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HILLGROVE
SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2017

Secondary 3 Express

SCIENCE (CHEMISTRY) 5076

Monday, 2 October 2017

TIME: 10:30 am – 11:45 am **DURATION:** 1 hour 15 min

Additional materials: OTAS

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number on all the work you hand in.
Write in blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

SECTION A
There are **fifteen** questions. 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 answers in soft pencil on the OTAS provided.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in the question paper.

SECTIONS B AND C
Answer **all** questions on the Question Paper provided.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

Submit the question paper and OTAS separately at the end of the exam.
A copy of the Periodic Table is given in Page 14.

For Examiner's Use	
Section A	15
Section B	35
Section C	10
TOTAL	60

Name of Student: _____ ( )

Class: _____

Parent's Signature: _____

Setter: Mrs Lin Hui'en

Section A [15 marks]

Answer **all** questions on the OTAS provided

1 Which apparatus is most suitable to measure 30.60 cm^3 of aqueous acid?

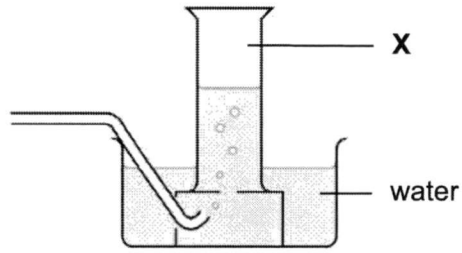
A beaker

B burette

C measuring cylinder

D pipette

2 Gas **X** can be collected using the apparatus shown below.



What can you infer about **X**?

A **X** is flammable.

B **X** is insoluble in water.

C **X** is less dense than air.

D **X** is soluble in water.

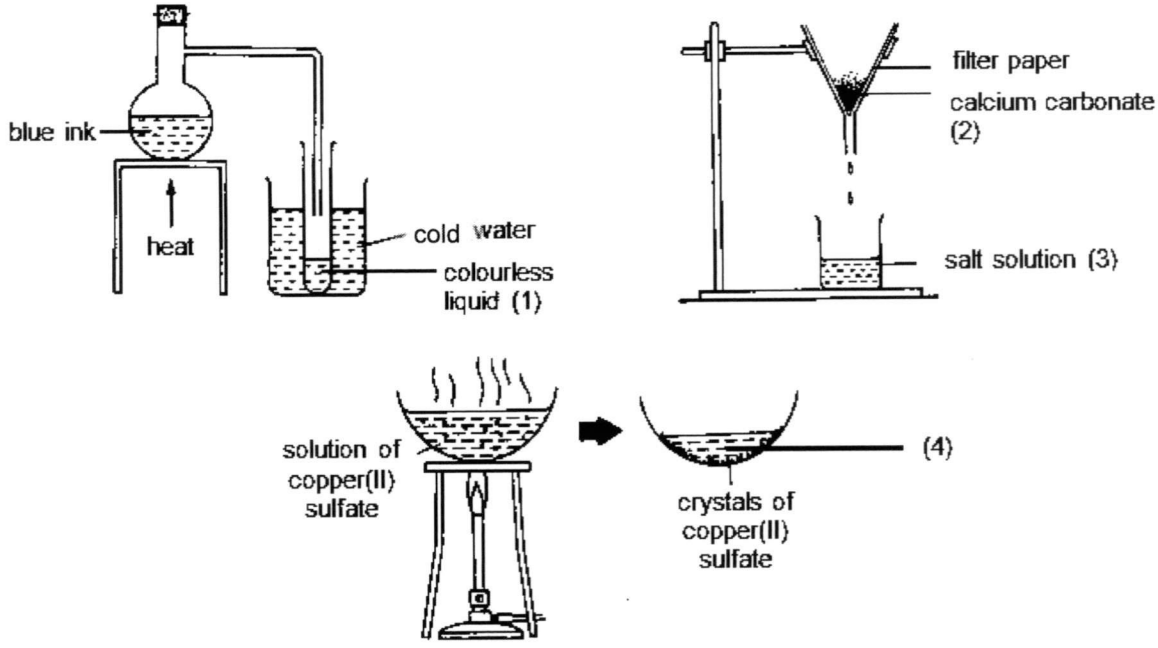
3 Three separations are listed below.

I obtaining solid sodium sulfate from aqueous sodium sulfate
II obtaining solid iodine from a mixture of iodine and copper
III obtaining water from copper(II) sulfate solution

Which method is most suitable for the three separations?

