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‘Perseverance Yields Success’**Ping Yi Secondary School**

Preliminary Examination 2022

 Secondary 4 Express/ 5 Normal
SCIENCE (PHYSICS/CHEMISTRY)
5076/5078/01

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Write your name, register number on the Answer Sheet in the spaces provided unless this has been done for you.

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

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.

A copy of the data sheet is printed on page 10.

A copy of the periodic table is printed on page 11.

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

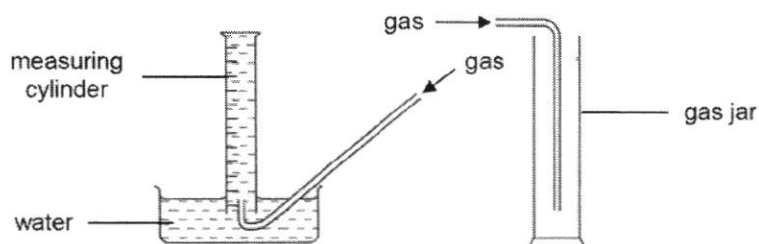
Expected Grade	☐ A1	☐ A2	☐ B3	☐ B4	☐ C5
Teacher's Comment					
Student's Comment					
Parent's Comment and Signature					

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2

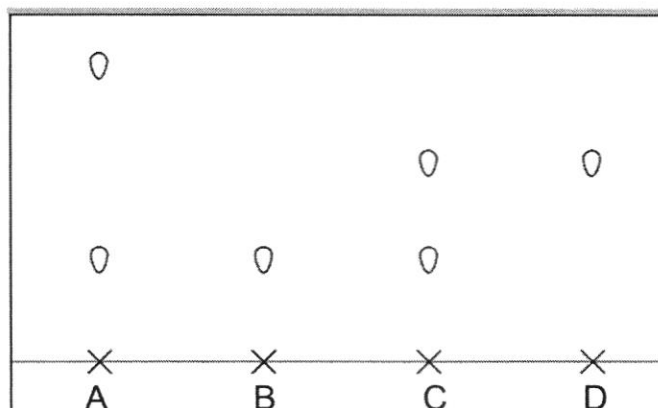
1. The diagram below shows two methods of collecting gases.



Which row gives the properties of a gas which can be collected by both methods?

	property 1	property 2
A	soluble in water	denser than air
B	soluble in water	less dense than air
C	insoluble in water	denser than air
D	insoluble in water	less dense than air

2. The diagram shows paper chromatograms of four substances A, B, C and D.

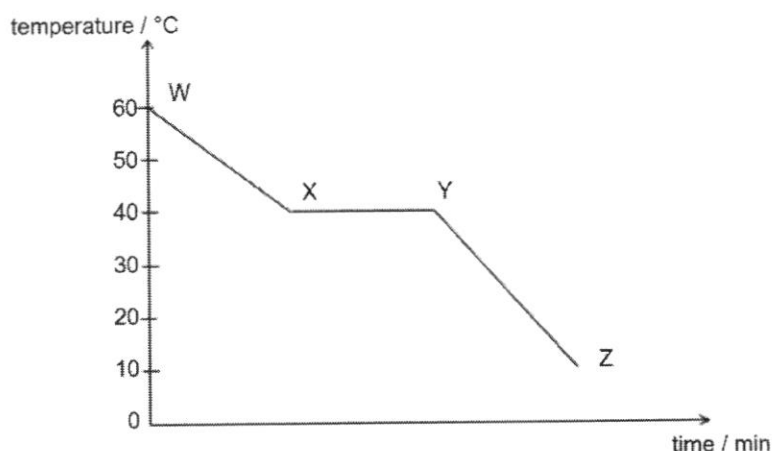


Which of the following statements is true?

- A** Substance A is a pure substance.
- B** Substance B has a variable melting point.
- C** Substance C is found in substance B.
- D** Substance D is found in substance C.

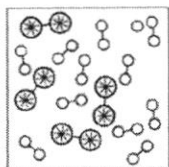
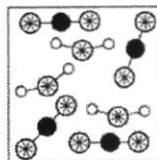
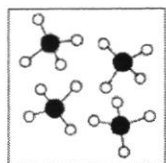
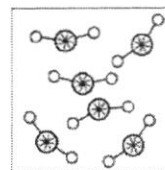
3

3. The curve below shows the temperature changes as liquid Q was cooled from 60 °C to 10 °C.



Which statement correctly describes the particles of liquid Q at various regions of the curve?

- A** Heat energy is gained by the particles at region XY to overcome the forces of attraction.
B The particles exist as a mixture of gas and liquid at region XY.
C The particles are vibrating about fixed positions at region YZ.
D The particles are arranged far apart and in a disorderly manner at region WX.
4. Which diagram best represents a mixture of elements?

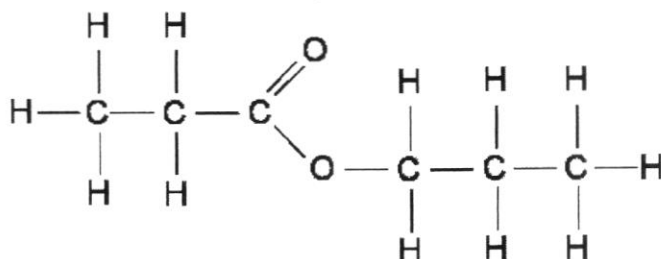
A**C****B****D**

[Turn Over]

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5

8. The diagram shows the molecule ethyl propanoate.



How many bonding pairs of electrons are there in the molecule?

