SPRINGFIELD SECONDARY SCHOOL
End-Of-Year Examination 2021

STUDENT NAME

CLASS S - INDEX NUMBER

SCIENCE (CHEMISTRY/BIOLOGY) 5078/01
SECONDARY 3 EXPRESS **October 2021**
Paper 1 Multiple Choice **45 minutes**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, registration number and class in the spaces at the top of this page and all the work you hand in.

There are **thirty** questions in this section. 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**.

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 8.

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

Do not turn over this question paper until you are told to do so.

This question paper consists of 17 printed pages

1 Which methods are used to test the purity of a substance?

1 filtration

2 measurement of melting point

3 fractional distillation

4 chromatography

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

2 The particles in substance T are in contact but still able to move freely.

Substance T changes to a state in which the particles can only vibrate and rotate about their fixed positions.

What is this change called?

A condensation

B evaporation

C freezing

D melting

3 Which mixture can the underlined substance be obtained by adding water, stirring and filtering?

A <u>calcium carbonate</u> and calcium chloride

B <u>copper(II) sulfate</u> and sodium chloride

C <u>copper(II) carbonate</u> and iron

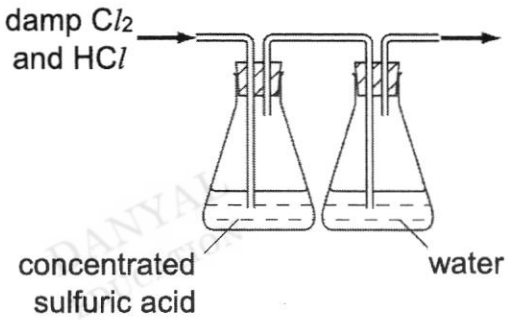
D <u>iron</u> and magnesium

4 Hydrogen chloride gas is very soluble in water, whereas chlorine is only slightly soluble in water.

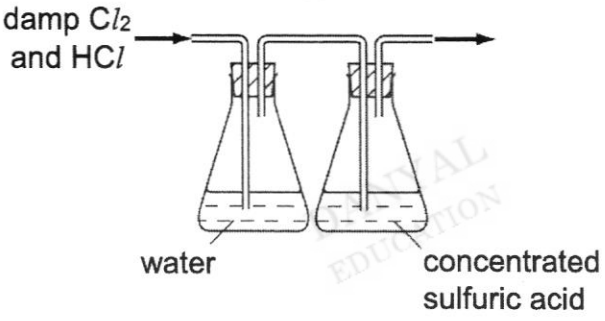
Both gases can be dried using concentrated sulfuric acid.

Which diagram represents the correct method of obtaining pure and dry chlorine gas from a sample of damp chlorine gas containing a small amount of hydrogen chloride?

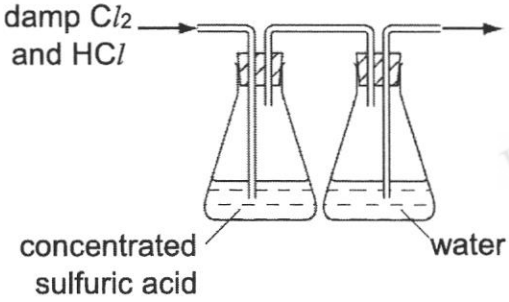
A



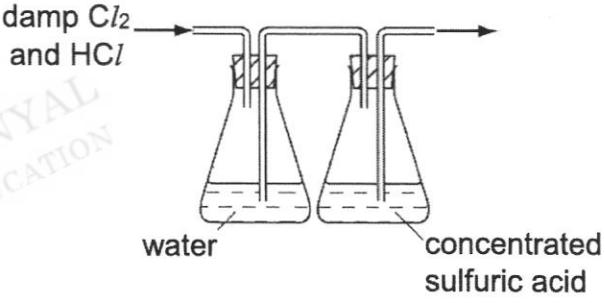
B



C



D



5 Which of the following is **not** a mixture?

A bronze

B crude oil

C steel

D silver

6 Which pair of atoms have the same number of neutrons?

A $^{19}_{40}Ar$ and $^{20}_{40}Ca$ **B** $^{16}_{32}S$ and $^{19}_{39}K$

C $^{4}_{9}Be$ and $^{2}_{4}He$ **D** $^{14}_{28}Si$ and $^{13}_{27}Al$

7 Atom X gains three electrons when it forms an ion.

Which is the electronic structure of X?

