Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2021
SECONDARY THREE EXPRESS

SCIENCE (CHEMISTRY/BIOLOGY) **5076/01, 5078/01**
Paper 1 (Multiple Choice) **8 Oct 2021**

Additional Materials: Multiple Choice Answer Sheet, Periodic Table

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** 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 Answer Sheet.

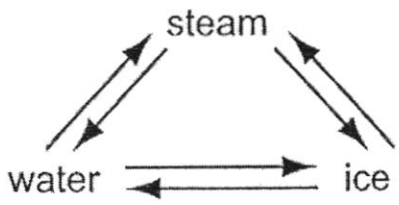
Read the instructions on the Answer Sheet very carefully.

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

For Examiner's Use	
Total	

This paper consists of **17** printed pages and **1** blank page.
Setters: Mr Tan Kok Heong and Ms Tan Yin Chin

1 In which conversion do water molecules lose speed?



A ice → steam
B ice → water
C steam → water
D water → steam

2 Three substances have the following properties:

Substance 1 is brittle;
Substance 2 melts at 8 °C and boils at 180 °C;
Substance 3 has a high melting point of 800 °C.

What is the state of each substance at room temperature and pressure?

	substance 1	***substance 2***	***substance 3***
A	gas	liquid	solid
B	solid	gas	solid
C	solid	liquid	solid
D	solid	gas	gas

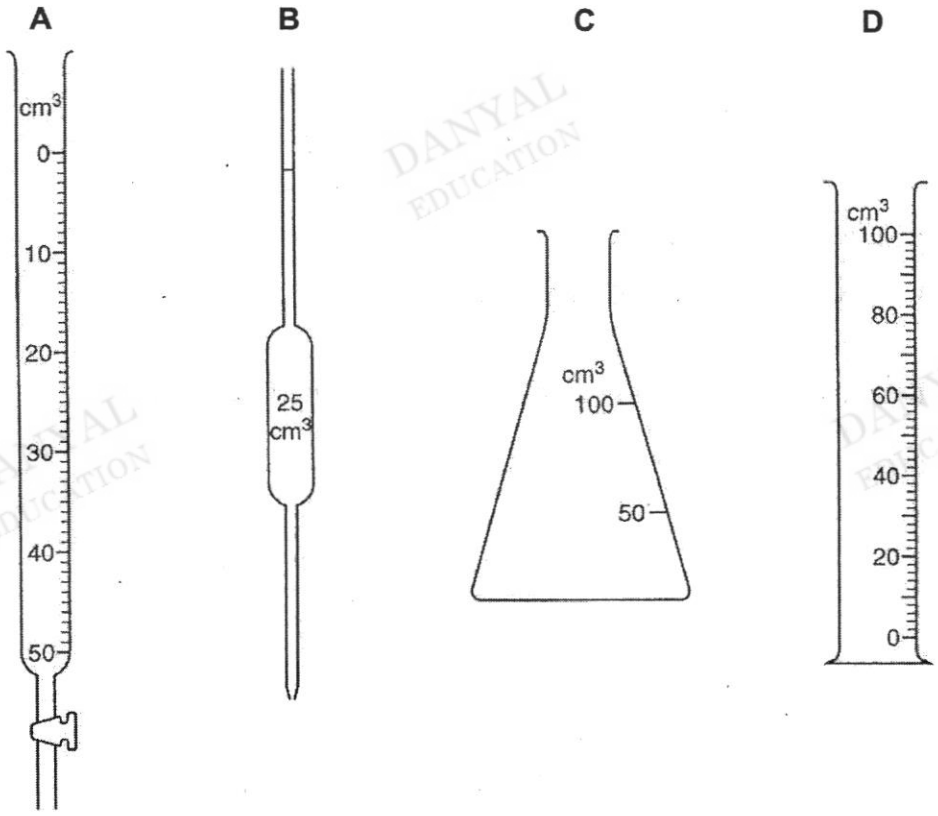
3 The table below lists the properties of oxygen and carbon dioxide.

name of gas	density	solubility of gas
ammonia	less dense than air	extremely soluble
chlorine	denser than air	soluble

Which is the best method to collect each gas?

	ammonia	chlorine
A	displacement of water	downward delivery
B	displacement of water	upward delivery
C	upward delivery	displacement of water
D	upward delivery	downward delivery

4 Which piece of apparatus is most suitable for accurately measuring out 12.35 cm^3 of water?



5 A natural sample of camphor was found to be contaminated with rust [iron(III) oxide] and salt (sodium chloride).

The effects of two liquids on these three solids are given in the table.

