

Class/ Index Number	Centre Number/ 'O' Level Index Number	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

CHEMISTRY

Paper 2

6092/02

24 August 2020
1 hour 45 minutes

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

This is Section A of the paper.

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

The number of marks is given in brackets [] at the end of each question or part question.
The total number of marks for this paper (sections A and B) is 80.
A copy of the Periodic Table is printed on page 11.

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

At the end of the examination, hand in the following separately:

- (1) Section A
- (2) Section B

For Examiner's Use	
Section A	50
Section B	30
Total	80

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

A1 Use the substances in the list to answer the following questions.

ammonium chloride

sodium nitrate

sodium chloride

potassium iodide

magnesium

vanadium (V) oxide

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

- (a) Which substance reacts with aqueous sodium hydroxide and aluminium to produce ammonia gas upon warming?

..... [1]

- (b) Which substance will produce a violet vapour when it conducts electricity in molten state?

..... [1]

- (c) Which substance could act as a catalyst in a chemical reaction?

..... [1]

- (d) Which substance reduces dilute sulfuric acid in a redox reaction?

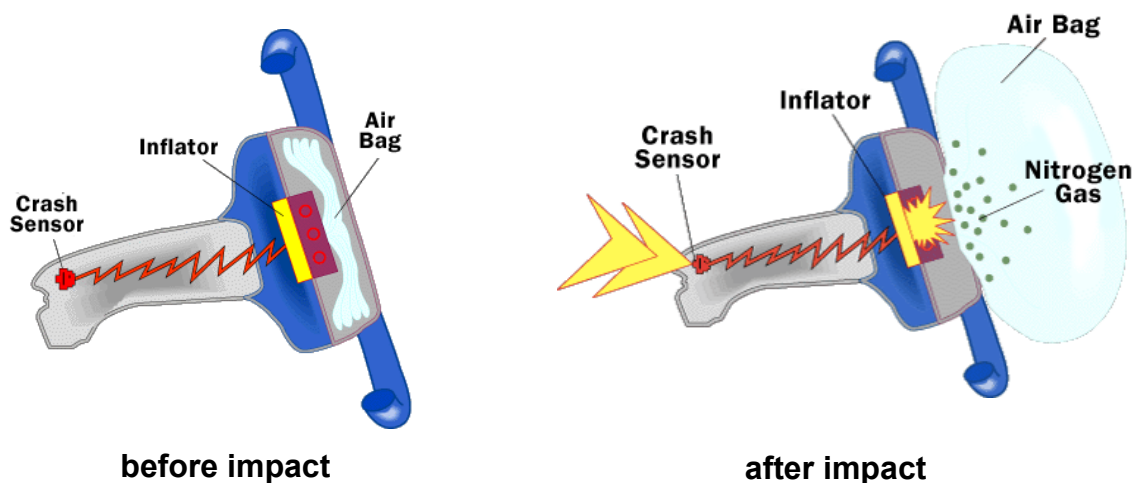
..... [1]

- (e) Which two substances, when mixed together, can be separated by heating the mixture gently?

..... [1]

[Total : 5]

A2 Air bags are used to protect passengers in a car during an accident. When the crash sensor detects an impact, it causes a mixture of chemicals to be heated to a high temperature. The reactions that take place produce nitrogen gas, which fills the air bag.



- (a) The mixture of chemicals contained in the automobile air bags include sodium azide (NaN_3), which decomposes upon heating to form sodium and nitrogen gas according to the equation shown below.



Explain, in terms of Kinetic Particle Theory, how the above reaction helps to protect passengers during a car accident.

.....

 [2]

- (b) A certain model of auto mobile is equipped with a 60 dm^3 air bag. Calculate the mass of sodium azide needed to produce just sufficient gas to fill the air bag.

- (c) The sodium produced when sodium azide decomposes is dangerous. [2]
 The mixture of chemicals in the air bag contains potassium nitrate which helps to make the sodium safe by converting it to less harmful products.

Sodium reacts with potassium nitrate to produce sodium oxide, potassium oxide and nitrogen.

Write a balanced chemical equation for this reaction.

..... [2]

[Total : 6]

- A3** The following tests were carried out on three aqueous solutions, **P**, **Q** and **R**. **R** is an aqueous solution formed by dissolving an alkaline gas in water.

test	observations
test 1	When a few drops of R were added to Q , a white precipitate was observed, and it dissolved when an excess of solution R was added.
test 2	When R was added to P , a green precipitate was formed which gradually turned brown on standing in air. When acidified barium nitrate solution was added to P , a white precipitate S was produced.
test 3	When aqueous potassium carbonate was added to Q , a white precipitate T was formed. When the residue was filtered, washed and heated strongly, a residue U was obtained. U was yellow when hot but turned white on cooling.
test 4	When aqueous silver nitrate were added to Q , a white precipitate was observed. The precipitate is insoluble in dilute nitric acid.