A 2,7 **B** 2,5

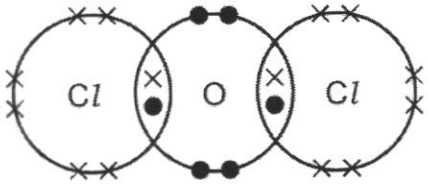
C 2,8,1 **D** 2,8,3

8 An atom of chlorine has seven outer electrons.

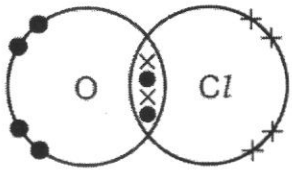
An atom of oxygen has six outer electrons.

Which is the dot-and-cross diagram of the compound formed when oxygen reacts with chlorine?

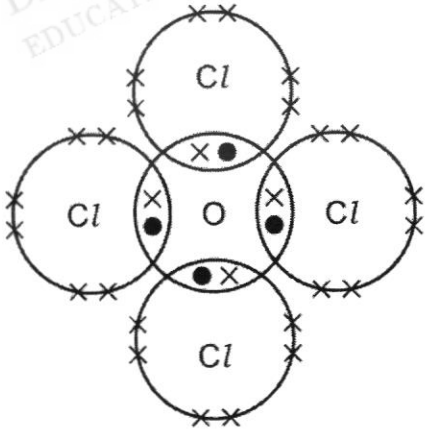
A



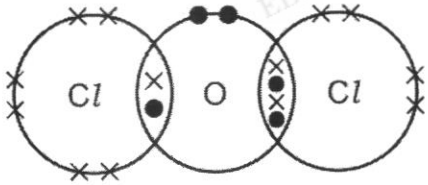
B



C



D



9 Why does molten calcium chloride conduct electricity?

A Electrons completely transferred from calcium atoms to chlorine atoms.

B Electrons in molten calcium chloride are free to move.

C Calcium ions are strongly attracted to chloride ions.

D The calcium ions and the chloride ions are free to move.

10 Which statement describes a solution that contains hydroxide ions?

A It reacts with alkali to form salt and water.

B It produces an alkaline gas when heated with ammonium salt.

C It turns blue litmus red.

D It reacts with metals to produce carbon dioxide gas.

11 The oxide of an element is added to hydrochloric acid and aqueous sodium hydroxide.

It dissolves in both hydrochloric acid and aqueous sodium hydroxide.

What is the likely formula of the oxide?

A CaO **B** CO_2 **C** Na_2O **D** ZnO

12 Which equation shows the method of preparation of a pure salt solution that requires the use of a pipette and burette?

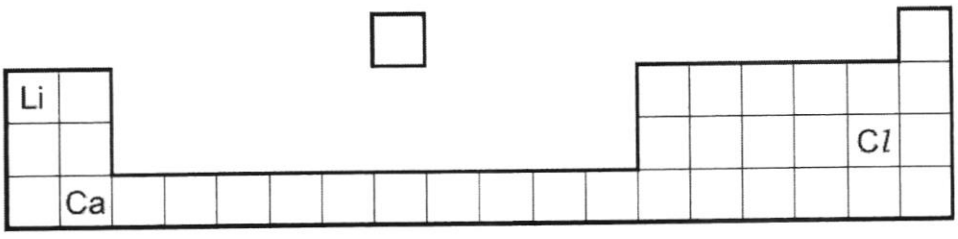
A $BaCl_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$

B $CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$

C $KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(l)$

D $MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2(g)$

13 The diagram shows part of the Periodic Table.



Which element has the highest proton number and which element has the largest number of valence electrons?

	highest proton number	largest number of valence electrons
A	Ca	Ca
B	Ca	Cl
C	Li	Ca
D	Li	Cl

14 Chlorine is a Group VII element.

Which row describes the properties of chlorine?

	colour	state at room temperature	reaction with aqueous potassium bromide
A	reddish brown	liquid	bromine displaced
B	yellow	gas	no reaction
C	yellow	gas	bromine displaced
D	reddish brown	liquid	no reaction

15 Which statement about properties of some elements is correct?

A Astatine is expected to be a liquid at room temperature.