Solid	Effect of	
	Water	Ethanol
Camphor	no effect	dissolves to produce a colourless solution
Iron(III) oxide	no effect	no effect
Sodium chloride	dissolves to produce a colourless solution	no effect

Which method is suitable for obtaining pure camphor from the impure sample of camphor?

A Add ethanol and stir; then filter; then add water to the residue and stir, then filter and collect the residue.
B Add water and stir; then filter and collect the residue.
C Add water and stir; then filter; then add ethanol to the residue and stir; then filter and evaporate the solvent in the filtrate.
D Add water and stir; then filter; then evaporate the filtrate to dryness.

6 Which statement about pure sodium chloride, NaCl, is correct?

A It boils over a range of temperatures.
B It decomposes into sodium and chlorine upon heating.
C It melts at a fixed temperature.
D It is insoluble in water.

7 What is the total number of elements present in one unit of chromium(III) picolinate, $Cr(C_6H_4NO_2)_3$?

A 5
B 6
C 17
D 40

8 Which of the following list of substances contains an element, a compound and a mixture?

A air, carbon, iodine
B air, ethanol, water
C ammonia gas, gold, ice
D carbon dioxide, iron, steel

9 Which statement about the particles ${}^{19}_{9}F^-$, ${}^{20}_{10}Ne$ and ${}^{23}_{11}Na^+$ is correct?

A They all contain more electrons than protons.
B They all contain more neutrons than protons.
C They all contain the same number of electrons.
D They all contain the same number of protons.

10 A particle has 10 electrons, 8 protons and 10 neutrons.

What is the symbol for the particle?

A F^-
B N^{3-}
C Ne
D O^{2-}

11 What is the correct formula of ammonium sulfate?

A NH_3SO_4
B $NH_4(SO_4)_2$
C $(NH_3)_2SO_4$
D $(NH_4)_2SO_4$

12 The elements **X** and **Y** form the compound X_2Y.

What is the correct electronic configuration of the atoms **X** and **Y**?

	electronic configuration	
	atom of **X**	atom of **Y**
A	2, 1	2, 7
B	2, 2	2, 7
C	2, 1	2, 6
D	2, 2	2, 6

13 Study the equation below carefully; letters **p**, **q**, **r** and **s** are numbers which balance the equation.

$$\mathbf{p}CaCl_2 + \mathbf{q}AgNO_3 \rightarrow \mathbf{r}Ca(NO_3)_2 + \mathbf{s}AgCl$$

Which of the values below correctly correspond to the letters?

	p	**q**	**r**	**s**
A	1	2	1	2
B	1	2	2	1
C	2	1	1	2
D	2	2	1	1

14 Which of the following consists of the greatest number of particles at room temperature and pressure?

A 3 mole of water molecules
B 54 g of solid aluminium
C 60 dm^3 of carbon dioxide gas
D 71 g of chlorine gas

15 The equation below shows how water decomposes into hydrogen and oxygen gas.

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

If 2.5 moles of water is fully decomposed, what is the volume of oxygen gas produced?

A 2.5 dm^3
B 9.6 dm^3
C 30 dm^3
D 60 dm^3

16 Which of the following reactions can be represented by the ionic equation below?

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

A Reaction between aqueous sodium hydroxide and aqueous ammonium chloride.
B Reaction between dilute sulfuric acid and sodium.
C Reaction between dilute sulfuric acid and sodium carbonate.
D Reaction between dilute sulfuric acid and sodium hydroxide.

