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ZHONGHUA SECONDARY SCHOOL

End-Of-Year Examination 2017

CANDIDATE
NAME

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CLASS

3	E	1
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SCIENCE (CHEMISTRY)

5076 Chem

11 October, 2017

1 hour 30 minutes

Secondary 3 Express

Set by: Mr Tan Li Chun

Vetted by: Ms Maybrie Ang

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

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

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

Section A

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

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

Section B

Answer **all** questions.

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

Section C

Answer all questions.

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

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

All essential working must be shown clearly.

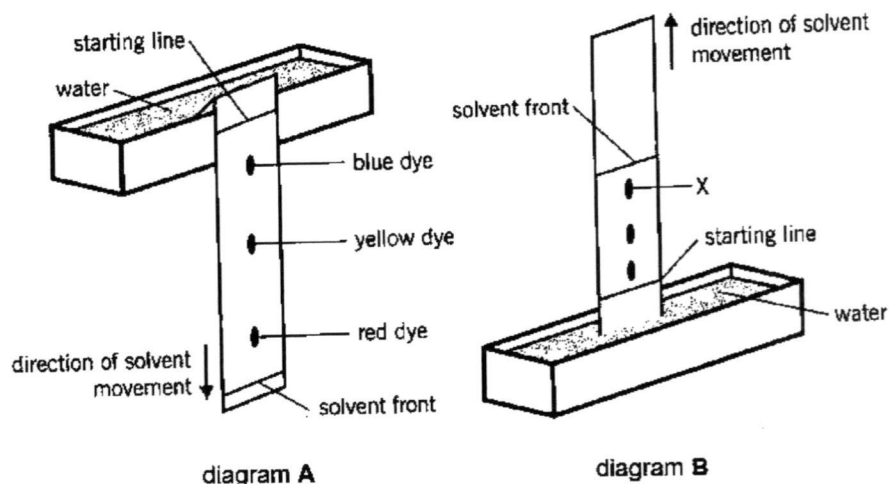
A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
Section A	20
Section B	30
Section C	20
Total	

This document consists of **16** printed pages, including this cover page.

Answer **all** the questions.

- 1 Diagram **A** shows a descending paper chromatography and diagram **B** shows an ascending paper chromatography.

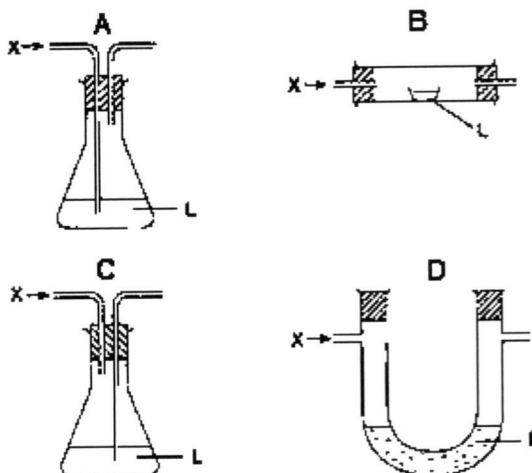


Both experiments are used to separate the same sample of ink for two minutes. The distance between the starting line and the solvent front in Diagrams **A** and **B** is 5 cm and 3 cm respectively after two minutes.

Which statement about these experiments is **not** correct?

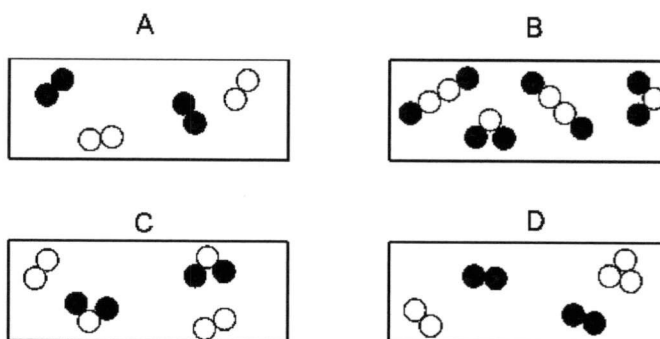
- A** Blue is the least soluble in water in descending paper chromatography.
 - B** The ink sample is made up of three different substances.
 - C** The substances move faster in descending paper chromatography because they are more soluble in this setup
 - D** Spot **X** is the red dye.
- 2 A contaminated sample of gas **X** can be purified by using liquid **L**.