- (a) Identify **P**, **Q**, **R**, **T** and **U**.

P

Q

R

T

U

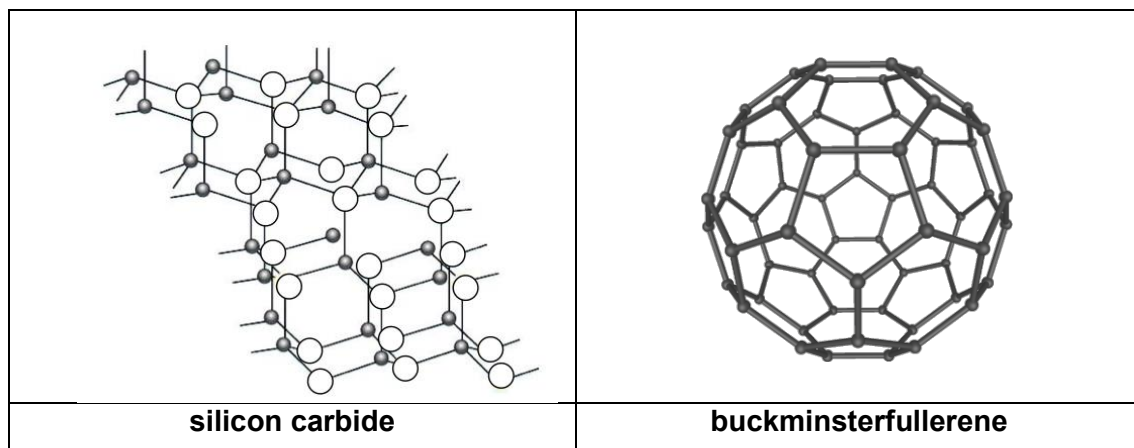
[5]

- (b) Write the ionic equation for the reaction that produced the precipitate **S**.

..... [1]

[Total : 6]

- A4 Silicon carbide (SiC)** is a naturally occurring rare mineral containing carbon and silicon atoms. **Buckminsterfullerene (C₆₀)** is an allotrope of carbon, which has a cage-like fused-ring structure that resembles a soccer ball, made of a certain number of hexagons and pentagons. The diagrams below show the structures of silicon carbide and buckminsterfullerene.



- (a) With reference to the structures shown above, explain why silicon carbide has a high melting point, but buckminsterfullerene has a low melting point.

.....

.....

.....

.....

.....

.....

..... [4]

- (b) Graphite is another allotrope of carbon. State **one similarity** and **one difference** between the bonding and structure in buckminsterfullerene and in graphite.

Similarity :

.....

Difference :

..... [2]

- (c) Deduce one use of silicon carbide, based on its structure.

..... [1]

[Total : 7]

A5 Sulfur dioxide reacts with chlorine gas in the presence of a catalyst to form a single liquid product, sulfuryl chloride (SO_2Cl_2). This is possible because the atom, sulfur can expand its octet structure to contain **more than eight** electrons.

- (a) Draw a 'dot-and-cross' diagram for sulfuryl chloride.
Show the outer shell electrons only.

[2]

- (b) Student **A** says, "The sulfur in sulfur dioxide is oxidised."

Student **B** says, "Sulfur dioxide is an oxidising agent."

Do you agree with both of them, one of them or neither of them? Explain your answer.

.....

 [2]

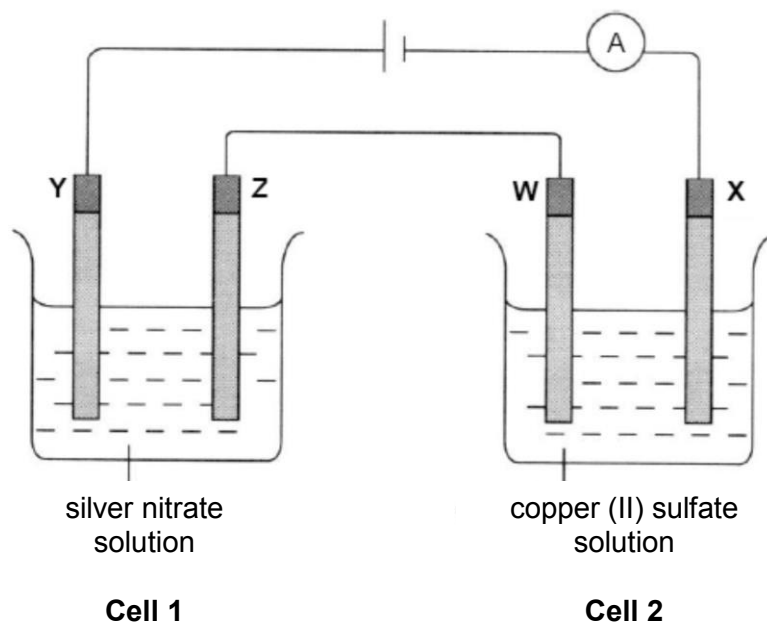
- (c) Sulfuryl chloride reacts with water to form two strong acids.
One is a dibasic acid while the other is a monobasic acid.