17 The table below shows the colour of two indicators, bromophenol blue and phenolpthalein in acid and alkali, as well as the pH at which the colour changes take place.

Name of Indicator	Colour in strongly acidic solution	Colour in strongly alkaline solution	pH at which colour changes
Bromophenol blue	yellow	blue	4
Phenolpthalein	colourless	red	9

What is the colour of a mixture of bromophenol blue and phenolpthalein in a solution with pH 2?

A blue
B colourless
C red
D yellow

18 Which of the following elements, when burnt in oxygen, produces a new substance that reacts with both acids and alkalis?

A aluminium
B barium
C copper
D phosphorus

19 Michelle would like to prepare some copper(II) nitrate. Which of the following reactants are not suitable for her preparation of copper(II) nitrate?

A copper and nitric acid
B copper(II) carbonate and nitric acid
C copper(II) hydroxide and nitric acid
D copper(II) oxide and nitric acid

20 Which compound in polluted air can lead to the damage of stonework and killing of trees?

A carbon dioxide
B carbon monoxide
C sulfur dioxide
D unburnt hydrocarbon

Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2021
SECONDARY THREE EXPRESS

SCIENCE
Paper 3 Chemistry

5076/03, 5078/03
6 Oct 2021
1 hour 15 minutes

Candidates answer on the Question Paper.
Additional Materials: Periodic Table

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
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 not use appropriate units

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

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

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.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

This paper consists of **16** printed pages and **0** blank page.
Setter: Mr Tan Kok Heong

Section A

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

1 Name the pieces of apparatus best used to carry out the following procedures.

(a) Add 30 cm^3 of liquid to a beaker.

..... [1]

(b) Collect and measure the volume of ammonia gas.

..... [1]

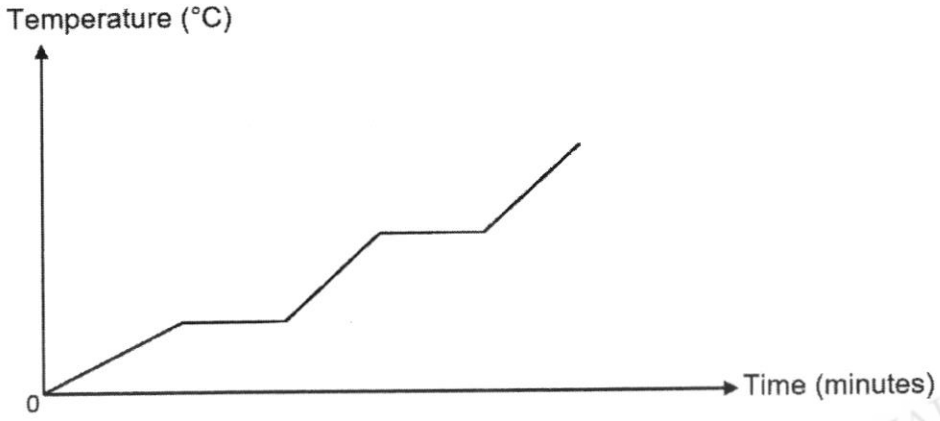
(c) Measure a fixed volume of 25.0 cm^3 of hydrochloric acid.

..... [1]

(d) Measure 1 g of zinc powder.

..... [1]

2 **X** melts at 18 °C and boils at 47 °C. Its heating curve is shown below.



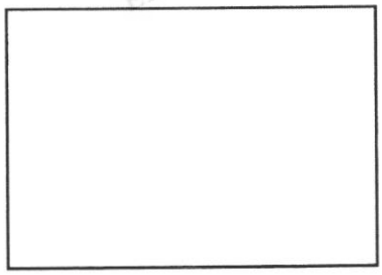
(a) On the heating curve, indicate the

(i) melting point of **X**;
(ii) boiling point of **X**. [2]

(b) Name the state of **X** at room temperature.

..... [1]

(c) In the box below, draw the particulate arrangement of **X** at 16 °C.



