EXP

PUNGGOL SECONDARY SCHOOL
SECONDARY 4/5
EXPRESS
2022 PRELIMINARY EXAMINATION

QUESTION & ANSWER BOOKLET

NAME			
CLASS		INDEX NUMBER	

Science Chemistry 5076/03

Paper 3

26 August 2022

1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
You may use a HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black ink.
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 (45 marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B (20 marks)
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Periodic Table is printed on page **14.**
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's use	
Section A	/45
Section B	/20
-	**-**
Total	/65

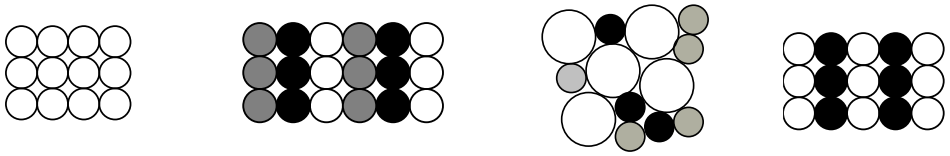
Parent's Signature

This paper consists of **14** printed pages and **0** blank page.

Section A

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

1 The diagrams show the atoms in four substances, **W, X, Y** and **Z.**



W **X** **Y** **Z**

(a) Which of the above diagram represents

(i) copper wire : ……

(ii) stainless steel wire : …… [2]

(b) Explain why stainless steel wire is more difficult to bend than a copper wire.

……...…

……...

……

……[2]

[Total:4]

2 Iron (III) chloride, $FeCl_3$, is formed when iron, Fe, is heated in chlorine gas.

(a) Write a balanced chemical equation for this reaction.

……[2]

(b) State with reasons, whether iron is being oxidised or reduced or neither of these.

……..

……..

……[2]

[Total:4]

3 Separating atmospheric air into its constituent gases is an important process for obtaining nitrogen and oxygen.

(a) **(i)** State the process used to separate air to obtain nitrogen and oxygen.

……...….[1]

(ii) Describe why this process is able to separate the two gases.

…….

……..…….[1]

(b) Describe the observation when a glowing splint is placed into a gas jar filled with oxygen.

…….....[1]

(c) Draw a 'dot and cross' diagram to show the bonding in a molecule of oxygen. Show only the outer shell electrons.

[2]

[Total:5]

4 **Table 4.1** describes three different oxides. Complete the table.

Table 4.1

oxides	**formula of oxide**	**nature of oxide (acidic /basic /amphoteric)**	**solubility in water**
sulfur	SO_2	acidic	
magnesium	MgO		
zinc			No

[Total:5]

5 **Table 5.1** contains details of seven different atoms.

The letters do not represent chemical symbols of elements.

Table 5.1

	S	**T**	**V**	**W**	**X**
nucleon number	3	19	14	19	40
proton number	2	9	7	10	20
electronic configuration	2	2.7	2.5	2.8	2.8.8.2

Use **Table 5.1** to state which atom(s) **S**, **T**, **V**, **W**, and **X**.

(a) has only one neutron ……

(b) can form positive ions ……....

(c) forms covalent compounds that are diatomic …… and ……

(d) are noble gases …… and …… [6]

[Total:6]

6 **Table 6.1** shows some properties of lithium and other Group I elements.

Table 6.1

metal	**density g/cm^3**	**melting point /°C**	**boiling point /°C**
lithium	0.53	181	1342
sodium	0.97	98	883
potassium	0.86	63	759
rubidium	1.53	39	686

Use the information in **Table 6.1** to answer the following when relevant.

(a) **(i)** Write the balanced equation for the reaction of lithium with water.

……..[2]

(ii) Explain why Group I elements are also known as alkali metals.

……..…...

……..….[1]

(b) **(i)** Explain why rubidium is a liquid at a temperature of 40 °C.

……...……..[1]

(ii) Explain why a piece of rubidium strip will not float on a beaker of water.

……[1]

(c) Describe two observations when sodium reacts with water.

……..…

……

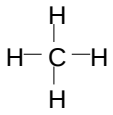
……[2]

[Total:7]

7 A homologous series is a group of compounds that have similar chemical properties and the same general formula.

Complete **Table 7.1.** Show all the bonds in the structures.

Table 7.1

homologous series	name of compound	structures
alkanes		
alkenes	propene	
	propanol	

[4]

[Total:4]

8 **Fig 8.1** describes some properties of compound **A**.