B The reactivity of alkali metals decreases down the group.

C When halogens react with alkali metals, a covalent compound is formed.

D Noble gases are unreactive because all of its electron shells are filled up.

SPRINGFIELD SECONDARY SCHOOL
End-Of-Year Examination 2021

STUDENT NAME

CLASS S - INDEX NUMBER

SCIENCE (CHEMISTRY)
SECONDARY 3 EXPRESS
Paper 3

5076/03, 5078/03
30 September 2021
1 hour

Candidates answer on the question paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do no use appropriate units.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **one** question.
Write your answers in the spaces provided on the question paper.

A copy of the Periodic Table is printed on page 14.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/40
Section B	/10
Total	/50

Do not turn over this question paper until you are told to do so.

This question paper consists of 14 printed pages.

[Turn Over

Section A

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

1 Name the pieces of apparatus most suitable to complete the following laboratory actions.

(a) Separate oil from a mixture of oil and river water.

..... [1]

(b) Measure accurately 22.4 cm^3 of solution into a beaker.

..... [1]

(c) Collect and measure the volume of a water-soluble gas.

..... [1]

(d) Add exactly 25 cm^3 of acid into a conical flask.

..... [1]

2 When complete, Table 2.1 describes five processes and their names.

Complete the table.

Table 2.1

description of process	name of process
separating a precipitate from a solution	*filtration*
cooling a vapour into a liquid	
mixing equal amounts of strong acid and strong alkali	
separating water from a salt solution	
heating a solid into a gas	
cooling a saturated solution to produce a pure salt	

[5]

3 Fig 3.1 shows representations of elements, compounds and mixtures.

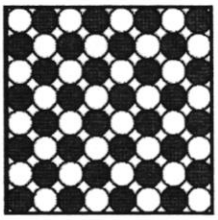


diagram **P**

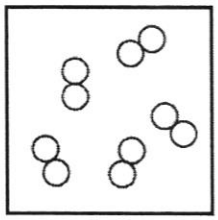


diagram **Q**

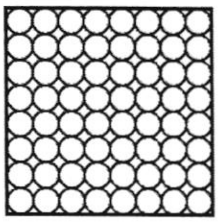


diagram **R**

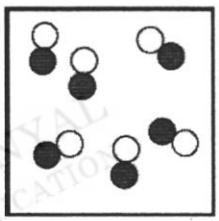


diagram **S**

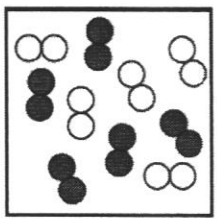


diagram **T**

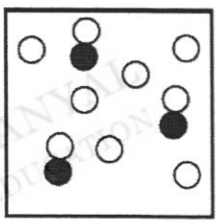


diagram **U**

Fig 3.1

Choose a diagram from Fig 3.1 that represents

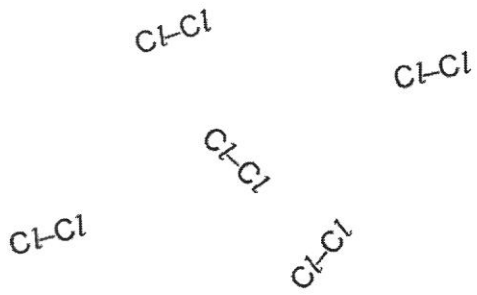
(a) a mixture of two elements, ...

(b) a pure metallic element, ...

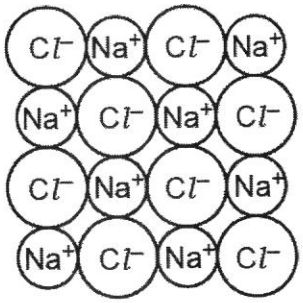
(c) a gaseous halogen, ...

[3]

4 Part of the structures of chlorine gas and table salt, sodium chloride, are shown below.



chlorine



sodium chloride

(a) Explain why, in terms of structure and bonding, chlorine is a gas while sodium chloride is a solid at room temperature.

.....

.....

.....

.....

.....[2]

(b) Draw the dot-and-cross diagram to show the electronic structure of sodium chloride. You are required to show all the electrons in the diagram.

[2]

5 Fig 5.1 shows the results of an experiment to identify the components of mixtures **X** and **Y**. Each mixture is known to contain one or more of the pure substances **L**, **M**, **N** and **P**.