Which experimental setup below is most suitable to be used to purify gas **X**?



- 3 ○ and ● represent atoms of different elements.

Which diagram shows a mixture of an element and a compound?



- 4 Which substance, **A** to **D** undergoes changes in physical states from room temperature to 0°C?

	melting point / °C	boiling point / °C
A	-192	-65
B	-15	4
C	40	65
D	90	385

- 5 Which of the following substances has its molecules in the most orderly arrangement?

- A** water at 0 °C **B** ice at 0 °C
C water at 100 °C **D** steam at 100 °C

- 6 The electronic structures of the atoms **P**, **Q** and **R** are given in the table below.

atom	electronic structure
P	2.1
Q	2.6
R	2.7

What are the formulae of the compounds formed between **P** and **Q**, and **P** and **R**?

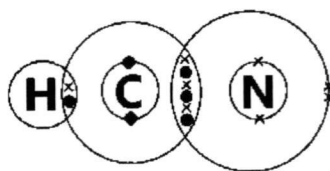
	P and Q	P and R
A	PQ₂	P₂R₂
B	P₂Q	PR
C	PQ	P₂R
D	PQ₂	PR

- 7 The table below shows the group which various elements belong to.

element	Group
W	I
X	III
Y	VI
Z	VIII

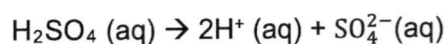
Which of the pair of elements will form a compound through the sharing of electrons?

- A** between atoms of elements **W** and **Z**
B between atoms of elements **X** and **Y**
C between atoms of element **Y**
D between atoms of element **Z**
- 8 The electronic structure of hydrogen cyanide is shown below:



Which is the correct structural formula of hydrogen cyanide?

- A** H–C–N
B H–C≡N
C H=C≡N
D H=C=N
- 9 Sulfuric acid ionises in aqueous solution as follows,



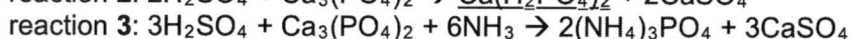
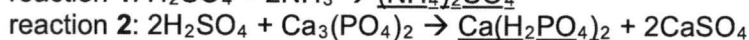
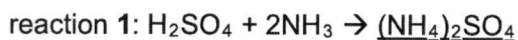
What is the concentration of hydrogen ions in 1.25 mol/dm³ of aqueous sulfuric acid?

- A** 0.625 mol/dm³ **B** 1.25 mol/dm³
C 2.50 mol/dm³ **D** 3.75 mol/dm³

10 Which quantity is the same for one mole of water and one mole of carbon dioxide gas?

- A mass
- B number of atoms
- C number of molecules
- D volume at r.t.p

11 Below are the overall equations for the manufacture of three fertilizers (underlined).

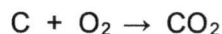


(Mr of H_2SO_4 : 98; Mr of $(\text{NH}_4)_2\text{SO}_4$: 132; Mr of $\text{Ca}(\text{H}_2\text{PO}_4)_2$: 234; Mr of $(\text{NH}_4)_3\text{PO}_4$: 149)

In each reaction, 98 tonnes of sulfuric acid was used. Which reaction gave the greatest, and which the least, mass of fertilizer?

	greatest mass	least mass
A	reaction 1	reaction 2
B	reaction 1	reaction 3
C	reaction 2	reaction 1
D	reaction 3	reaction 2

12 A 18 g sample of pure carbon is completely burned in oxygen.



What volume of carbon dioxide gas is produced at room temperature and pressure?