[1]

3 Fig. 3.1 shows a laboratory experimental set-up of a distillation process.

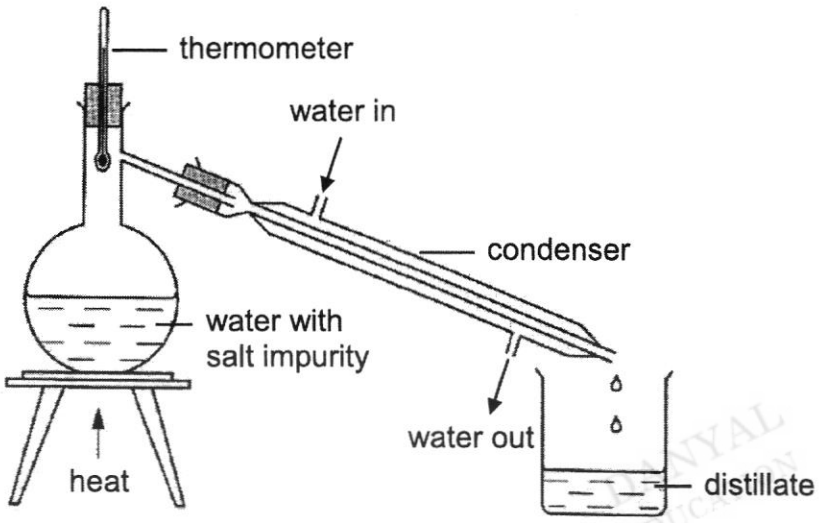


Fig. 3.1

(a) Identify on fig.3.1, the mistakes made in this experimental set-up. Briefly describe how the mistakes could be rectified.

.....

.....

..... [3]

(b) Explain why the bulb of the thermometer must be positioned at the inlet to the condenser.

.....

..... [1]

(c) Using Kinetic Particle Theory, describe the arrangement and movement of the particles in the distillate.

.....

.....

..... [2]

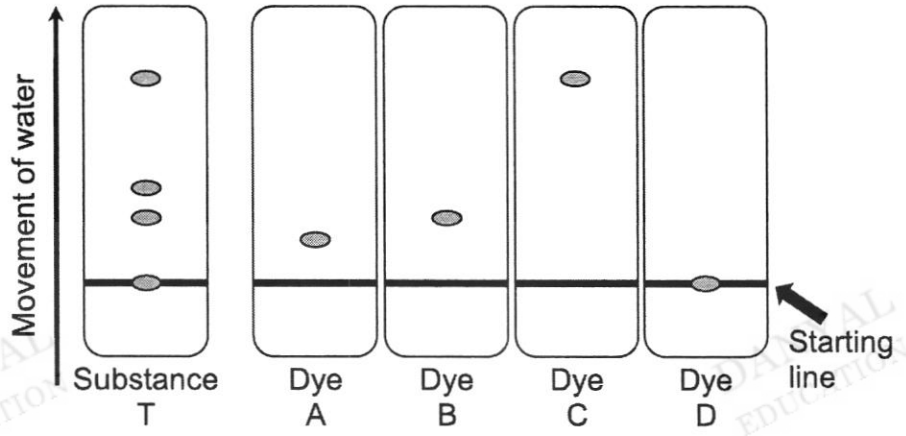
(d) Sam was asked by his teacher to separate a mixture of ethanol and water. What modification must be made in order to carry out the separation?

.....

.....

..... [2]

4 Substance T contains a mixture of dyes that is used as a food colouring in one brand of an ice cream company. Paper chromatography was used to identify the dyes in T. The resulting chromatograms are shown below. Dyes A and C have a harmful effect on the health of some people.



(a) Which of the dyes A, B, C, D are present in T?

..... [1]

(b) Suggest why substance T should not be used as a food colouring.

.....

..... [1]

(c) Dye D is made up of two substances.

Suggest why dye D did not separate into its two substances.

.....