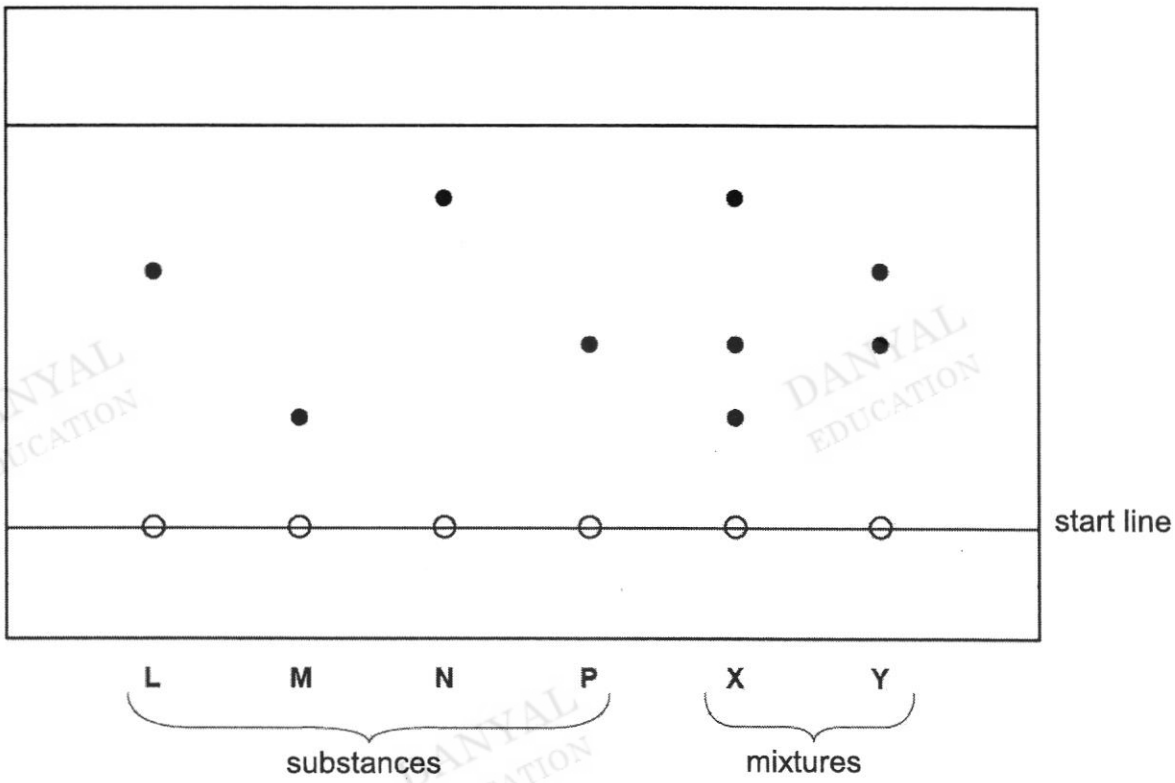


Fig 5.1

(a) What is the name given to this experiment?

.....[1]

(b) Suggest why the start line was drawn in pencil and not in ink.

.....

.....[1]

(c) Use the diagram to deduce which of the substances **L**, **M**, **N** or **P** is / are present in

(i) mixture **X** .....

(ii) mixture **Y** .....

[1]

(d) Which substance, **L**, **M**, **N**, **P**, is found in **both** mixture **X** and **Y**?

.....[1]

(e) Which substance, **L**, **M**, **N** or **P**, is the most soluble substance in the solvent used in this experiment?

.....[1]

6 A scientist discovered a new element and named it 'eka'. The symbol of this element is Ea.

The atom of this element has four electron shells and it has six electrons in its valence shell.

Use this information to complete Table 6.1.

Table 6.1

information about element	
symbol	Ea
group of the Periodic Table	
period of the Periodic Table	
charge on each ion	
nature of its oxide (acidic / basic / amphoteric)	

[4]

7 The neutralisation reaction between an acid and an alkali produces heat. It results in a rise in temperature of the reaction mixture.

A student was provided with solution **H**, nitric acid, and solution **J**, aqueous sodium hydroxide.

He investigated the temperature changes that occured when mixing different volumes of solution **H** and solution **J**.

