ST. MARGARET'S SCHOOL (SECONDARY)

Preliminary Examinations 2023

CANDIDATE NAME					
CLASS				REGISTER NUMBER	

SCIENCE (PHYSICS,CHEMISTRY) **5105/04, 5107/04**

SCIENCE (CHEMISTRY,BIOLOGY)

17 August 2023

Paper 4 Chemistry

1 hour 15 minutes

Secondary 4 Normal (Academic)

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

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

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.
A copy of the Periodic Table is printed on page 11.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Section A	/14
Section B	/16
Total	/30
Parent's Signature	

Section A [14 marks]

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

A1 A list of substances is given below.

Ag Cl_2 H_2 $MgCl_2$

Na_2O SiO_2 ZnO

You may only use each substance once.
From the list, choose the substance which

(a) can react with both acid and alkali. .....

(b) is produced when magnesium reacts with sulfuric acid. .....

(c) can be dissolved in water to form a solution with pH greater than 7. .....

(d) can displace iodine from aqueous potassium iodide. ..... [4]

[Total: 4]

A2 Table 2.1 shows the number of protons and nucleons in six particles.

Table 2.1

particle	proton number	nucleon number
T	3	7
U	8	16
V	11	23
W	13	26
X	13	27
Z	18	40

(a) Which particle exists as monatomic element in nature? .....

(b) Which particles are isotopes of the same element? .....

(c) Which particle belongs to Group I of the Periodic Table? ..... [3]

(d) Draw a 'dot and cross' diagram for the compound formed when particle **W** reacts with particle **U**, showing only the outermost electrons.

[2]

[Total: 5]

A3 Propene can react with hydrogen, in the presence of a suitable catalyst, to form propane.

The chemical equation for the reaction is as below:

$$C_3H_6 + H_2 \rightarrow C_3H_8$$

propene

(a) Draw the structural formula for propene in the box provided. [1]

(b) Name the conditions required for the reaction between ethene and hydrogen.

..... [1]

(c) Describe a test to distinguish propene from propane.

.....

.....

..... [2]

Propene can also react with chlorine to form dichloropropane.

(d) Draw the structural formula of the dichloropropane formed.

[1]

[Total: 5]

Section B [16 marks]

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

B4 Crystals of copper(II) sulfate, $CuSO_4$ can be prepared using the method shown in Fig. 4.1.

Fig. 4.1 shows the first three steps used to prepare the crystals. Solid **Q** is added in excess.

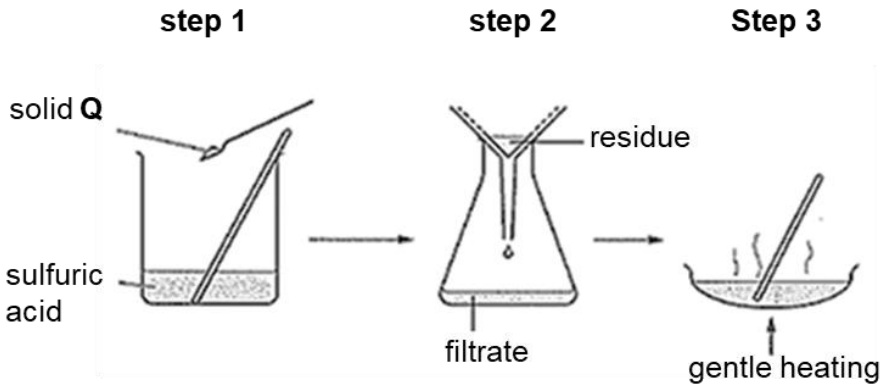

Fig. 4.1

(a) What can solid **Q**, added to sulfuric acid to form copper(II) sulfate, be?

.....

[1]

(b) Name the apparatus used to measure 50.0 cm^3 of the sulfuric acid for step 1.

.....

[1]

(c) What is the purpose of heating the solution gently in step 3?

.....

[1]

(d) What is the purpose of adding solid **Q** in excess?

.....