	I	II	III
A	crystallisation	sublimation	distillation
B	filtration	sublimation	distillation
C	evaporation	crystallisation	filtration
D	filtration	crystallisation	sublimation

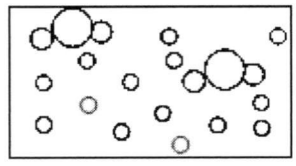
4 The diagrams below show three sets of apparatus used in the laboratory.



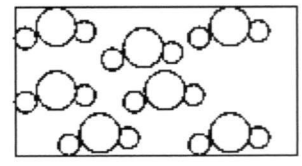
Which row correctly labels a distillate, a filtrate and a saturated solution?

	distillate	filtrate	saturated solution
A	1	2	4
B	1	3	4
C	2	3	4
D	4	3	1

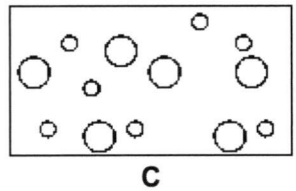
5 Which diagram shows a mixture of element and compound?



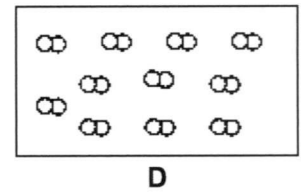
A



B



C

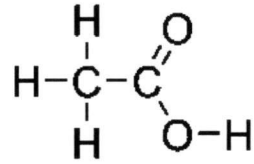


D

6 Which particle, **A**, **B**, **C** or **D**, represents the composition of a negative ion?

particle	number of protons	number of neutrons	number of electrons
A	2	2	2
B	7	7	10
C	11	12	10
D	13	14	13

7 The structural formula of an organic compound is shown below.



How many electrons are involved in bonding?

A 3 **B** 8

C 4 **D** 16

8 Which best describes the definition of relative atomic mass?

A The average mass of one atom of that element compared to 1/12 of the mass of one carbon-12 atom.

B The average mass of one atom of that element compared to 1/12 of the mass of one hydrogen-1 atom.

C The average mass of one molecule of that element compared to 1/12 of the mass of one carbon-12 atom.

D The average mass of one molecule of that element compared to 1/12 of the mass of one hydrogen-1 atom.

9 What is the concentration of sodium hydroxide solution when 30 g of sodium hydroxide (NaOH) dissolves in 250 cm^3 of water?

A 0.75 mol/dm^3

B 1.50 mol/dm^3

C 3.00 mol/dm^3

D 120 mol/dm^3

10 What is a property of **all** acids?

A Their aqueous solutions have a pH greater than 7.

B They are solids at room temperature.

C They react with bases.

D They react with copper to form hydrogen gas.

11 The pH values of four aqueous solutions are shown.

Which solution is a weak acid?

solution	pH
A	2
B	5
C	7
D	9

12 The oxide of an element **M** was added separately to dilute nitric acid and aqueous sodium hydroxide. The word equations for the reactions are shown.

M oxide + nitric acid → **M** nitrate + water
M oxide + sodium hydroxide → no reaction

Which row describes **M** and its oxide?

	M	oxide of **M**
A	metal	amphoteric
B	metal	basic
C	non-metal	acidic
D	non-metal	basic

13 Universal Indicator was placed into 4 solutions, **A**, **B**, **C** and **D**.

Which solution is likely to contain equal concentrations of hydrogen ions and hydroxide ions?

solution	colour of Universal Indicator
A	green
B	red
C	violet
D	yellow

14 Experiments are carried out to arrange metals **X**, **Y** and **Z** in order of decreasing reactivity. The table shows the results.

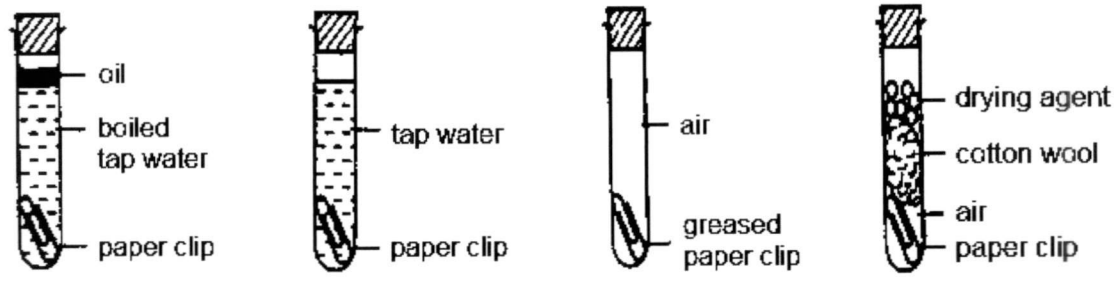
experiment	**X**	**Y**	**Z**
does the metal liberate hydrogen from dilute hydrochloric acid?	yes	no	yes
is the metal oxide reduced by heating with carbon?	yes	yes	no