The starting temperatures for both solutions, **H** and **J**, were at 20 °C.

Fig 7.1 shows the maximum temperature recorded in each experiment.

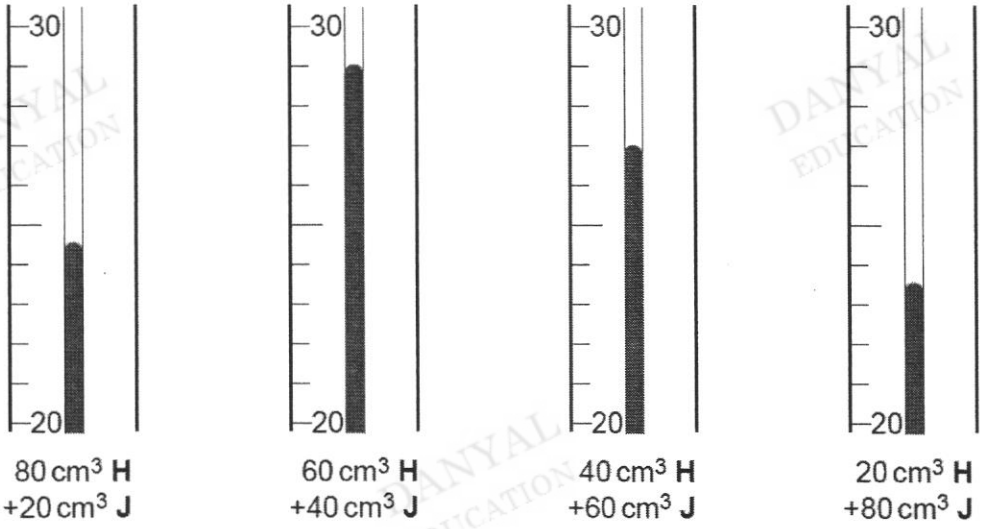


Fig 7.1

(a) Record these temperatures by completing Table 7.1 below then calculate the temperature rise for each of the four mixtures.

Record your values correct to 1 decimal place.