- A** 10 **B** 15 **C** 17 **D** 20
9. Ethane, C_2H_6 , burns completely in oxygen to produce carbon dioxide and water.
- $$2 \text{C}_2\text{H}_6 + 7 \text{O}_2 \rightarrow 4 \text{CO}_2 + 6 \text{H}_2\text{O}$$
- What is the total volume of gaseous products obtained at room temperature and pressure when 0.5 moles of ethane is burnt completely?
- A** 6 dm³ **B** 12 dm³ **C** 24 dm³ **D** 60 dm³
10. 0.1 mol of sodium chloride was dissolved in 100 cm³ of water to form solution X. What can Cassandra do to obtain a 2 mol/dm³ solution of sodium chloride?
- A** add 100 cm³ of water to solution X
B evaporate 50 cm³ of water from solution X
C dissolve 1 mol of sodium chloride in solution X
D prepare another 100 cm³ of solution X and mix the solution together
11. Aqueous solution of an unknown salt gives the following observations when added to the following reagents.

reagent used	result
acidified aqueous barium chloride	white precipitate
aqueous sodium hydroxide	green precipitate that turns brown slowly

Which compound could have been present in the water?

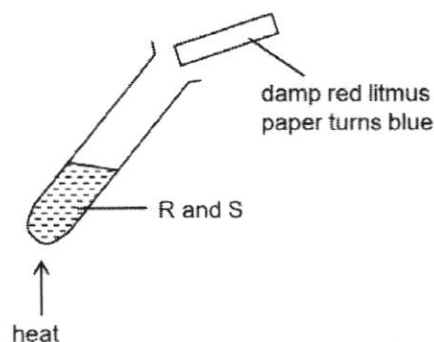
- A** iron(II) sulfate **B** copper(II) sulfate
C iron(III) chloride **D** zinc chloride

[Turn Over

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6

12. The diagram shows two substances, R and S, being heated together.



Which row identifies R and S?

	substance R	substance S
A	aluminium	aqueous sodium nitrate
B	aluminium	hydrochloric acid
C	ammonium sulfate	aqueous sodium hydroxide
D	ammonium sulfate	hydrochloric acid

13. Four different solids, W, X, Y and Z, are dissolved in equal volumes of water at 20 °C. The table shows the change in temperature when each solid dissolves in water.

	W	X	Y	Z
change in temperature /°C	+10	-6	-5	+15

Which row correctly describes the energy changes when each solid is dissolved in water?

	solid	energy change	solid	energy change
A	W	endothermic	Y	exothermic
B	X	exothermic	W	endothermic
C	X	endothermic	Z	exothermic
D	Y	exothermic	Z	endothermic

14. The table below shows the reactions of three oxides X, Y and Z.

oxide	reacts with acid	reacts with alkali
X	no	no
Y	yes	yes
Z	no	yes

Which of the following correctly describes the oxides?

	X	Y	Z
A	amphoteric	neutral	acidic
B	amphoteric	neutral	basic
C	neutral	amphoteric	acidic
D	neutral	amphoteric	basic

15. In an experiment to determine the reactivity of metals Q, R and S, the reactions of the metals with cold water and dilute hydrochloric acid were recorded in the table below. A shaded box indicates that the reaction is not carried out.

metal	reaction with cold water	reaction with dilute hydrochloric acid	displacement reaction
Q		no reaction	
R	no reaction	readily	
S	slow		can displace metal Q from its salt solution

What is the order of reactivity of the metals from the most reactive to least reactive?

- A** $S \rightarrow R \rightarrow Q$ **B** $S \rightarrow Q \rightarrow R$
C $Q \rightarrow R \rightarrow S$ **D** $R \rightarrow S \rightarrow Q$

16. Which air pollutant is **not** correctly matched to its source?

	air pollutant	source
A	carbon monoxide	complete combustion of carbon-containing fuels
B	oxides of nitrogen	lightning activity
C	sulfur dioxide	volcanic eruption
D	unburnt hydrocarbon	incomplete combustion of carbon-containing fuels

[Turn Over

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17. Which statement about trends in the Periodic Table is **not** correct?
- A Elements in the same period have the same number of electron shells.
 - B The elements change from metals to non-metals from left to right.
 - C The number of protons in an atom of an element increases from left to right.
 - D The oxides of the elements change from acidic to basic from left to right.

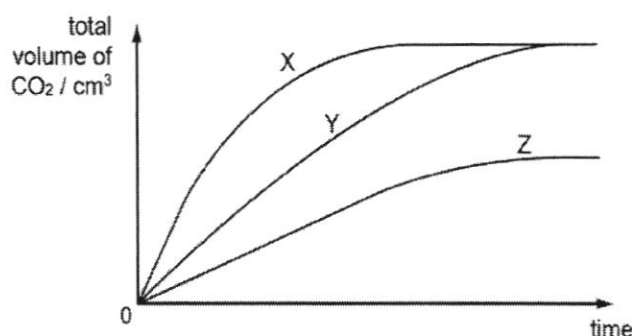
18. Which of the following is a redox reaction?