What is the order of reactivity of the metals?

	most reactive ⟶		least reactive
A	**X**	**Y**	**Z**
B	**Y**	**X**	**Z**
C	**Z**	**X**	**Y**
D	**Z**	**Y**	**X**

15 Four shiny steel paper clips were placed in test tubes as shown below.

In which test tube would the paper clip rust?



A **B** **C** **D**

Section B [35 marks]

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

1 Table 1.1 shows a list of substances.

Table 1.1

copper metal	potassium sulfate	dilute sulfuric acid
lead(II) chloride	aluminium oxide	magnesium oxide
calcium metal	sodium hydroxide	barium nitrate

(a) From Table 1.1, select substances which fit each of the following descriptions. Each substance can be used once, more than once, or not at all.

(i) an alkali

.....[1]

(ii) a metal that cannot react with acid

.....[1]

(iii) a salt that can be prepared by titration

.....[1]

(vi) an insoluble salt

.....[1]

(b) When two of the substances in Table 1.1 are mixed together in solution, they form a precipitate of barium sulfate.

(i) Name these two substances that will form a precipitate of barium sulfate.

I .....

II .....[1]

(ii) Outline the three processes that you would carry out to obtain a pure sample of barium sulfate from the result of this mixing.

I .....

II .....

III .....[3]

[Total: 8]

2 At 140°C, the vapour of a pure substance **X** was allowed to cool. The temperature was measured at regular intervals and the results were plotted on a graph shown in Fig. 2.1.

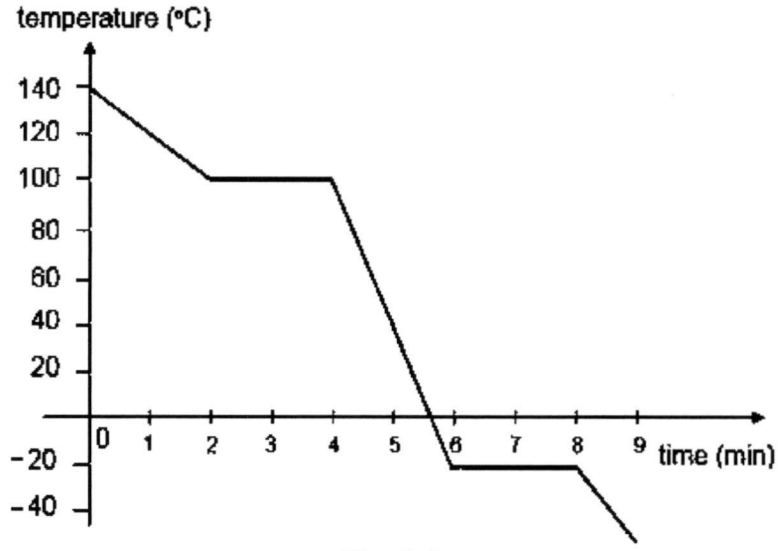


Fig. 2.1

(a) State the melting point of substance **X**.

.....[1]

(b) Name the process in substance **X** that was taking place during the 6th to 8th minute.

.....[1]

(c) Describe the arrangement and movement of the particles in substance **X** at 0°C.

.....

.....

.....

.....[2]

(d) Suggest if **X** is a covalent or ionic compound. Explain your answer.

.....

.....[1]

(e) A student suggested that substance **X** is water. Do you agree with this statement? Give a reason for your answer.

.....

.....[1]

[Total: 6]

3 An excess of calcium hydroxide was reacted with 10.7 g of ammonium chloride to liberate ammonia gas, according to the equation below:

$$Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2NH_3 + 2H_2O$$

(a) Calculate the relative molecular mass of ammonium chloride.

.....[1]

(b) Calculate the mass of calcium chloride produced in the reaction.

Mass of calcium chloride = ...g [3]

(c) Calculate the volume of ammonia gas produced at room temperature and pressure.