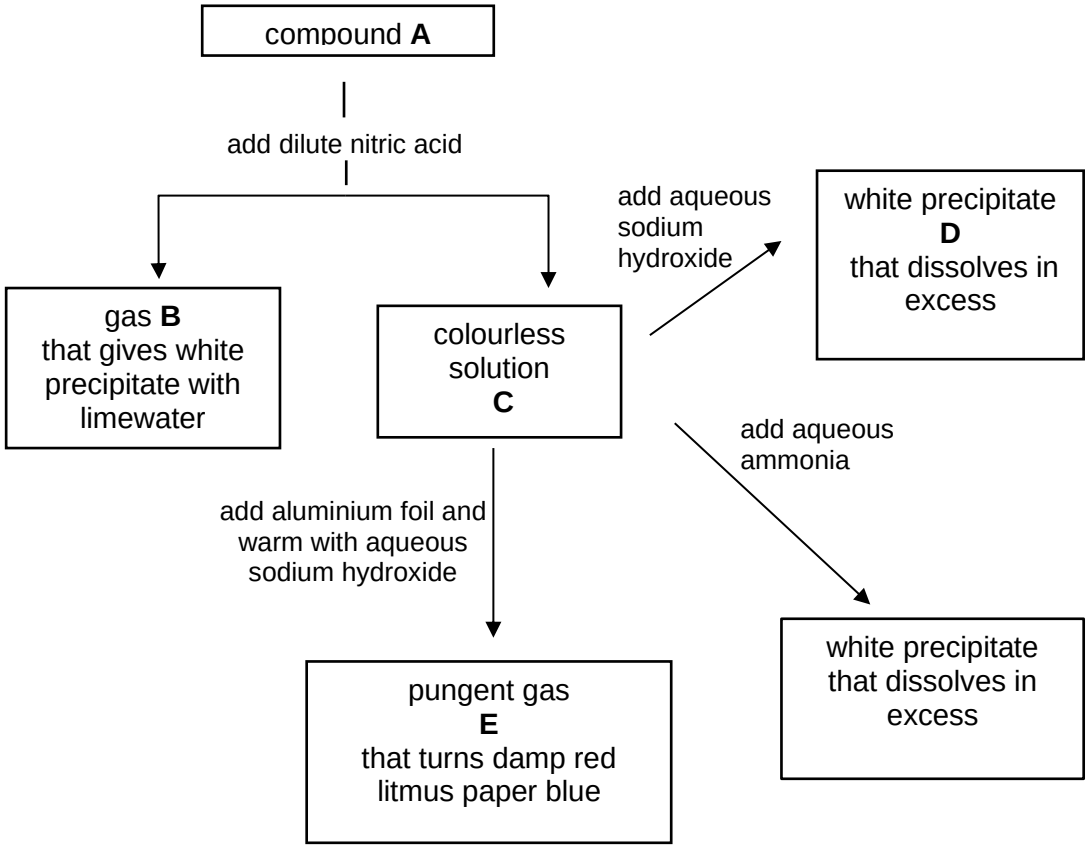


Fig 8.1

Suggest the identity of substances **A, B, C, D** and **E**.

A: ……..

B: ……..

C: ……..

D: ……..

E: …….. [5]

[Total:5]

9 **Table 9.1** shows some information about the compounds in a homologous series.

Table 9.1

compound	molecular formula	relative molecular mass, M_r	boiling points / °C
methanol	CH_3OH	32	65
ethanol	C_2H_5OH	46	78
propanol	C_3H_7OH	60	97
butanol	C_4H_9OH	74	117

(a) What is a homologous series?

……..……..……

……..……..

…….....….....….[2]

(b) Describe the change in the flammability from methanol to propanol.

……..……..…...[1]

(c) **(i)** Calculate the relative molecular mass of pentanol, which has five carbon atoms in a molecule.

[1]

(ii) Predict the boiling point of pentanol.

……...…..…..…[1]

[Total:5]

Section B

Answer any **two** questions from this section in the spaces provided.

10 A student investigates how the speed of a reaction changes over time.

100 ml of 1 mol/dm^3 dilute hydrochloric acid, HC*l*, is added into a conical flask. Excess powdered sodium carbonate is added to the acid in the flask.

A gas syringe is immediately attached to the conical flask with suitable connectors and the volume of gas produced over time was measured with a stop watch regularly. The measurement was stopped after 10 mins when no more fizzing was observed.

(a) **(i)** Sketch the graph that you would obtain from the data collected.

Name the axes correctly and label the curve as **X**.