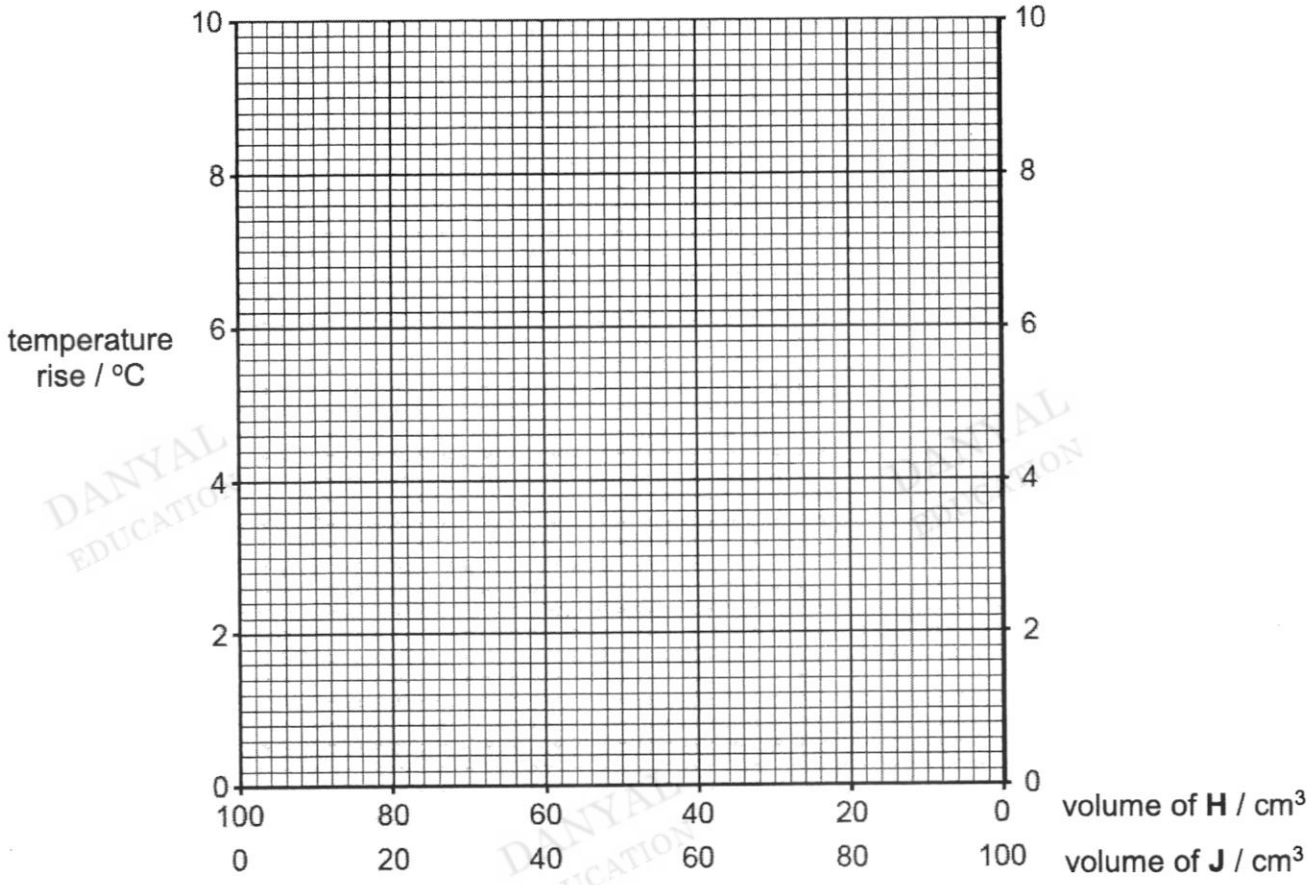
Table 7.1

volume of **H** / cm^3	volume of **J** / cm^3	maximum temperature / °C	temperature rise / °C
80	20		
60	40		
40	60		
20	80		

[2]

[Turn over

(b) Plot these results on the grid below and join the points with two intersecting straight lines.



[2]

Use the graph to deduce

(c) **(i)** the greatest temperature rise that could occur,

..... °C [1]

(ii) the volumes of **H** and **J** which would produce this temperature rise.

volume of **H** ..... cm^3

volume of **J** ..... cm^3
[1]

(d) Write the ionic equation for this reaction.

.....[1]

8 Use the following information to suggest the steps needed to prepare by precipitation pure lead(II) chloride, starting from lead(II) oxide.

- lead(II) chloride is insoluble in water
- lead(II) oxide is insoluble in water
- lead(II) nitrate is soluble in water

.....

.....

.....

.....

.....

.....[3]

9 Table 9.1 contains details of seven different particles. The letters are **not** the chemical symbols.

Table 9.1

	K	L	M	N	O	P	Q
nucleon number	1	10	11	14	19	23	37
proton number	1	5	5	7	10	11	17
total number of electrons	0	5	5	7	10	11	18

Each letter can be used once, more than once or not at all.

Use table 9.1 to state which particles **K**, **L**, **M**, **N**, **O**, **P** and **Q**

(a) is a halide, ...

(b) has no neutron, ...

(c) produces a flammable gas when reacts with water, ...

(d) is an ion with a single positive charge, ...

(e) are both isotopes of the same element. ..... and .....

[5]

[Turn over

Section B

Answer any **one** question in this section.

Write your answers in the spaces provided.

10 The alkali metals, lithium, sodium, potassium are in Group I of the Periodic Table.

(a) Use the Periodic Table to:

(i) identify and name another alkali metal,

name .....[1]

(ii) help you determine the number of valence electrons in an atom of the alkali metal that you have named in **10(a)(i)**.

.....[1]

(b) The reactivity of the elements in Group I increases down the group.

Use your knowledge on the atomic radii to help you explain this increase.

.....

.....

.....

.....

.....[3]

(c) Potassium was added into a beaker of water. A reaction took place and a solution and a gas was produced.

(i) Name the solution and the gas produced from this reaction.

solution

.....

gas

.....
[2]

(ii) Write the balanced chemical equation for this reaction.

.....[2]

(iii) Describe what you would observe if a few drops of methyl orange is added into the solution.

.....

.....[1]

11 **(a)** Iron is a very useful element.

Wrought iron is a type of iron that is melted and worked on with tools by blacksmiths. It is an iron alloy with a very low carbon content.

Wrought iron melts over a range of 1482 °C to 1593 °C.