- A $\text{AgNO}_3 + \text{HCl} \rightarrow \text{AgCl} + \text{HNO}_3$
- B $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
- C $\text{LiOH} + \text{HNO}_3 \rightarrow \text{LiNO}_3 + \text{H}_2\text{O}$
- D $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_4\text{OH}$

19. In experiment 1, an excess of finely powdered marble is added to 20 cm³ of dilute hydrochloric acid.

In experiment 2, an excess of large marble chips is added to 20 cm³ of dilute hydrochloric acid of the same concentration.

The total volume of carbon dioxide given off are determined at regular time intervals and plotted in the following graph.



Which part of curves is obtained in the two experiments?

	experiment 1	experiment 2
A	X	Z
B	X	Y
C	Y	Z
D	Y	X

20. A student investigated the reaction of vegetable oils with hydrogen. 100 cm³ of hydrogen was bubbled through 1 g sample of four different vegetable oils containing a suitable catalyst.

The volume of hydrogen remaining after each experiment was recorded.

vegetable oil	volume of hydrogen remaining /cm ³
P	100
Q	87
R	63
S	0

Which vegetable oil(s) is/are unsaturated?

- | | | | |
|----------|------------|----------|--------------|
| A | P, Q and R | B | Q and R only |
| C | Q, R and S | D | S only |

END OF PAPER

Name: _____

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'Perseverance Yields Success'**Ping Yi Secondary School**

Preliminary Examination 2022

Secondary 4 Express / 5 Normal**SCIENCE (CHEMISTRY)****Paper 3 Chemistry****5076/5078/03****1 hour 15 minutes**

Candidates answer on the question paper.

Additional materials: Answer paper

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name on the work you hand in.

Write in dark blue or black pen.

You may use a HB pencil for any diagrams, graphs, tables 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 not use appropriate units.

Section A – Answer **all** questions in the spaces provided.**Section B** – Answer **any two** questions in the spaces provided.

A copy of the Data Sheet is printed on page 17.

A copy of the Periodic table is printed on page 18.

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	
Paper 1	20
Paper 3 Section A	45
Paper 3 Section B	20
Paper 5 Chemistry Practical	15
Total	100

Expected Grade	☐ A1	☐ A2	☐ B3	☐ B4	☐ C5
Teacher's Comment					
Student's Comment					
Parent's Comment and Signature					

This paper consists of **18** printed pages including the cover page and inserts.**[Turn over**

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PartnerInLearning

Section A

Answer **all** the questions.

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

1. The following are terms used to describe chemical reactions.

addition	rusting	redox
decomposition	neutralisation	substitution

Using the terms above, identify the type of reaction that each chemical equation represents.

[4]

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

	description of reaction	chemical reaction
(a)	$C_3H_6 + H_2 \rightarrow C_3H_8$	
(b)	$ZnCO_3 \rightarrow ZnO + CO_2$	
(c)	$H_2 + F_2 \rightarrow 2HF$	
(d)	$C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$	

- 2 The diagram below represents part of the Periodic Table. The code letters **K** to **Q** represent elements.

											M
	P						K			N	
Q				O							

Using the code letters, identify the following element(s) in (a) to (d). [You may use any code letter once, more than once or not at all.]

Write down the symbol for an element which

- (a) does not react with any other element,

..... [1]

Turn over

- 2 (b) forms an oxide that reacts only with acid,
 [1]
- (c) has variable oxidation state number,
 [1]
- (d) forms oxide and is added to decrease the acidity of the soil.
 [1]

- 3 Table 3.1 contains details of seven different particles. The letters are not the chemical symbols.

	D	E	F	G	H	I	J
nucleon number	3	10	11	14	19	23	35
proton number	2	5	5	7	10	11	17
total number of electrons	2	5	5	7	10	11	18

Table 3.1

Use the table to state which of the particles, **D, E, F, G, H, I** and **J**

- (a) has a single neutron, [1]
- (b) will form an ionic compound with chlorine, XCl_3 , [1]
- (c) is soft and shiny. [1]
- 4 Most substances can be placed into only one of the five groups listed in Table 4.1.

group	letter
element	A
compound	B
mixture of elements	C
mixture of compounds	D
mixture of elements and compounds	E

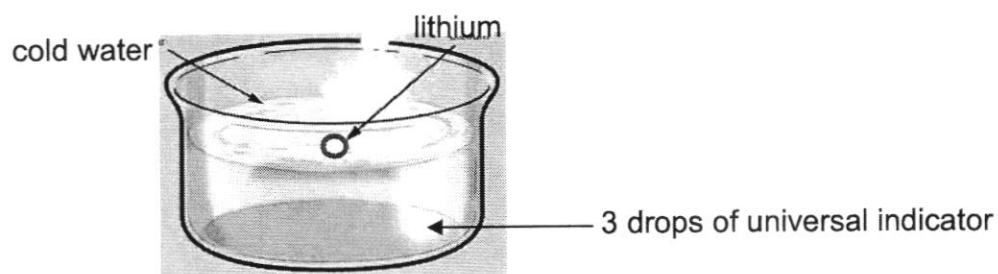
Table 4.1

Which of the groups, **A, B, C, D** or **E** in Table 4.1, best describes each of the following substances? [2]

	substances	group
(a)	air	
(b)	hydrogen	
(c)	brass	
(d)	sodium carbonate	

[Turn over

- 5 7 g of lithium reacts with 50 cm³ cold water as shown below.