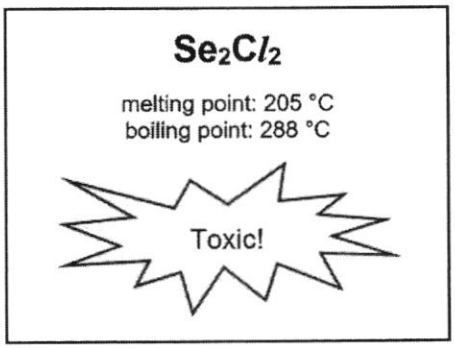
..... [1]

(d) Suggest what can be done in order to separate the substances in Dye D.

.....

..... [1]

5 A bottle has the following label:



(a) Using data from the label, suggest if the bottle contains an element or a compound? Explain your answer.

.....

.....

..... [2]

(b) Using data from the label, suggest if the bottle contains a pure substance or a mixture? Explain your answer.

.....

.....

..... [2]

6 An isotope of element **Q** can be represented as $^{69}_{31}\mathbf{Q}$.

(a) Name element **Q**.

..... [1]

(b) **(i)** Suggest the chemical formula (or symbol) of the ion of **Q**.

..... [1]

(ii) How many electrons will there be in an ion of **Q**?

..... [1]

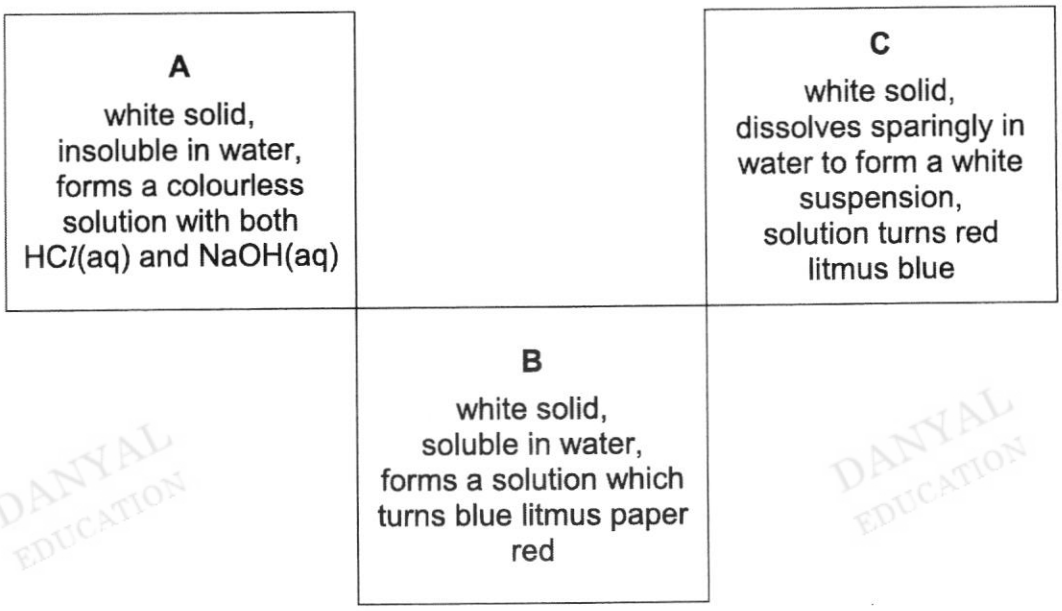
(c) Element **Q** has another isotope $^{71}_{31}\mathbf{Q}$. In terms of atomic structure, compare isotopes **Q**-69 and **Q**-71

.....

.....

..... [2]

7 Using the observations below, identify the oxides **A**, **B** and **C** as either amphoteric, basic or acidic.



A: .....[1]

B: .....[1]

C: .....[1]

8 **(a)** **(i)** A solution is made by dissolving 48 g of ammonium carbonate, $(NH_4)_2CO_3$, in water and making the volume up to 500 cm^3.
Calculate the concentration, in g/dm^3, of this solution.

concentration = ... g/dm^3 [1]

(ii) A solution is made by dissolving 48 g of ammonium carbonate, $(NH_4)_2CO_3$, in 2 dm^3 of water.
Calculate the concentration, in mol/dm^3, of this solution.
[Relative atomic masses: A_r: H, 1; C, 12; N, 14; O, 16]

concentration = ... mol/dm^3 [2]

(b) **(i)** Write the balanced chemical equation for the reaction between ammonium carbonate and hydrochloric acid.