- A 12 dm³
- B 24 dm³
- C 36 dm³
- D 48 dm³

13 The relative molecular mass, Mr, of copper(II) sulfate, CuSO_4 , is 160.
The relative molecular mass, Mr, of water is 18.

What is the percentage by mass of water in copper(II) sulfate crystals, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?

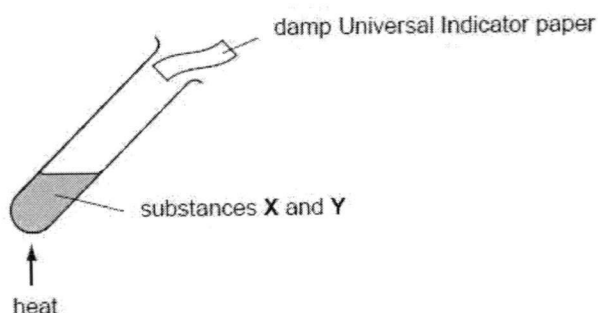
- A 11.25 %
- B 50.56 %
- C 10.11 %
- D 36.00 %

- 14 A solution of hydrochloric acid has a pH of 2. Excess zinc metal is added to the solution.

What is the pH of the solution at the end of the reaction?

- | | | | |
|----------|---|----------|----|
| A | 2 | B | 5 |
| C | 7 | D | 11 |

- 15 The diagram shows two substances, **X** and **Y**, being heated together.

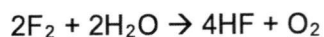


The Universal Indicator paper turns blue during the experiment.
What are substances **X** and **Y**?

- | | |
|----------|--|
| A | sodium carbonate and hydrochloric acid |
| B | sodium carbonate and sodium hydroxide |
| C | ammonium nitrate and hydrochloric acid |
| D | ammonium nitrate and sodium hydroxide |
- 16 Which of the following substance is not appropriate for use in the reaction with dilute sulfuric acid to prepare zinc sulfate?

- | | | | |
|----------|----------------|----------|----------------|
| A | zinc | B | zinc nitrate |
| C | zinc carbonate | D | zinc hydroxide |

- 17 The reaction below shows fluorine reacts with water.



Which of the following correctly shows the oxidation state of fluorine before and after the reaction?

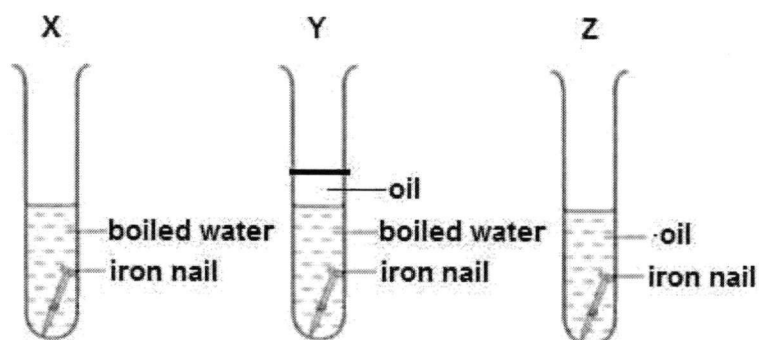
- | | | | |
|----------|--------------|----------|---------------|
| A | 0 to -1 | B | -1 to 0 |
| C | remains at 0 | D | remains at -1 |

- 18 Alloys are usually harder and stronger than pure metals.

Which of the following property helps to explain this difference?

- A number of valence electrons
- B relative atomic mass
- C density
- D atomic size

- 19 Experiments are set up to investigate conditions for rusting of an iron nail.



In which test-tube(s) will the iron nail not rust?

- A X only
- B Y only
- C X and Z
- D Y and Z

- 20 Elements X, Y and Z are in the same period of the Periodic Table. Some information on the elements are shown below,

X is used in advertising lights.

Y forms a halide when react with a Group I metal.

Z forms a positive ion in order to achieve stable octet structure.