- (a) Write the chemical equation for this reaction. Include state symbols in your equation.
 [2]
- (b) Describe what is observed (apart from release of hydrogen gas) when lithium reacts with cold water.

 [1]
- (c) Calculate the number of moles of lithium used. [1]

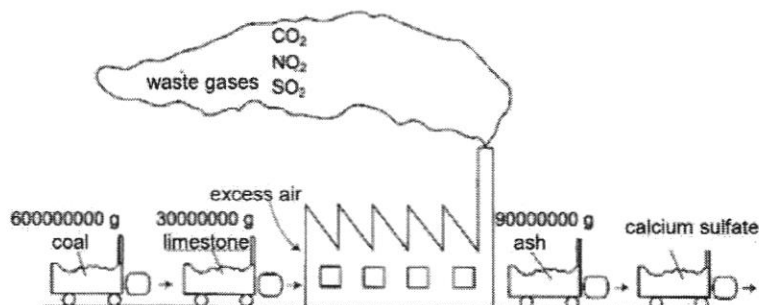
no of moles of lithium = mol

- (d) Calculate the concentration of lithium hydroxide formed. [2]
 [Relative atomic masses: Ar: H, 1; O, 16; Li, 7]

concentration of lithium hydroxide = mol/dm³

[Turn over]

- 6 Some power stations use coal as fuel. Coal contains sulfur impurities. On combustion, sulfur is oxidized to sulfur dioxide. The melting and boiling points of sulfur are $-73\text{ }^{\circ}\text{C}$ and $-10\text{ }^{\circ}\text{C}$ respectively. Before the waste gases are released into the atmosphere, the sulfur dioxide is removed by limestone. The diagram shows the amount of substances used and produced by a coal-fired power station in a day.



- (a) Draw a 'dot and cross' diagram for one of the waste gas, carbon dioxide. Show only the valence electron. [2]

- (b) State one harmful effect of sulfur dioxide.

..... [1]

- (c) Using Kinetic Particle Theory, describe the changes in arrangement and movement of sulfur dioxide from $-63\text{ }^{\circ}\text{C}$ to $0\text{ }^{\circ}\text{C}$.

arrangement:

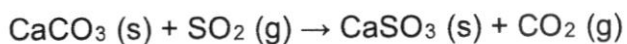
.....

movement:

..... [2]

[Turn over

- 6 (d) Limestone removes sulfur dioxide from the waste gases, as shown in the equation below.



Calculate the maximum volume of carbon dioxide produced from 30000000 g (30 tonnes) of limestone at room temperature and pressure. [3]

[Relative atomic masses: Ar: Ca, 40; O, 16; C, 12; S, 32;]

volume of carbon dioxide gas =dm³

- (e) When the limestone was first used in the power stations, some scientists claimed they 'solved all pollution problems at the power stations'. Explain why this is not true.

.....

 [1]

[Turn over

- 7 5 g of magnesium ribbon was added to 100 cm³ of 1.0 mol/dm³ of excess hydrochloric acid. Volume of hydrogen is collected and recorded every 30 seconds.

Fig. 7.1 shows the results obtained for the experiment.

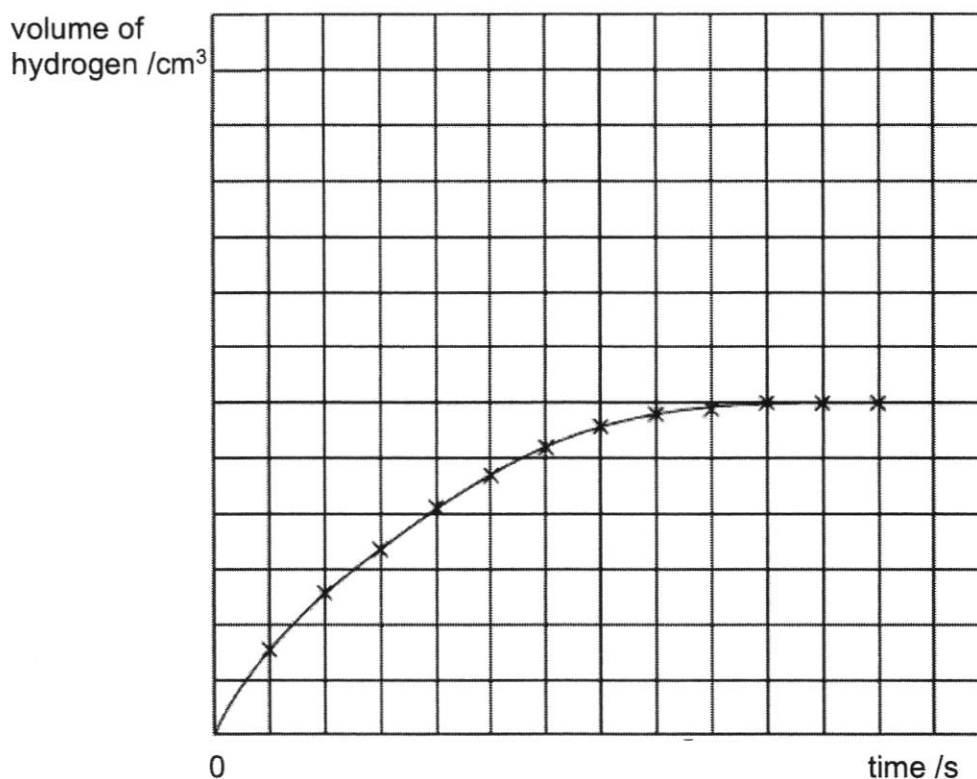


Fig. 7.1

- (a) The experiment is repeated with 5 g of magnesium ribbon and 100 cm³ of 0.5 mol/dm³ excess hydrochloric acid. Sketch the graph that you would obtain from the results of this experiment on the same grid in Fig. 7.1. Label the graph X. [1]
- (b) The experiment is repeated with 2.5 g of magnesium ribbon and 100 cm³ of 1.0 mol/dm³ excess sulfuric acid. Sketch the graph that you would obtain from the results of this experiment on the same grid in Fig. 7.1. Label the graph Y. [1]