[1]

On the other hand, insoluble salts like barium sulfate, can be prepared by precipitation reaction.
The equation shows the reaction between barium nitrate and potassium sulfate to form precipitate, barium sulfate.

$$Ba(NO_3)_2 + K_2SO_4 \rightarrow 2KNO_3 + BaSO_4$$

(e) **(i)** Calculate the relative formula mass of barium sulfate.

Relative formula mass = ... [1]

(ii) At the end of the reaction, 5 g of barium sulfate is formed.
Calculate the number of moles of barium sulfate formed at the end of the reaction.

number of moles = ... mol [1]

(iii) Based on the equation and your answer in **(e)(ii)**, calculate the number of moles of barium nitrate used at the start of the reaction.

number of moles of barium nitrate = ... mol [1]

(iv) Hence, calculate the mass of barium nitrate used at the start of the reaction.

mass of barium nitrate = ... g [1]

[Total: 8]

B5 The National Environment Agency (NEA) monitors air pollution in five regions in Singapore. Air pollution levels are reported every hour on the NEA website.

Table 5.1 shows the concentration of a few air pollutants at 5 pm, on 3 July 2023, for the five regions in Singapore. The Central Business District (CBD) is the financial hub, where there is a dense concentration of trading and banking offices, while the rest of the regions are mainly residential.

It was raining heavily in the CBD at the time the report was generated.

Table 5.1

regions	sulfur dioxide (μg/ m^3)	nitrogen dioxide (μg/ m^3)	carbon monoxide (μg/ m^3)
North	2	27	300
South	3	9	300
East	6	27	300
West	7	28	300
Central Business District (CBD)	2	44	400

(a) In which region is the concentration of carbon monoxide the highest at 5 pm on 3 July 2023?
Suggest a possible reason for the higher concentration in the region chosen.

.....

.....

..... [2]

(b) State a possible source of nitrogen dioxide at the CBD.

..... [1]

(c) Describe one harmful effect of sulfur dioxide on human health.

.....

..... [1]

(d) Sulfur dioxide can dissolve in rainwater to form acid rain.

(i) Describe a simple test to confirm the presence of acid in a sample of rainwater.

.....

.....

..... [2]

(ii) The acid rain formed can acidify the soil and this may make it unsuitable for the growth of certain crops.
Suggest a substance that can be used and explain how it can help to increase the pH of the soil.

.....

.....

..... [2]

[Total: 8]

B6 Different metals have different uses and can be extracted using different methods.

(a) Nickel metal can be obtained via the reaction of magnesium and nickel chloride.

The reaction of magnesium with nickel chloride is represented by the following equation.

$$NiCl_2(aq) + Mg(s) \rightarrow MgCl_2(aq) + Ni(s)$$

(i) From the equation, which metal, magnesium or nickel is more reactive?

..... [1]

(ii) Explain your answer in **(a)(i)**.

.....

..... [1]

Nickel is a metal that resists corrosion and is commonly used to plate other metals to protect them.

(iii) Explain how nickel can protect iron from corrosion when plated on it.

.....

..... [2]

(b) Iron is extracted from iron(III) oxide in haematite by reduction with coke in the blast furnace shown in Fig. 6.1.

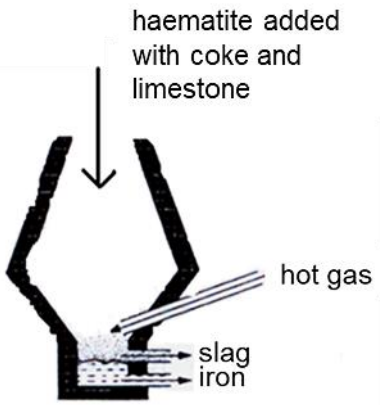

Fig. 6.1

(i) Explain the importance of adding limestone into the blast furnace.

.....

.....

..... [2]

Iron is an important substance used in the making of an alloy, steel.
Steel is harder and stronger than iron and can be used to build bridges, construction materials and machinery.

(ii) Explain why steel is harder and stronger than pure iron.

.....

.....

..... [2]

[Total: 8]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).