..... [2]

(ii) How many moles of ammonium carbonate will react with 4 moles of hydrochloric acid?

number of moles = ... moles [1]

9 Aqueous potassium hydroxide was titrated against dilute sulfuric acid.

(a) State the type of reaction between dilute sulfuric acid and aqueous potassium hydroxide.

..... [1]

(b) State the colours of Universal Indicator in aqueous potassium hydroxide and dilute sulfuric acid.

aqueous potassium hydroxide: .....

dilute sulfuric acid: ..... [2]

10 The diagram shows the formulae of some gases found in air.

CO	CO_2	N_2	NO
NO_2	SO_2	O_2	O_3

Choose formulae from the box above to answer the following questions.
Each gas can be used once, more than once, or not at all.

(a) Give the formula of a gas that is produced by incomplete combustion of carbon containing fuels.

..... [1]

(b) Give the formulae of two gases that are neutral oxides.

..... and ..... [1]

(c) Give the formulae of two gases that are responsible for the formation of acid rain.

..... and ..... [1]

(d) Give the formulae of two gases that are also present in unpolluted air.

..... and ..... [1]

Section B

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

Write your answers in the spaces provided.

11 (a) Carbon reacts with fluorine to form a potent greenhouse gas called carbon tetrafluoride, CF_4.

(i) Draw a 'dot and cross' diagram to show the bonding in carbon tetrafluoride. Show only the valence electrons.
[Proton (atomic) number: C, 6; F, 9]

[2]

(ii) Explain whether the compound formed in **(a)(i)** has a high or low melting point.

.....

.....

.....

..... [2]

(b) Sodium reacts with nitrogen to form an extremely unstable compound, sodium nitride, Na_3N.

(i) Draw a 'dot-and-cross' diagram showing the bonding in sodium nitride. Show only the valence electrons.
[Proton (atomic) number: N, 7; Na, 11]

[2]

(ii) Explain why compounds with this type of bonding have high melting points.

.....

.....

.....

..... [2]

(iii) State two other physical properties of compounds with this type of bonding.

.....

.....

.....

..... [2]

12 (a) Besides pH values, state three other physical properties of sodium hydroxide.

.....

.....

..... [3]

(b) Explain the following.

(i) An insoluble base does not conduct electricity but alkalis do.

.....

.....

.....

.....

..... [2]

(ii) Upon warming, the reaction between potassium hydroxide and ammonium sulfate produces ammonia gas. A piece of dry red litmus paper placed at the mouth of the test tube does not change colour.

.....

.....

.....

.....

..... [2]

(c) Acid rain contains nitric acid. When plants grown in soils are exposed to acid rain, the growth and development of the plants will be affected.

(i) Write the chemical formula of a substance that may be added to soil to treat the acidity.

..... [1]

(ii) Write a balanced chemical equation to show how a farmer can neutralise the acid in the soil using the substance mentioned in **(c)(i)**.

..... [2]

13 **(a)** A student wants to prepare a dry sample of the salt calcium sulfate.

(i) Suggest a suitable method to prepare the salt and name the chemicals used in the preparation.

.....

.....

..... [2]

(ii) Describe the process in preparing the salt.

.....

.....

.....

.....

..... [4]

(iii) Suggest why the method in **(a)(i)** cannot be used to prepare a sample of sodium nitrate.

.....

..... [1]

(b) Another student adds excess copper(II) oxide to a solution of dilute sulfuric acid.

(i) Predict what would be observed when copper(II) oxide is added to dilute sulfuric acid.

.....

..... [1]

(ii) Write the chemical equation for the reaction in **(b)(i)**.