[Turn over

- 8 (a) Sodium chloride and lead(II) chloride are two different salts which require two different methods of preparation. Complete Table 8.1 below to name the possible reactants used to prepare these two different salts. [2]

salt	reactant 1	reactant 2
sodium chloride		
lead(II) chloride		

Table 8.1

- (b) Nicholas wrote his Chemistry notes by hand while preparing for his Chemistry examination. The following is an extract taken from his notes illustrating the following instructions for preparing magnesium nitrate crystals.

Place 100 cm³ of dilute sulfuric acid in a beaker. Heat the acid until it is almost boiling. Add magnesium powder until no more can dissolve. Filter the mixture. Place the residue in an evaporating dish. Place the evaporating dish on a tripod and heat it until the liquid has been reduced to about one-third of its volume. Set aside the mixture and allow it to cool. Filter off the crystals from the cooled solution. Wash with large quantities of tap water and dry them between pieces of filter paper.

- (i) State the purpose of the underlined instructions in Table 8.2. [2]

instruction	purpose
until no more can dissolve	
about one-third of its volume	

Table 8.2

- (ii) Nicholas has made several mistakes in his notes. Complete Table 8.3 to list one of the mistakes and correction to the mistake. [2]

mistake	correction to mistake

Table 8.3

- 9 Aldehydes are a homologous series of organic compounds like alkanes and alkenes. Table 9.1 shows the names and formulae of some aldehydes.

name	formula
methanal	HCHO
ethanal	CH ₃ CHO
propanal	C ₂ H ₅ CHO
pentanal	C ₄ H ₉ CHO

Table 9.1

- (a) Using the information in Table 9.1, give two pieces of evidence that suggest aldehydes are a homologous series.

.....

 [2]

- (b) Predict the chemical formula of the next member (after pentanal) in the aldehydes homologous series. [1]

Chemical formula:

[Turn over

10 Study the series of chemical reactions shown in Fig. 10.1.

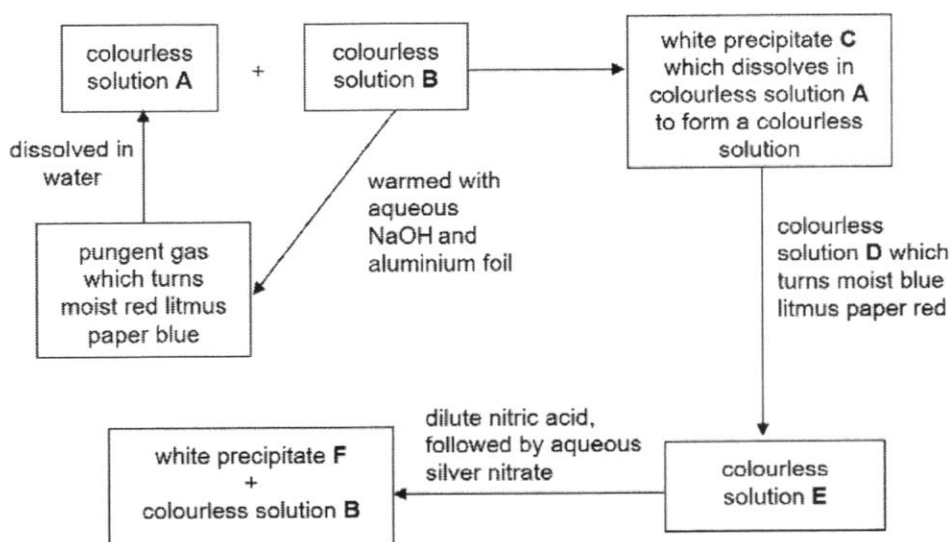


Fig. 10.1

(a) Identify the following substances.

substance	identity of substance
A	
B	
D	
E	
F	

[5]

(b) Write the ionic equation for the formation of white precipitate C.

..... [1]

Register No. Class

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Name: _____

Section B (20 marks)Answer any **two** questions from this section.

Write your answers in the spaces provided.

- 11** Group VII elements exist as diatomic molecules and are strong oxidising agents. Chlorine is an example of a group VII element that is highly reactive.

(a) Chlorine gas reacts readily with Group II metals to form a chloride salt.

- (i)** Name a Group II metal. Write a balanced chemical equation to show the reaction of chlorine with the metal.

.....
 [2]

- (ii)** Draw a 'dot and cross' diagram to show the bonding of the metal chloride salt formed. Show only valence electrons. [2]

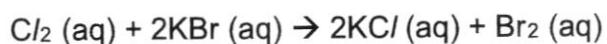
- (iii)** Predict the electrical conductivity of the chloride salt at room temperature and pressure. Explain your answer.