Volume of ammonia gas = ...dm^3 [1]

[Total: 5]

4 An unknown solution, **N**, has a sour taste. It also turns blue litmus paper red. It takes part in a number of chemical reactions to give various products, as shown in Fig. 4.1.

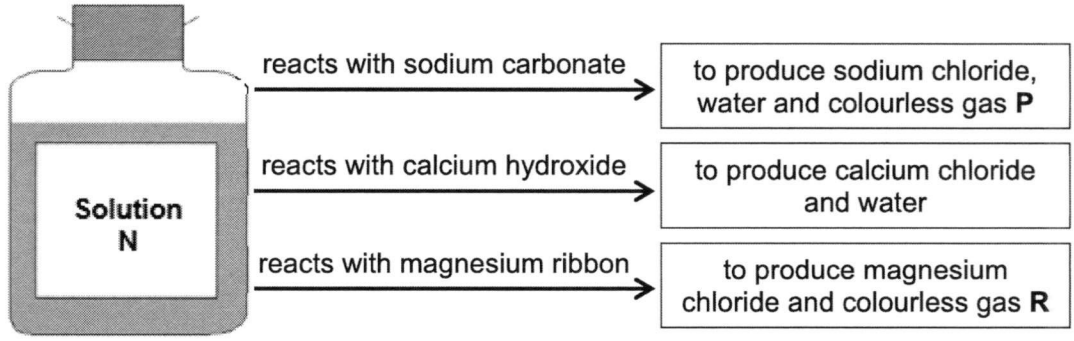


Fig. 4.1

(a) Identify solution **N**.

.....[1]

(b) Identify gases **P** and **R** and describe how you would test for the presence of these gases.

Gas **P** .....

Test .....

.....

.....[2]

Gas **R** .....

Test .....

.....

.....[2]

(c) Using your answer in part (a), write a balanced chemical equation for the reaction between solution **N** and magnesium. State symbols are not necessary.

.....[2]

(d) Give the name for the type of reaction between solution **N** and calcium hydroxide.

.....[1]

(e) Suggest the colour of Universal Indicator when added to solution **N**.

.....[1]

[Total: 9]

5 Fig. 5.1 shows how iron is extracted from its ore in a blast furnace.

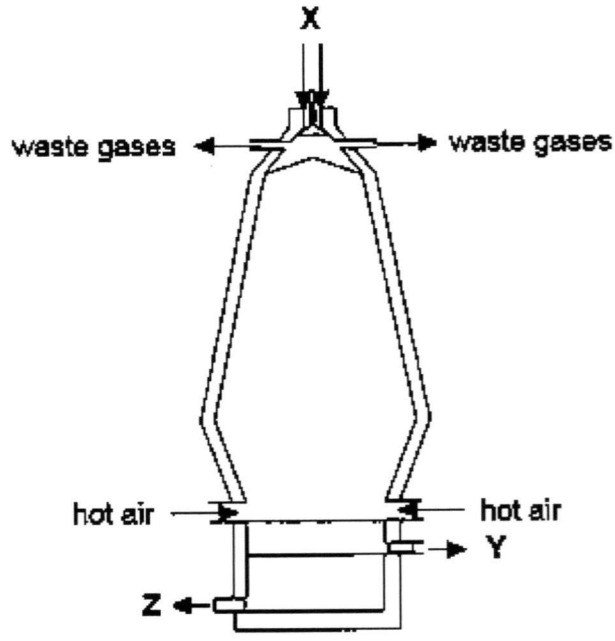


Fig. 5.1

(a) State the substances that go into the blast furnace at **X**.

.....[2]

(b) State the substances that are collected from the blast furnace at **Y** and **Z**.

Y .....

Z .....[2]

(c) The cast iron obtained from this process often made into steel. Suggest why cast iron is made into steel instead of undergoing further purification to become pure iron.

.....

.....[1]

(d) Iron rusts easily. State **two** methods that prevent the rusting of iron.

.....

.....

.....

.....[2]

[Total: 7]

Section C [10 marks]

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

6 Table 6.1 shows the information on 5 atoms.

Table 6.1

atom	number of protons	number of neutrons
R	17	20
S	17	18
T	10	10
U	11	12
V	6	12

(a) State the **two** atoms which are isotopes of each other.

.....[1]

(b) State the atom which is stable and unreactive. Explain your answer with reference to its electronic configuration.

.....

.....

.....

.....

.....[2]

(c) State the formula of the ion formed by atom **S**. Explain your answer with reference to its electronic configuration.

.....

.....

.....

.....

