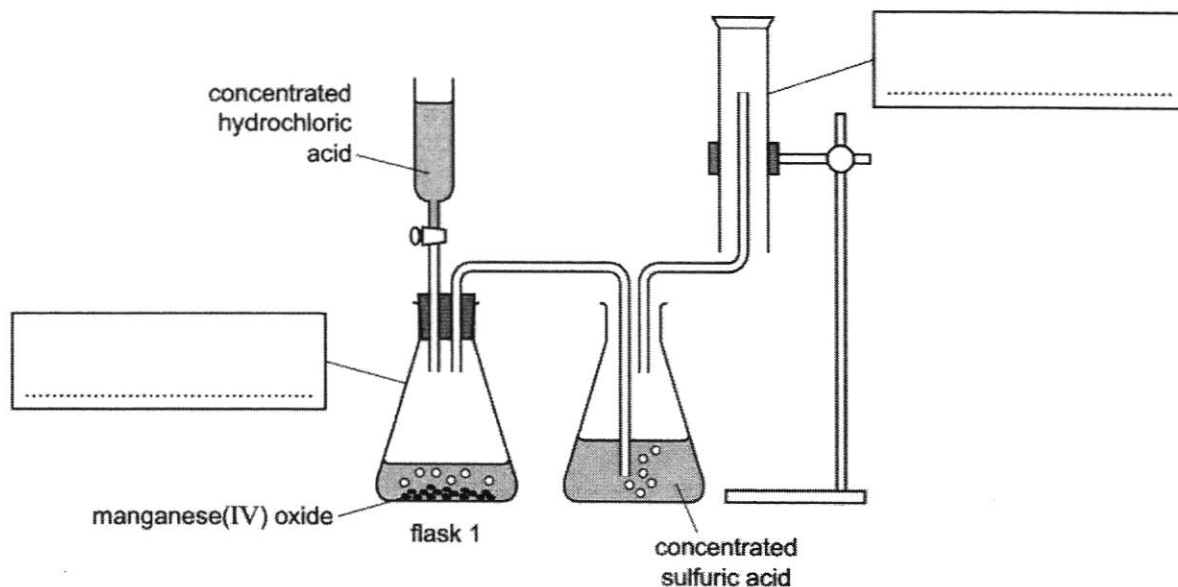


Fig. 6.1

- (a) Complete the boxes in Fig. 6.1 to name the apparatus. [2]
- (b) Using Fig. 6.1, identify **two** mistakes made by the student.
- 1
- 2 [2]
- (c) Concentrated sulfuric acid is used as a drying agent to remove the water content in chlorine gas. Deduce the nature of chlorine gas. [1]
- (d) Chlorine gas is tested with a piece of damp blue litmus paper. What observation could be made? [1]

- 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.

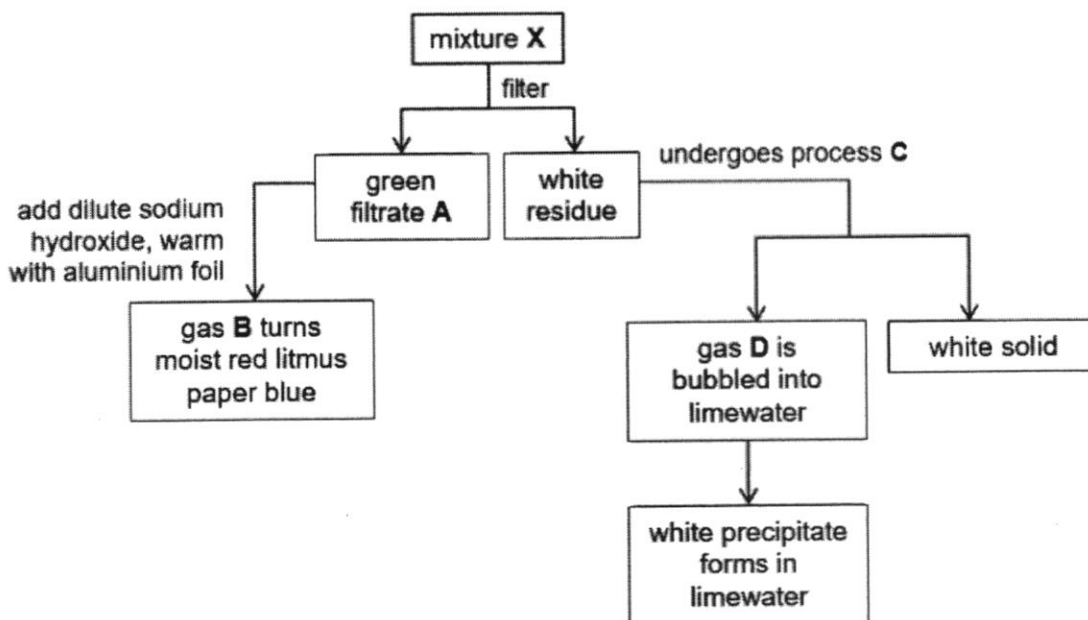


Fig. 7.1

- (a) Identify the names of the following:
- (i) green filtrate A [1]
 - (ii) gas B [1]
 - (iii) process C [1]
- (b) Describe one method, other than process C, to obtain gas D. State one observation that can be made.
-
- [2]
- (c) Write a balanced chemical equation for the formation of white precipitate in limewater as described in Fig. 7.1.
- [2]

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.