.....

 [2]

[Turn over

- 11 (b) Aqueous chlorine is added to aqueous potassium bromide. The equation for the reaction is:



- (i) Explain, in terms of oxidation states, why aqueous chlorine is a strong oxidizing agent.

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

- (ii) Describe and explain the observation made for the reaction.

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

- 12 Four metals, **W**, **X**, **Y** and **Z** are tested with cold water, steam and dilute hydrochloric acid separately.

Table 12.1 below shows the results of the experiment.

metal	reaction with			
	cold water	steam	dilute hydrochloric acid	aqueous copper(II) sulfate
W	x	√	√	
X	√	√	√	
Y	x	x	x	
Z	x	x	√	

Table 12.1

key:

√: reaction occurred

x: no visible reaction

- (a) Arrange the four metals, **W**, **X**, **Y** and **Z** in increasing order of reactivity.

..... [1]

- (b) Predict the reaction of the four metals with aqueous copper(II) sulfate by filling in the blanks with '√' or 'x' in the table above. [2]

- (c) Metal **W** is often mixed with carbon to form an alloy, steel, in industries. Explain why steel is preferably used in industries as compared to metal **W**.

.....

 [2]

[Turn over

- 12 (d) Outline a laboratory investigation that can be used to decide the reactivity of metals, namely zinc, iron and copper.

You are provided with the metals and their aqueous solutions.

- zinc nitrate
- iron (II) nitrate
- copper (II) nitrate

You may include equations in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

13 Ethanol is a member of the alcohol homologous series.

(a) Draw the full structural formula of ethanol.

[1]

(b) Ethanol is manufactured by the fermentation of glucose. Briefly describe this process. Include in your answer the conditions needed for fermentation and how ethanol is purified.

.....

.....

.....

.....

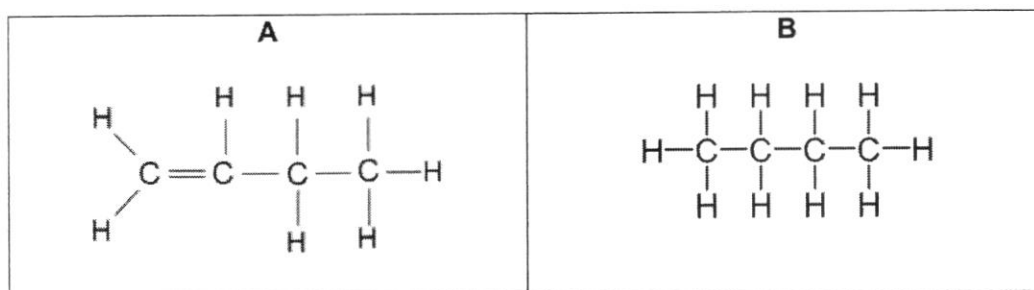
.....

..... [3]

(c) Ethanol is oxidized by oxygen in the air to form ethanoic acid. Draw the full structural formula of ethanoic acid. [1]

[Turn over

- 13 (d) Some organic compounds are given below.



- (i) Describe a chemical test to differentiate between compounds **A** and **B**.

.....

.....

.....

..... [2]

- (ii) Compound **A** undergoes polymerization. Draw the monomer and polymer with 2 repeating units for compound **A**. [2]

monomer of compound A	polymer with 2 repeating units for compound A

- (iii) Compound **B** undergoes a chemical reaction to produce smaller chains hydrocarbons. Name the chemical reaction.

..... [1]

END OF PAPER

Ping Yi Secondary School
Combined Science Chemistry 4E5N Prelim 2022

P1 [20 marks]

5076 /01 [Chem section only]

21	C	31	A
22	D	32	C
23	C	33	C
24	A	34	C
25	D	35	A
26	A	36	A
27	B	37	D
28	D	38	B
29	C	39	B
30	B	40	C

5078 /01 [Chem section only]

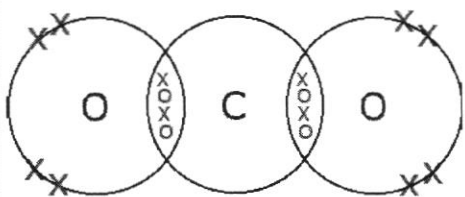
1	C	11	A
2	D	12	C
3	C	13	C
4	A	14	C
5	D	15	A
6	A	16	A
7	B	17	D
8	D	18	B
9	C	19	B
10	B	20	C

P3

Structured Questions Section A

1			description of reaction	chemical reaction		4
	(a)	$C_3H_6 + H_2 \rightarrow C_3H_8$		addition		
	(b)	$ZnCO_3 \rightarrow ZnO + CO_2$		decomposition		
	(c)	$H_2 + F_2 \rightarrow 2HF$		redox		
	(d)	$C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$		substitution		
<i>*every 1 correct, 1 mark</i>						
2	(a)	M				1
	(b)	Q or P				1
	(c)	O				1
	(d)	P				1
3	(a)	D				1
	(b)	E or F				1
	(c)	I				1
4			substances	group		2
	(a)	air		E		
	(b)	hydrogen		A		
	(c)	brass		C		
	(d)	sodium carbonate		B		
<i>*every 2 correct, 1 mark</i>						
5	(a)	$2 Li(s) + 2 H_2O(l) \rightarrow 2 LiOH(aq) + H_2(g)$				2
	<i>*1m for balancing equation, 1m for state symbols</i>					
	(b)	Lithium darts/reacts moderately on the surface of the water.				1
	(c)	No of mole of Lithium = $7/7 = 1 \text{ mol}$				1
	(d)	From the equation, mole ratio $H_2O : Li$ 2:2 1:1 Concentration of $LiOH = 1/(50/1000)$ $= 20 \text{ mol/dm}^3$				1 1