If X, Y and Z were placed in order of increasing atomic numbers, the order would be:

- | | |
|-------|-------|
| A XYZ | B ZYX |
| C YZX | D ZXY |

Zhonghua Secondary School
End of Year Examination 2017
Secondary 3 Express

NAME: _____ ()

CLASS: _____ **3E1** _____

For Examiner's Use	
Section B	30
Section C	20
Total	

Section B

Answer **all** the questions.

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

B1 Choose from the following substances to answer the questions below.

oxygen	sodium nitrate	sodium oxide
magnesium	fluorine	sodium chloride
sulfur dioxide	sodium	neon

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

(a) Two salts that can accelerate rusting of an iron nail when placed in its solution.

..... [1]

(b) The element that has the most number of valence electrons.

..... [1]

(c) The element which can form ions with an oxidation state of -2.

..... [1]

(d) A substance which dissolves in water to form an acid.

..... [1]

(e) An element which is a halogen.

..... [1]

(f) An element which is a more reactive metal than calcium.

..... [1]

- B2** The boiling point and melting point for hydrogen chloride and potassium chloride are shown below.

substance	melting point / °C	boiling point / °C
hydrogen chloride	- 114	- 85
potassium chloride	770	1 420

- (a) Complete the table below by describing,
- the type of bonds between atoms in each substance
 - how their structures account for the difference in melting points.

	hydrogen chloride	potassium chloride
type of bond		
explain difference in melting point in terms of bonding and structures		

[3]

- (b) Explain why molten potassium chloride can conduct electricity.

.....

[1]

- (c) Describe the arrangement and movement of hydrogen chloride at r.t.p.

.....

[2]

- (d) Draw a 'dot and cross' diagram to show the bonding in hydrogen chloride.
Draw the outer shells electrons only.

[2]

B3 Magnesium sulfate is a hydrated salt that can be prepared from sulfuric acid and magnesium oxide.

- (a) Write the chemical equation with state symbols for the above reaction.

[2]

- (b) Describe the experimental steps required to produce a dry sample of magnesium sulfate from sulfuric acid and magnesium oxide.

[3]

B4 Magnesium reacts with hot steam to form an oxide and a gas.

- (a) Write the chemical equation with state symbols for the above reaction.

..... [2]

- (b) Describe a test for gas given off.

..... [1]

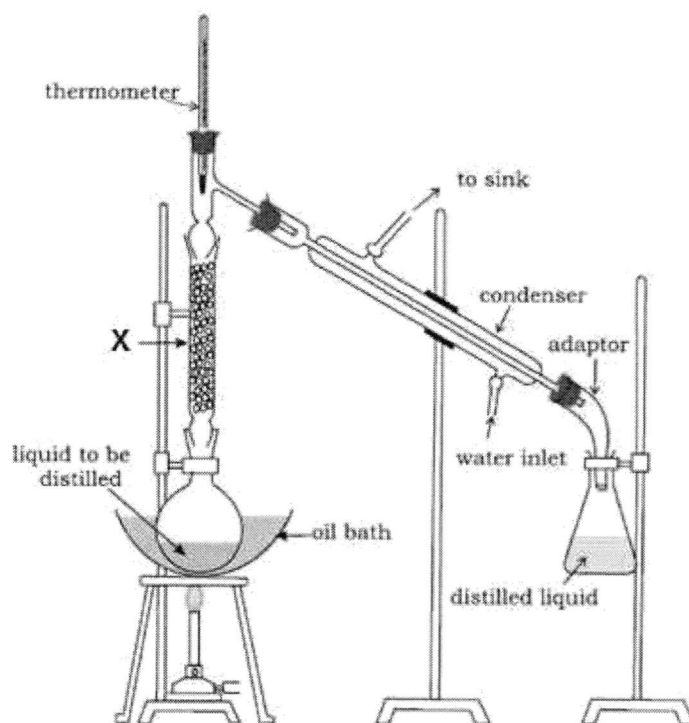
- (c) The oxide dissolves readily in dilute hydrochloric acid but is insoluble in aqueous sodium hydroxide.

Explain what can be deduced about the nature of the oxide from this information.