..... [2]

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

..... [1]

- (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.

.....

 [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; Cl, 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; Cl, 35.5; Cu, 64]

[2]

- 9 (a) Silver chloride, AgCl , is insoluble. It can be made by a precipitation reaction between aqueous barium chloride and a suitable aqueous reactant **X**.

(i) What is meant by the term *precipitate*?

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

(ii) Write a balanced ionic equation, including state symbols, to represent the formation of silver chloride.

..... [2]

(iii) Name a suitable aqueous reactant **X** that can be used to prepare silver chloride.

..... [1]

(b) Describe how you would obtain a **pure** and **dry** sample of the precipitate from the reaction mixture.

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

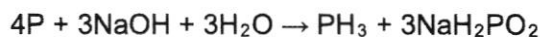
(c) Suggest one reactant, other than aqueous barium chloride, that can react with aqueous reactant **X** to obtain silver chloride.

..... [1]

(d) Explain why titration is **not** a suitable method to prepare silver chloride.

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

- 10** Phosphine, PH_3 , is a gas which has a smell of garlic. It is formed when white solid phosphorus is warmed with aqueous sodium hydroxide.



- (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]

[2]

- (ii) Predict **one** physical property of phosphine besides its low boiling point.

..... [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.

..... [2]

(d) Phosphine reacts with hydrogen iodide to form the salt phosphonium iodide, PH_4I . 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.

..... [1]

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

..... [1]

End of Paper

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

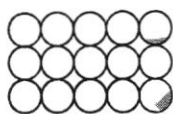
Marking Scheme

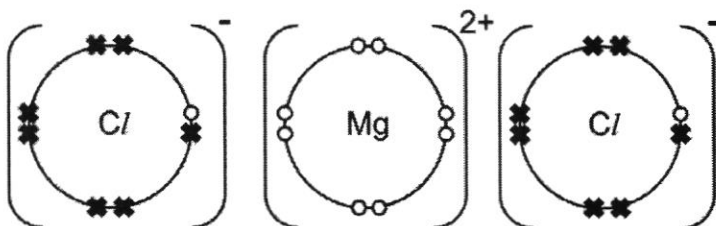
Paper 1

1	2	3	4	5	6	7	8	9	10
D	C	D	C	B	C	B	B	A	D

Paper 2

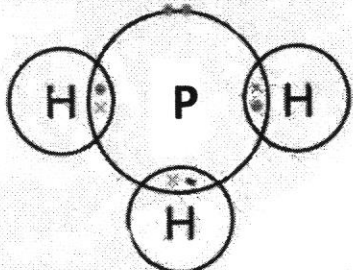
Paper 2

Question		Marking Scheme		Marks	Remarks
Section A					
1	(a)		Y	1	
	(b)		W	1	
	(c)			1	0.5m – at least 3 rows of particles particles 0.5m – particles touching each other and same size
	(d)		From -10°C to -7°C, the particles in solid state are <u>packed very closely together in an orderly manner*</u> and <u>vibrate 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	1m – comparison between arrangement of particles* 1m – comparison between movement of particles [#]
2	(a)		The <u>total number of positive charges from the protons is equal to the total number of negative charges from the electrons</u>. Hence, net charge is zero. <i>Reject: "number of protons is equal to number of electrons."</i>	1	

	(b)	(i)	<table><tr><td></td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr><tr><td>$^{23}_{11}\text{Na}$</td><td><u>11</u></td><td><u>12</u></td><td><u>11</u></td></tr><tr><td>$^{24}_{11}\text{Na}$</td><td><u>11</u></td><td><u>13</u></td><td><u>11</u></td></tr></table>		number of protons	number of neutrons	number of electrons	$^{23}_{11}\text{Na}$	<u>11</u>	<u>12</u>	<u>11</u>	$^{24}_{11}\text{Na}$	<u>11</u>	<u>13</u>	<u>11</u>	2	Minus 0.5m for every incorrect answer.				
	number of protons	number of neutrons	number of electrons																		
$^{23}_{11}\text{Na}$	<u>11</u>	<u>12</u>	<u>11</u>																		
$^{24}_{11}\text{Na}$	<u>11</u>	<u>13</u>	<u>11</u>																		
		(ii)	Isotopes.	1																	
		(iii)	They have the same number of valence electrons.	1																	
		(iv)	$^{24}_{11}\text{Na}$ has a higher density / boiling point / melting point than $^{23}_{11}\text{Na}$. <i>Reject: "...higher mass..."</i>	1	Comparison must be made.																
	(c)		<table><tr><td>charge of particle</td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr><tr><td>2+</td><td>12</td><td>12</td><td>10</td></tr><tr><td><u>0</u></td><td>4</td><td>5</td><td>4</td></tr><tr><td><u>1-</u></td><td>17</td><td>20</td><td>18</td></tr></table>	charge of particle	number of protons	number of neutrons	number of electrons	2+	12	12	10	<u>0</u>	4	5	4	<u>1-</u>	17	20	18	2	1m each
charge of particle	number of protons	number of neutrons	number of electrons																		
2+	12	12	10																		
<u>0</u>	4	5	4																		
<u>1-</u>	17	20	18																		
3	(a)	(i)	Ionic bonding.	1																	
		(ii)	 Key: x – electrons from chlorine o – electrons from magnesium	2	1m – correct charges for both ions 1m – correct valence electron Minus 0.5m for missing key																
		(iii)	Mobile ions in the molten state can act as charge carriers which enable the conduction of electricity. However in solid state, ions are held in their fixed positions and are not mobile . Hence magnesium chloride in the solid state is unable to conduct electricity.	2	1m – presence of mobile ions 1m – fixed position of ions in solid state																