..... [2]

PEIRCE SECONDARY SCHOOL
END OF YEAR EXAMINATION 2021
SECONDARY THREE EXPRESS
MARKING SCHEME

SCIENCE (CHEMISTRY)
Paper 1 (Multiple Choice)

5076/01, 5078/01
8 Oct 2021

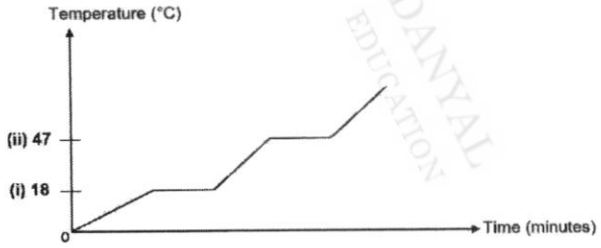
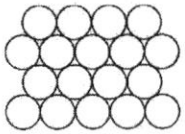
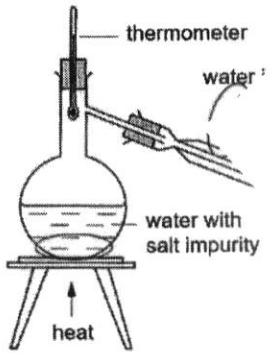
1/21	2/22	3/23	4/24	5/25	6/26	7/27	8/28	9/29	10/30
C	C	D	A	C	C	A	D	C	D
11/31	**12/32**	**13/33**	**14/34**	**15/35**	**16/36**	**17/37**	**18/38**	**19/39**	**20/40**
D	C	A	A	C	D	D	A	A	C

Paper 3 (Theory)

5076/03, 5078/03
6 Oct 2021

S/No	Answers		Remarks
	Section A		
1(a)	Measuring cylinder	[1]	
1(b)	Gas syringe	[1]	
1(c)	Pipette	[1]	
1(d)	Electronic balance	[1]	

Setter: Mr Tan Kok Heong

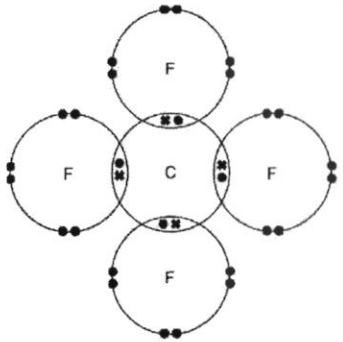
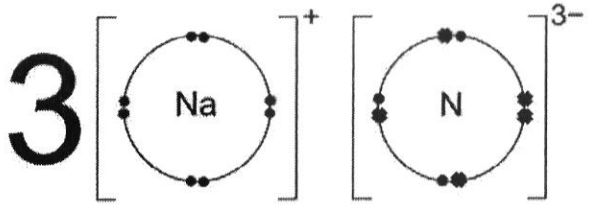
S/No	Answers		Remarks
2(a)		[2]	[1] each
2(b)	Liquid	[1]	
2(c)		[1]	
3(a)	 [1] for circles Boiling chips must be present in distilling flask [1]. Water must enter the condenser from the bottom and leave from the top [1].	[3]	

S/No	Answers		Remarks
3(b)	Measure the temperature of the vapour entering the condenser accurately	[1]	
3(c)	Particles in the distillate are packed close together in disorderly/irregular manner [1], able to slide over one another [1].	[2]	
3(d)	Add a fractionating column [1] between the round bottom flask and the condenser [1]	[2]	
4(a)	Dyes B and C	[1]	
4(b)	Substance T contains dye C which has a harmful effect on people's health.	[1]	
4(c)	Dye D is insoluble in the solvent used.	[1]	
4(d)	Use a different solvent.	[1]	

S/No	Answers		Remarks
5(a)	Compound [1] Se_2Cl_2 is made up of selenium and chlorine chemically combined together in a fixed ratio of 1:1. [1]	[2]	
5(b)	Pure substance [1]. Se_2Cl_2 has a fixed melting point of 205 °C and fixed boiling point of 288 °C.[1]	[2]	
6(a)	Gallium	[1]	
6(b)(i)	Q^{3+}/Ga^{3+}	[1]	
6(b)(ii)	28 electrons	[1]	
6(c)	Both isotopes have equal number of 31 protons and 31 electrons [1] Isotope **Q**-69 has 38 neutrons while isotope **Q**-71 has 40 neutrons/Isotope **Q**-71 has 2 neutrons more than the 38 neutrons in **Q**-69 [1]	[2]	