[2]

(ii) The experiment was repeated a second time. This time the experiment was conducted with the acid warm to 50 °C. The volume and concentration of the acid remains the same for the two experiments.

Sketch the graph that you would obtain on the same axes in **(i)**
Label this curve **W**. [1]

(b) Explain why the initial speed of the reaction has changed in **(a)(ii)**.

……

……

……

……

……

……[3]

Excess sodium bicarbonate, $NaHCO_3$, reacts with 100 cm^3 of 38.4 g/dm^3 of citric acid, $C_3H_5O(COOH)_3$, to produce sodium citrate, carbon dioxide and water.

$3NaHCO_3(s) + C_3H_5O(COOH)_3(aq) \rightarrow C_3H_5O(COONa)_3(aq) + 3CO_2(g) + 3H_2O(l)$

[Relative atomic mass: A_r: C,12; H,1; O,16]

(c) **(i)** Calculate the M_r of citric acid, $C_3H_5O(COOH)_3$

relative molecular mass = ……. [1]

(ii) Calculate the concentration of the citric acid solution in mol/dm^3.

concentration = ……mol/dm^3 [1]

(iii) Calculate the number of moles of citric acid, $C_3H_5O(COOH)_3$, that has reacted.

number of moles = ……mol [1]

(iv) Calculate the volume of carbon dioxide, CO_2, produced at room temperature and pressure.

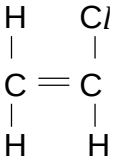
[The volume of one mole of any gas is 24 dm^3 at room temperature and pressure.]

volume = …… dm^3 [1]

[Total:10]

11 Polyvinyl chloride**,** PVC, is an example of non-biodegradable plastics. It is a versatile material that can be used to produce drainage pipe, water service pipe, medical devices, cable and wire insulation, stationery and footwear,

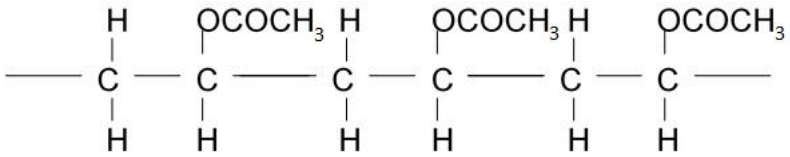
The structure of the monomer of PVC is shown:



(a) Draw the full structural formula of PVC, showing three repeated units of the polymer.

[2]

(b) Another polymer known as polyvinyl acetate (PVA) is shown:



Draw the structure of the monomer of PVA.

[1]

(c) As much as 650 000 tonnes of non-biodegradable plastics waste are produced each year.

State **two** of the problems caused by disposal of non-biodegradable plastics.

……..……

……..……[2]

An organic acid is formed when ethanol is left open to the air for a few days. Oxidation of ethanol has taken place.

(d) Draw the structure of this acid.

[1]

Ethanol can be oxidised to the acid formed in (d) by an oxidising agent in the laboratory.

(e) **(i)** Identify the reagent: ……..… [1]

(ii) Describe how the acid can be prepared by this reagent and state any colour changes during the process.

……..…

……..……

……..…

……..……

……

……...……..…[3]

[Total:10]

12 Aqueous sodium hydroxide, NaOH, is an alkali.

(a) State two properties of alkalis.

……

……

……

……[2]

Aqueous sodium hydroxide, NaOH, reacts with ammonium sulfate, $(NH_4)_2SO_4$, to form ammonia, sodium sulfate and water.

$$2NaOH(aq) + (NH_4)_2SO_4(s) \rightarrow Na_2SO_4(aq) + 2NH_3(g) + H_2O(l)$$

[relative atomic mass: A_r: Na, 23; H, 1; N,14; S,32; O,16]

(b) **(i)** Calculate the relative molecular mass of ammonium sulfate.

relative molecular mass = …… [1]

(ii) Calculate the mass of sodium sulfate that will be produced when 264 g of ammonium sulfate react with sodium hydroxide.

mass of sodium sulfate =…… g [2]

(c) To prepare crystals of sodium sulfate, a neutral and colourless solution of sodium sulfate must be prepared first using titration.

Outline how you would prepare a neutral sodium sulfate solution with sodium hydroxide, sulfuric acid and methyl orange as an indicator.

Methyl orange is red in acidic solution, orange in neutral solution and yellow in alkaline solution.

……

……

……

……

……

……

……

……

……

……[5]

[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											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 A*l* aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* 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 T*l* 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 F*l* flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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.).