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

7	(a)	(i)	<u>iron(II) nitrate</u>	1	
		(ii)	<u>ammonia</u>	1	
		(iii)	<u>thermal decomposition</u>	1	reject: heating
	(b)		<u>Add any named dilute acid (e.g. nitric acid) to the white residue.</u> <u>Effervescence</u> can be observed / <u>white residue dissolves in the acid</u> to form a colourless solution.	2	
	(c)		<u>$\text{CO}_2 + \text{Ca(OH)}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$</u> 1m – balanced equation 1m – correct chemical formulae for reactants and products	2	State symbols not insisted for chemical equation
Section B					
8	(a)	(i)	<u>$\text{CuCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CuCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$</u> 1m – formulae are correctly written and the equation is balanced 1m – state symbols are all correct	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 form</u> . <u>Filter</u> the mixture <u>to obtain the crystals</u> . <u>Dry the crystals between sheets of filter paper</u> .	3	1m each
	(b)	(i)	Number of moles of hydrochloric acid = $(50 / 1000) \times 20 = \underline{1.00 \text{ mol}}$ [1] Molar ratio of hydrochloric acid : copper(II) chloride = 2 : 1 Number of moles of copper(II) chloride = $1.00 / 2 = \underline{0.500 \text{ mol}}$ [1]	2	Allow ecf of molar ratio based on 8(a)(i)
		(ii)	Relative molecular mass of copper(II) chloride = $(64 + 35.5 + 35.5) = \underline{135}$ [1] Maximum mass of copper(II) chloride = $0.500 \times (64 + 35.5 + 35.5) = \underline{67.5 \text{ g}}$ [1]	2	

9	(a)	(i)	Precipitate is the <u>solid formed when</u> at least two aqueous <u>solutions are mixed.</u>	2	
		(ii)	<u>$\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$</u> 1m – formulae are correctly written and the equation is balanced 1m – state symbols are all correct	2	
		(iii)	<u>Silver nitrate</u> solution <i>Any soluble silver salt solutions</i>	1	
	(b)		<u>Filter</u> the reaction <u>mixture</u> to obtain <u>silver chloride</u> as the <u>residue.</u> <u>Wash</u> the residue with a little <u>distilled water.</u> <u>Dry</u> the residue between <u>sheets of filter paper.</u>	1 1	
	(c)		Aqueous <u>hydrochloric acid / sodium chloride / potassium chloride / any group I chloride</u>	1	
	(d)		Titration is used for <u>preparation of soluble salt</u> (1m) <u>from two aqueous solutions / containing sodium, potassium or ammonium ions.</u> (1m)	2	
10	(a)	(i)	 Key: x - electron of H • - electron of P	2	-0.5 m if legend missing is correct electronic structure of three bonding pairs [1] and a lone pair [1]
		(ii)	<u>insoluble in water / does not conduct electricity in any state / low density</u> <i>reject "poor conductor"</i> <i>reject "low melting point" as it is similar to "low boiling point" as given in the question.</i>	1	
	(b)	(i)	Number of moles of phosphorus = $1.86/31 = \mathbf{0.06 \text{ mol}}$ Number of moles of phosphine = $0.06/4 = \mathbf{0.015 \text{ mol}}$ mass of phosphine = $0.015 \times 34 = \mathbf{0.510 \text{ g}}$	0.5 0.5 1	

	(ii)	Volume of phosphine = $0.015 \times 24 = \underline{0.360 \text{ dm}^3}$ <i>Also accept : 360 cm^3</i>	1	ecf allowed
	(c)	<u>$2\text{PH}_3(\text{g}) \rightarrow 2\text{P}(\text{s}) + 3\text{H}_2(\text{g})$</u> 1m – formulae are correctly written and the equation is balanced 1m – state symbols are all correct	2	
	(d) (i)	<u>phosphine / PH_3</u> (0.5m) <u>sodium iodide / NaI</u> (0.5m)	1	accept both names and formulae
	(ii)	<u>smell of garlic / effervescence</u>	1	