S/No	Answers		Remarks
7(a)	**A:** amphoteric oxide **B:** acidic oxide **C:** basic oxide	[3]	
8(a)(i)	Concentraton of $(NH_4)_2CO_3 = 48 \div \frac{500}{1000} = 96$ g/dm^3	[1]	
8(a)(ii)	M_r of $(NH_4)_2CO_3 = \{[14 + (1 \times 4)] \times 2\} + 12 + (16 \times 3) = 96$ Number of moles of $(NH_4)_2CO_3 = 48/96 = 0.5$ mol [1] Concentraton of $(NH_4)_2CO_3 = 0.5 \div 2 = 0.25$ mol/dm^3	[2]	
8(b)(i)	$(NH_4)_2CO_3 + 2HCl \rightarrow 2NH_4Cl + H_2O + CO_2$	[2]	[1] chemical formulae [1] balanced equation
8(b)(ii)	HCl : $(NH_4)_2CO_3$ 2 : 1 4 : **2**	[1]	

S/No	Answers		Remarks
9(a)	Neutralisation reaction	[1]	
9(b)	aqueous potassium hydroxide: violet/purple dilute sulfuric acid: red	[2]	[1] each
10(a)	CO	[1]	
10(b)	CO and NO	[1]	
10(c)	NO_2 and SO_2	[1]	
10(d)	N_2, O_2 and/or CO_2	[1]	any 2 of the 3 possible answers

S/No	Answers		Remarks
	Section B		
11(a)(i)		[2]	[1] valence shell [1] type of bonding
11 (a)(ii)	Low melting point [1] because it requires a small amount of energy to overcome the weak intermolecular force of attraction [1] in the simple molecular structure	[2]	
11 (b)(i)		[2]	[1] valence shell/charges [1] type of bonding
11 (b)(ii)	Large amount of energy [1] is needed to overcome the strong electrostatic force of attraction between oppositely charged ions [1] in the giant crystal lattice structure	[2]	

S/No	Answers		Remarks
11 (b)(iii)	Good electrical conductor in molten or aqueous state but not in the solid state [1] Usually soluble in water but insoluble in organic solvents [1]	[2]	
12(a)	Sodium hydroxide has a soapy feel [1], bitter taste [1] and conduct electricity in aqueous state [1]	[3]	
12 (b)(i)	Insoluble base does not have free moving OH^- ions [1], hence unable to carry electric charges and cannot conduct electricity. Alkalis has free moving OH^- ions [1] which is able to carry electric charges and can conduct electricity.	[2]	
12 (b)(ii)	The alkaline ammonia gas produces OH^- hydroxide ions only in water [1] The absence of water will not give the dry ammonia gas its alkaline properties [1]	[2]	
12(c)(i)	$CaO/Ca(OH)_2$	[1]	
12 (c)(ii)	$CaO + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$ OR $Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$	[2]	[1] chemical formulae [1] balanced equation

S/No	Answers		Remarks
13(a)(i)	Calcium sulfate is prepared by **precipitation method** [1] Chemical used are **calcium nitrate/chloride** solution and **sodium/potassium/ammonium sulfate** solution [1]	[2]	
13 (a)(ii)	**Add** sodium sulfate solution to calcium nitrate in a beaker [1] **Filter** to obtain the white precipitate of calcium sulfate as residue [1] **Wash** the residue with cold distilled water to remove impurities [1] **Dry** the residue between sheets of filter paper [1]	[4]	
13 (a)(iii)	Sodium nitrate is a soluble salt [1] and cannot be prepared by the precipitation method	[1]	
13 (b)(i)	A blue solution is formed OR Copper(II) oxide dissolves in the dilute sulfuric acid	[1]	Either answer acceptable
13 (b)(ii)	$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$	[2]	[1] chemical formulae [1] balanced equation