[Turn over

6	(a)	 *1m for equal sharing of electrons between carbon and oxygen 1m for valence electrons of oxygen			2
	(b)	Sulfur dioxide dissolves in rainwater to form acid rain which corrodes building and harm aquatic life.			1
	(c)	Change from <i>liquid</i> → <i>gas</i> <i>arrangement:</i> At -63°C, particles are arranged closely packed in a disorderly manner. At 0°C, particles are spaced far apart in a disorderly manner. <i>movement:</i> At -63°C, particles are sliding past each other. At 0°C, particles are moving rapidly in any direction.			1 1
	(d)	No of mole of $\text{CaCO}_3 = 30000000 / (40 + 12 + 48)$ $= 300000$ mole From the equation, mole ratio of $\text{CaCO}_3 : \text{CO}_2$ $1 : 1$ $300000 : 300000$ Volume of $\text{CO}_2 = 300000 \times 24$ $= 7200000 \text{ dm}^3$			1 1 1
	(e)	While limestone helps to remove the waste gas SO_2, it has resulted in the release of CO_2. CO_2 is a greenhouse gas that <i>contributes to global warming, raising earth's temperature and causing floods in low lying areas.</i>			1
	(a)	Graph X • <i>gradient is lower than original graph / time taken is more than original time</i> • <i>final volume is same</i>			1
7	(b)	Graph Y • <i>gradient is steeper than original graph</i> • <i>final volume is half of the original volume</i>			1
8	(a)	salt	reactant 1	reactant 2	2
		sodium chloride	sodium hydroxide sodium oxide sodium carbonate	hydrochloric acid	
		lead (II) chloride	lead(II) nitrate solution *need the word solution or aqueous	sodium chloride solution or group I chloride salts *need the word solution or aqueous	

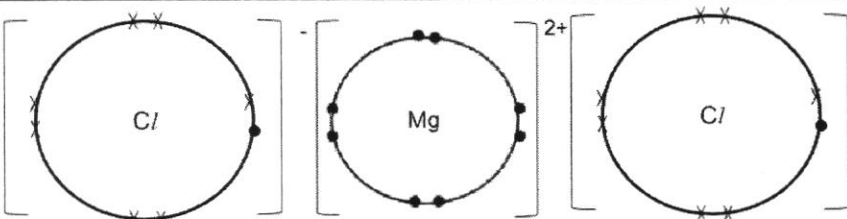
[Turn over

		*1m for each correct reagents				
9	(b) (i)	instruction		purpose		2
		until no more can dissolve		To ensure that all acid is used.		
		about one-third of its volume		To obtain a saturated solution for crystallization to take place		
		*1m for each purpose				
	(ii)	mistake		correction to mistake		2
		Place 100 cm ³ of dilute sulfuric acid		Place 100cm ³ of dilute nitric acid		
		Place the residue in the evaporating dish		Place the filtrate in the evaporating dish		
		Wash with large quantities of tap water		Rinse with distilled water		
	*1m each for each mistake and correction. The mistake needs to tally with the correction accordingly.					
	(a)	Each member has a functional group of CHO Each member name ends with -al Each successive member differ in chemical formula from the next member by a -CH ₂ group *any 2 marks for 2 of the points				2
(b)		C ₅ H ₁₁ CHO				1
10	(a)	substance	identity of substance		5	
		A	aqueous ammonia/ ammonia/ NH ₃ ;			
		B	zinc nitrate/ Zn(NO ₃) ₂ ;			
		D	hydrochloric acid/ HCl/;			
		E	zinc chloride/ ZnCl ₂ ;			
		F	silver chloride/ AgCl/;			
	(b)	Zn ²⁺ (aq) + 2OH ⁻ (aq) → Zn(OH) ₂ (s) *mindful that the state symbol for Zinc hydroxide is solid				1

Structured Questions Section B

11	(a)	(i)	magnesium	1
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[Turn over]