(i) Based on the information provided, is wrought iron an element, a mixture or a compound?

.....[1]

(ii) State **one** evidence that supports your answer in **11(a)(i)**.

.....

.....[1]

(iii) Describe the changes of movement and arrangement of atoms when wrought iron melts.

.....

.....

.....

.....[2]

(b) Iron(II) sulfate is a compound of iron. Two students have written instructions for the preparation of a pure, dry sample of iron(II) sulfate crystals.

They have made several mistakes.

Read their instructions and complete Table 11.1 with three of their mistakes and corrections of these mistakes.

Students' written instructions to prepare pure, dry iron(II) sulfate crystals.

1. Wear safety goggles and gloves.
2. Start with iron filings.
3. Warm excess filings with concentrated sulfuric acid to form a solution of iron(II) sulfate.
4. Filter the solution to remove excess unreacted iron.
5. Gently heat the solution until crystals begin to form.
6. Filter the crystals formed.
7. Using large quantities of warm water, wash the crystals thoroughly and then dry them by heating in an evaporating dish.

Table 11.1

students' mistake	correction to the mistake

[6]

SPRINGFIELD SECONDARY SCHOOL
"BETTER SELF FOR BETTER TOMORROW"
Science (Chemistry) 5076/5078
Secondary 3 Express
END-OF-YEAR EXAMINATION (2021)
Marking Scheme

Science (Physics/Chemistry) 5076

16	**C**	21	**D**	26	**D**
17	**C**	22	**B**	27	**C**
18	**A**	23	**A**	28	**B**
19	**B**	24	**D**	29	**C**
20	**D**	25	**B**	30	**D**

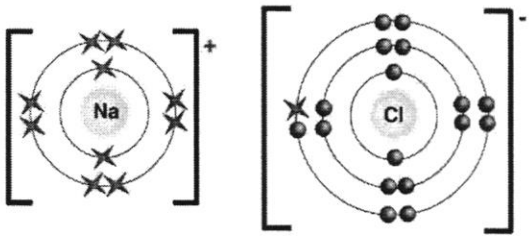
Science (Chemistry/Biology) 5078

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

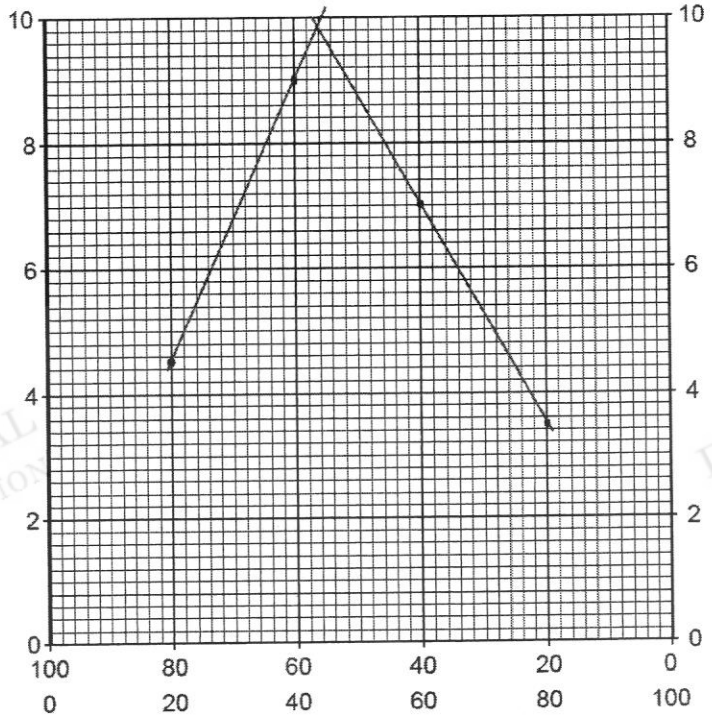
SPRINGFIELD SECONDARY SCHOOL
"BETTER SELF FOR BETTER TOMORROW"
Science (Chemistry) 5076/5078
Secondary 3 Express
END-OF-YEAR EXAMINATION (2021)
Marking Scheme

Paper 3
Section A [40 marks]