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

[2]

B5 The apparatus below is used to collect water from a mixture of an organic solvent and water.



- (a) Name the method of purification.
..... [1]
- (b) Name apparatus **X** and states its function
name: [1]
function: [1]
..... [1]
- (c) Suggest the purpose of the condenser.
..... [1]
- (d) How could you tell that water is being separated using the above set-up?
..... [1]
- (e) Suggest an advantage of using indirect heating with an oil bath instead of a water bath.
..... [1]

Section C

Answer **all** the questions.
Write your answers in the spaces provided.

- C6 (a)** The ease of obtaining a metal from its ore is related to the metal's position in the reactivity series. Suggest, with examples, why this is so.

.....

.....

.....

.....

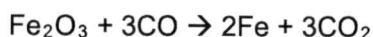
.....

.....

[3]

- (b)** In the modern blast furnace, a series of chemical reactions allows iron to be extracted from iron ore.

One of the reaction is shown below,



Explain why this reaction is a redox reaction.

.....

.....

.....

.....

[2]

- (c)** Explain with relevant chemical equations the purpose of adding limestone in the extraction of iron.

.....

.....

.....

.....

.....

.....

[3]

- (d) Magnetite, Fe_3O_4 , is another form of iron oxide in iron ore.
Calculate the mass of iron that can be obtained from 464 kg of magnetite.

[2]

C7

The table below gives information about the chlorides of some elements in Period 3. The elements are labelled as **W**, **X** and **Y**. (You do not need to identify the elements)

element	formulae of chloride	melting point / °C	boiling point / °C	able to conduct electricity in aqueous state
W	WCl_2	714	1418	yes
X	XCl	790	1407	yes
Y	YCl_4	-70	58	no

- (a) Arrange the elements **W**, **X**, and **Y** in order of increasing proton number.

..... [1]

- (b) Which of these elements is likely to be non-metal?

..... [1]

- (c) It is observed that an aqueous solution of WCl_2 is able to conduct electricity while solid WCl_2 is not able to conduct electricity. Explain the above observations.

.....

.....

.....

.....

.....

.....

.....

[3]

- (d) Which Group in the Periodic Table is element **X** likely to be found? Explain your answer.

.....

.....

[1]

- (e) A piece of element **X** is placed into a beaker of water.

- (i) Describe the observation seen.

.....

.....

.....

.....

[2]

- (ii) Tom wants to collect a sample of hydrogen gas. He suggests reacting element **X** with excess sulfuric acid.

Do you agree with the method that Tom would like to use? Explain your answer.

.....

.....

.....

.....

[2]

End of paper

The Periodic Table of Elements

The Periodic Table of Elements																		
Group												III	IV	V	VI	VII	0	
I	II																2	
																	1	He
																	H	4
																	hydrogen	
																	1	
</																		

lanthanoids

actinoids

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

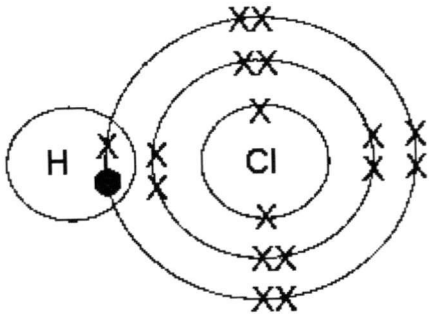
The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Zhonghua Secondary School
Sec 3E1 Sc(Chem)
End of year Examination 2017