		$\text{Mg} + \text{Cl}_2 \rightarrow \text{MgCl}_2$ [Accept any other Group II metals.]	1																													
	(ii)	 [1m for correct number of charges; 1m for correct number of valence electrons] [Deduct 1m if students do not show alternate arrangement of ions]	2																													
	(iii)	It <i>does not</i> conduct electricity at solid state.	1																													
		It <i>does not have free moving ions</i> to carry charges as they are held in fixed position in the giant lattice structure.	1																													
	(b)	(i) Aqueous chlorine / Cl_2 <i>oxidises</i> KBr to form Br_2 . The oxidation state of Br increases from -1 in KBr to 0 in Br_2 .	1 1																													
		(ii) Colourless solution turns reddish-brown. Chlorine, being more reactive, displaces bromine from potassium bromide to form aqueous bromine.	1 1																													
12	(a)	Y, Z, W and X	1																													
	(b)	<table><tr><th rowspan="2">metal</th><th colspan="4">reaction with</th></tr><tr><th>cold water</th><th>steam</th><th>dilute hydrochloric acid</th><th>aqueous copper(II) sulfate</th></tr><tr><td>W</td><td>x</td><td>√</td><td>√</td><td>√</td></tr><tr><td>X</td><td>√</td><td>√</td><td>√</td><td>√</td></tr><tr><td>Y</td><td>x</td><td>x</td><td>x</td><td>x</td></tr><tr><td>Z</td><td>x</td><td>x</td><td>√</td><td>√</td></tr></table> [Any 2 correct answers 1m; All 4 correct answers 2m]	metal	reaction with				cold water	steam	dilute hydrochloric acid	aqueous copper(II) sulfate	W	x	√	√	√	X	√	√	√	√	Y	x	x	x	x	Z	x	x	√	√	2
metal	reaction with																															
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X	√	√	√	√																												
Y	x	x	x	x																												
Z	x	x	√	√																												
	(c)	Steel is <i>stronger / harder</i> than metal W . The <i>atoms</i> of different elements have <i>different sizes</i> that <i>disrupt the orderly arrangement</i> of layers of metal atoms in pure metals. This <i>prevents the layers of atoms from sliding over one another</i> when a force is applied.	1 1																													
	(d)	Displacement reaction Add zinc into iron (II) nitrate and copper (II) nitrate solutions and observe. $\text{Zn} + \text{Fe}(\text{NO}_3)_2 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{Fe}$	1																													

[Turn over

		$\text{Zn} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{Cu}$ <i>Iron (II) nitrate changes from green to colourless while Copper (II) nitrate changes from blue to colourless</i> Add iron into zinc nitrate and copper (II) nitrate solutions and observe. $\text{Fe} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{no reaction}$ $\text{Fe} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Fe}(\text{NO}_3)_2 + \text{Cu}$ <i>Copper (II) nitrate changes from blue to green while zinc nitrate remains colourless</i> Add copper into zinc nitrate and iron (II) nitrate solutions and observe. <i>No visible observations is seen in both experiments</i> Zinc is more reactive than iron and copper <i>since displacement reactions occurred</i>. Iron is more reactive than copper but less reactive than zinc as only a displacement reaction is observed when iron is added to copper (II) nitrate. Hence, $\text{Zn} > \text{Fe} > \text{Cu}$ OR Place a clean strip of zinc into each of the solution. Observe what happens. Repeat the experiment with clean strips of iron and copper using fresh metal sulfate solution. Record the observations in the table below. <table border="1"> <thead> <tr> <th>metal</th><th>ZnSO_4</th><th>FeSO_4</th><th>CuSO_4</th></tr> </thead> <tbody> <tr> <td>zinc</td><td></td><td>$\text{Zn} + \text{FeSO}_4 \rightarrow \text{ZnSO}_4 + \text{Fe}$ <i>Solution changes from green to colourless</i></td><td>$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$ <i>Solution changes from blue to colourless</i></td></tr> <tr> <td>iron</td><td><i>No visible reaction</i></td><td></td><td>$\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$ <i>Solution changes from blue to green</i></td></tr> <tr> <td>copper</td><td><i>No visible reaction</i></td><td><i>No visible reaction</i></td><td></td></tr> </tbody> </table> Since <i>zinc can displace both iron and copper from aqueous solution, it is the most reactive metal</i>. Since <i>copper cannot displace any metal from aqueous solution, it is the least reactive metal</i>. Order of reactivity from least to most reactive is $\text{copper} < \text{iron} < \text{zinc}$	metal	ZnSO_4	FeSO_4	CuSO_4	zinc		$\text{Zn} + \text{FeSO}_4 \rightarrow \text{ZnSO}_4 + \text{Fe}$ <i>Solution changes from green to colourless</i>	$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$ <i>Solution changes from blue to colourless</i>	iron	<i>No visible reaction</i>		$\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$ <i>Solution changes from blue to green</i>	copper	<i>No visible reaction</i>	<i>No visible reaction</i>		1 1 1 1 2 1 1
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copper	<i>No visible reaction</i>	<i>No visible reaction</i>																	
13	(a)		1																
	(b)	Yeast acts on glucose to produce ethanol and carbon dioxide. Conditions: absence of oxygen and 37°C	1 1																

[Turn over

		Pure ethanol can be obtained via fractional distillation.	1				
	(c)		1				
	(d)	(i) Add <i>aqueous bromine</i> to compound A and compound B separately. Compound A would rapidly decolourise aqueous bromine from <i>reddish brown</i> to <i>colourless</i>. Compound B <i>remains reddish brown</i>.	1 1				
	(ii)	<table border="1"> <tr> <td>monomer of compound A</td> <td>polymer with 2 repeating units for compound A</td> </tr> <tr> <td> $\begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{C} = \text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{C}_2\text{H}_5 \end{array}$ </td> <td> $\left[\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{C}_2\text{H}_5 \end{array} \right]_2$ </td> </tr> </table>	monomer of compound A	polymer with 2 repeating units for compound A	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{C} = \text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{C}_2\text{H}_5 \end{array} $	$ \left[\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{C}_2\text{H}_5 \end{array} \right]_2 $	2
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$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{C} = \text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{C}_2\text{H}_5 \end{array} $	$ \left[\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{C}_2\text{H}_5 \end{array} \right]_2 $						
	(iii)	Catalytic cracking	1				