Question Number	Answer	Marks	Total Marks
1(a)	separating funnel	1	4
1(b)	burette	1	
1(c)	gas syringe	1	
1(d)	pipette	1	
2	• cooling a vapour into a liquid : **condensation**	1	5
	• mixing equal amounts of strong acid and strong alkali : **neutralisation**	1	
	• separating water from a salt solution : **distillation**	1	
	• heating a solid into a gas : **sublimation**	1	
	• cooling a saturated solution to produce a pure salt : **crystallisation**	1	
3(a)	T	1	3
3(b)	R	1	
3(c)	Q	1	
4(a)	The chlorine molecules are held by weak intermolecular forces. Hence, less energy is needed to overcome them. However, the ions in sodium chloride are held by strong electrostatic forces. Hence large amount of energy is needed to overcome them.	1 1	4

4(b)	1 mark for correct bonding and the correct charge of the ions. 1 mark for showing all the electrons in both ions.  	2	

5(a)	chromatography	1	5
5(b)	To prevent the line from dissolving in the solvent and interfering with the separation process.	1	
5(c)i	M, N and P	1	
5(c)ii	L and P		
5(d)	P	1	
5(e)	N	1	
6(a)	1 mark for correct answer information about element symbol: Ea group of the Periodic Table: group 6 period of the Periodic Table: period 4 charge on each ion: -2 nature of oxide (acidic / basic / amphoteric): acidic	1 1 1 1	4
7a	1 mark for each 2 correct pairs of reading (maximum temperature and temperature rise) volume of H / cm^3 | volume of J / cm^3 | maximum temperature / °C | temperature rise / °C 80 | 20 | 24.5 | 4.5 60 | 40 | 29.0 | 9.0 40 | 60 | 27.0 | 7.0 20 | 80 | 23.5 | 3.5	2	7

7b	1 mark for correct plotting 1 mark for drawing 2 lines intersecting one another  	1 1	
7(c)(i)	9.8 °C (allow +/- 0.2 °C)	1	
7(c)(ii)	H : 56 cm^3 J : 44 cm^3	1	
7(d)	$H^+ + OH^- \rightarrow H_2O$	1	
8	• Dissolve excess lead(II) oxide in nitric acid to obtain aqueous lead(II) nitrate. • Mix the aqueous lead(II) nitrate salt with aqueous sodium chloride (or any soluble chloride / hydrochloric acid) to obtain lead(II) chloride precipitate. • Filter the mixture and wash the precipitate with water and dry it by pressing it between two sheets of filter paper.	1 1 1	3

9(a)	Q	1	5
9(b)	K	1	
9(c)	P	1	
9(d)	K	1	
9(e)	L and M	1	

Section C [10 marks]

Question Number	Answer	Marks	Total Marks
10ai	rubidium / francium / caesium	1	10
10aii	It has one valence electron.	1	
10b	• The atomic sizes of alkali metals increases down the group. • This increases the distance between the positive charged nucleus and the negative charged valence electrons in the atom. • Due to the weakening of the force between the nucleus and the valence electrons, the ease of losing electrons increases down the group.	3	
10ci	solution : potassium hydroxide gas: hydrogen gas	1 1	
10cii	1 mark for correct chemical formulae 1 mark for balanced chemical equation $2K + 2H_2O \rightarrow 2KOH + H_2$	2	
10ciii	The methyl orange will change colour from orange to yellow.	1	
11ai	It is a mixture.	1	10
11aii	It is an iron and carbon alloy. Or Wrought metal melts at a range of temperature.	1	
11aii	When wrought iron melts, the movement of atom changes from vibrating and rotating on its fixed position to able to slide over one another. The arrangement of atoms changes from regularly arranged and closely paced to randomly arranged and less closely packed.	1 1	

11b	**students' mistake** *Warm excess filings* **corrections to the mistake** The student should warm the acid not the filings.	1 1	
	students' mistake *with concentrated sulfuric acid to form a solution of iron(II) sulfate.* **corrections to the mistake** The student should use dilute sulfuric acid instead of concentrated sulfuric acid.	1 1	
	students' mistake *Using large quantities of warm water, wash the crystals* **corrections to the mistake** The student should use small quantities of cool water to avoid the crystals from dissolving in the water.	1 1	
	Other answers **students' mistake** *wash the crystals thoroughly* **corrections to the mistake** The student should wash the crystals lightly to prevent it from dissolving in the water.		