Section A MCQ

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

	Section B			
B1	a) Sodium chloride and sodium nitrate b) Neon c) Oxygen d) Sulphur dioxide e) Fluorine f) Sodium			1 1 1 1 1 1
B2a		hydrogen chloride	potassium chloride	
	bonding	Covalent bonding	Ionic bonding	1
	explain difference in melting point in terms of molecular structures	Exist as simple molecules Molecules are attracted to one another by weak intermolecular forces, there needs lesser energy to overcome forces of attraction resulting in lower mp	Has a giant crystal lattice structure Ions are attracted to one another by strong electrostatic forces of attraction therefore needs a lot of energy to overcome forces of attraction resulting in higher mp	1 1
	Must be correct comparison [1 mark across]			
b	Molten potassium chloride can conduct electricity due to the presence of <u>free-moving ions</u> acting as charge carriers.			1
c	Random arrangement and far apart			1
	Random movement at high speed			1

d	 Correct symbol and drawing for, - Hydrogen atom - Chlorine atom *outer shell shown is sufficient **must be covalent bond (no marks given if ionic bonds are drawn)	1 1
B3a	$\text{MgO (s)} + \text{H}_2\text{SO}_4 \text{ (aq)} \rightarrow \text{MgSO}_4 \text{ (aq)} + \text{H}_2\text{O (l)}$ - correct formula - for state symbol	1 1
b	1 add magnesium oxide <u>in excess</u> to sulfuric acid and stir and <u>filter excess magnesium oxide</u> (collect the <u>magnesium sulfate as filtrate</u>) 2 <u>heat</u> the filtrate until it is <u>saturated</u> let it <u>cool</u> 3 <u>wash</u> crystals with small amount of <u>distilled water</u> and <u>dry</u> crystals between sheets of <u>filter paper</u>	1 1 1
B4a	$\text{Mg (s)} + \text{H}_2\text{O (g)} \rightarrow \text{MgO(s)} + \text{H}_2\text{(g)}$ Balanced equation States correctly stated	1 1
b	<u>Use a lighted splint. lighted splint extinguished with pop</u> basic oxide is formed as it <u>reacts with an acid but not with an alkali</u>	1 1
B5a	Fractional distillation	1
B	Fractionating column To separate miscible liquids into different fractions	1 1
C	To condense the vapours to liquid	1
D	Thermometer will show a constant temperature of 100°C	1
e	It allows heating of the mixture at temperature above 100°C.	1
Section C		
C6a	Concept: The higher the metal is in the reactivity series, the more stable will be its compound. For example, *sodium is a very reactive metal which have a very stable sodium ore compound. (This compound is stable and thus difficult to extract sodium from the ore by reduction of carbon). The sodium metal could only be extracted by *electrolysis. On the other hand, the *less reactive metal e.g. copper, can be extracted easily by *reduction of carbon with its ore as their ore are less stable.	1 1 1

	Award max of 2 marks if no examples are quoted. Award max of 2 marks if students are able to quote examples and relate to the method used to extract the metals.	
b	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ CO is reducing the Fe₂O₃ to Fe (as CO acts as the reducing agent) CO itself is oxidised to CO₂ in the process.	1 1
c	$\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$ $\text{CaO}_{(s)} + \text{SiO}_{2(s)} \rightarrow \text{CaSiO}_{3(l)}$ *remove sand impurities (SiO₂) as slag (CaSiO₃)	1 1 1
d	464kg = 464 000g, Ar of Fe = 56, O = 16 Mr of Fe₃O₄ = 232, No of mole of Fe₃O₄ = 464 000 / 232 = 2000 mol 1 mol of Fe₃O₄ → 3 mol of Fe 2000 mol of Fe₃O₄ → 2 000 x 3 = 6 000 mol of Fe Mass of iron = 6 000 x 56 = 336 000g = 336kg	1 1
C7a	X,W,Y	1
b	Y	1
c	WCl₂ is an ionic compound When dissolved in water, it forms mobile W²⁺ and Cl⁻ ions which conduct electricity In solid state, the W²⁺ and Cl⁻ ions are in fixed position held by strong electrostatic forces of attraction and not mobile.	1 1
d	High m.p / b.p suggestion that it is an ionic compound and it is in Group I since it forms XCl which means X forms a X ⁺ ion	1
ei	Floats on water and reacts vigorously with bubbles of gas formed	1 1
ii	Do not agree Element X will reacts very violently with an acid, producing a lot of heat produced / explosive / extreme exothermic reaction / Very dangerous and not advisable	1 1