.....[2]

[Turn over

(d) **(i)** State the formula of the compound formed between **R** and **U**.

.....[1]

(ii) Draw a 'dot and cross' diagram to show the arrangement of electrons in the compound formed between **R** and **U**.

[2]

(iii) Predict the electrical conductivity of this compound in molten state. Explain your answer.

.....

.....

.....

.....

.....[2]

[Total: 10]

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.).

END-OF-YEAR EXAMINATION 2017 — MARK SCHEME

Subject : SCIENCE (CHEMISTRY)
Paper : 5076
Level : Secondary Three Express
Duration : 1 hour 15 minutes

SECTION A

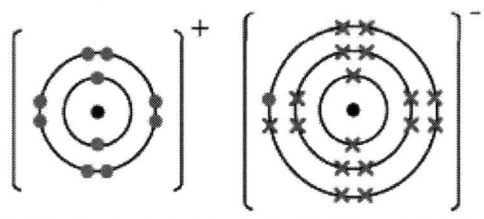
1. B
2. B
3. A
4. B
5. A
6. B
7. D
8. A
9. C
10. C
11. B
12. B
13. A
14. C
15. B

SECTION B

Qn	Answers	Marks
1 (a)	(i) sodium hydroxide;	1
	(ii) copper metal;	1
	(iii) potassium sulfate;	1
	(iv) lead(II) chloride;	1
	(ii) <u>filter</u> the mixture to obtain barium sulfate as the residue; <u>wash</u> the barium sulfate (residue) with deionized water; <u>dry</u> the residue between sheets of filter paper; [note: for full credit, *residue* should be mentioned at least once in the 3 points.]	3
	Total:	**8**
2 (a)	-20°C;	1
(b)	freezing; [A: solidification]	1
(c)	Particles are <u>closely packed</u> in a <u>disorderly</u> manner; Particles are able to <u>slide over each other</u>;	
(d)	covalent, as it has low melting and boiling points;	
	No, as the freezing point of this substance is not 0 point of water; [OWTTE, idea of <u>different</u> mp]	1
	Total:	**6**
3 (a)	53.5;	1
(b)	No. of mol of ammonium chloride = 10.7 / 53.5 = 0.2 mol; [ecf] No. of mol of calcium chloride = 0.2 / 2 = 0.1 mol; Mass of water = 0.1 x [40 + (2)(35.5)] = 11.1 g;	1 1 1
(c)	No. of mol of ammonia = 0.2 mol [ecf] Vol. of ammonia = 0.2 x 24 = 4.8 dm^3;	1
	Total:	**5**

Qn	Answers	Marks
4 (a)	Hydrochloric acid;	1
(b)	Gas P: carbon dioxide; Test: White precipitate produced when gas is bubbled into limewater; Gas R: hydrogen; Test: extinguishes a lighted splint with a 'pop' sound;	1 1 1 1
(c)	$2HCl + Mg \rightarrow MgCl_2 + H_2$ [ecf based on acid in (a)]	2
(d)	neutralisation;	1
(e)	red; [R: orange, yellow]	1
	Total:	**9**
5 (a)	haematite / iron ore, coke, limestone; [2m for 3 correct answers, 1m for 2 correct answers]	2
(b)	Y: (molten) slag; Z: molten iron;	1 1
(c)	the impure iron would be <u>stronger and harder</u> than pure iron; [A: impure iron is more resistant to corrosion than pure iron] [R: pure iron is too soft]	1
(d)	Any two: greasing / galvanizing / painting / sacrificial protection;	2
	Total:	**7**

SECTION C

Qn	Answers	Marks
6 (a)	R and S;	1
(b)	T (no marks if only correct atom is given) It has an electronic structure of 2.8; [A: first shell has 2 electrons, valence shell has 8 electrons…] With <u>8 valence electrons / fully-filled valence shell</u>, its electronic configuration is stable;	1 1
	[A: Cl]; It has 17 electrons with the electronic configuration of <u>2.8.7</u>, and hence <u>receives 1 electron</u> to achieve a <u>stable electronic configuration / fully-filled valence shell</u>; [A: noble gas configuration]	1 1
(d)	(i) UR / NaCl; [A: RU]	1
	(ii)  [atoms can be labelled Na and Cl, or U and R, based on answer in (i)]	2 [1m per ion]
	(iii) It can conduct electricity in molten state; The <u>ions</u> are able to <u>move</u> and carry the electric current; [A: mobile ions]	2
	Total:	**10**