Write the equation for this reaction.

..... [1]

[Total : 5]

- A6** The diagram below shows the set-up of an electrolysis experiment of cell 1 and cell 2. The electrolytes used in cell 1 and cell 2 are dilute silver nitrate and dilute copper(II) sulfate respectively. **W** is graphite electrode, **X** is copper electrode, **Y** and **Z** are silver electrodes.



- (a) Electrodes **X** and **Z** will increase in mass after some time.
- (i) Write the two ionic half-equations for the reactions at electrodes **X** and **Z**.
-
- [2]
- (ii) The rate of increase in mass of electrode **Z** is higher than that of electrode **X**. Use the equations in (a)(i) to explain why.

[3]

- (b) Other than the increase in size of electrode **X**, state **one other** observation in **cell 2**.

..... [1]

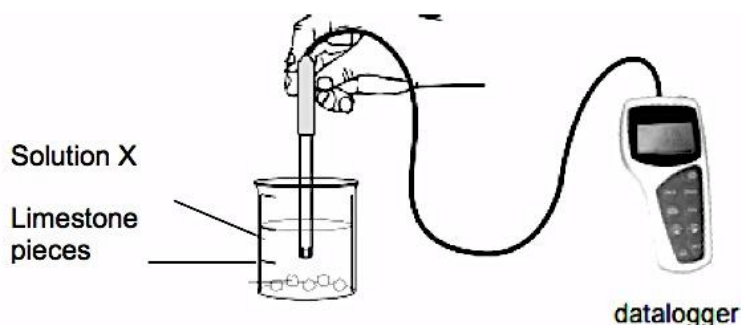
- (c) If electrolyte in cell 1 is replaced with sodium chloride solution, a white precipitate is formed in the electrolyte. Explain the formation of the precipitate.

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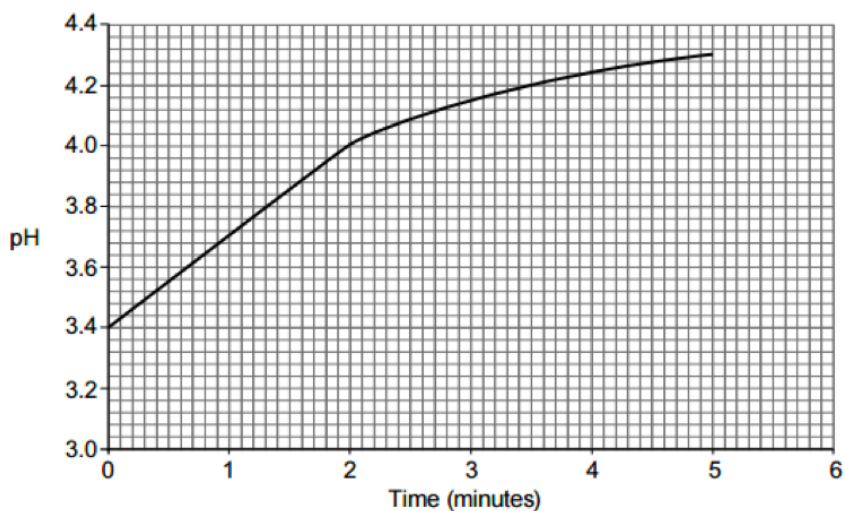
 [2]

[Total : 8]

- A7** A group of students conducted an experiment to investigate the pH change when limestone reacts with solution X. They added limestone pieces to the solution X and recorded the pH of the mixture for 5 minutes. The data collected was then downloaded to a computer.
 The experiment was carried out using the apparatus as shown below.



The graph below shows the recorded results.



- (a) Suggest the identity of solution X. Explain your answer using the information given.

.....

 [2]

- (b) State and explain the change in pH shown in the graph.

.....

 [2]

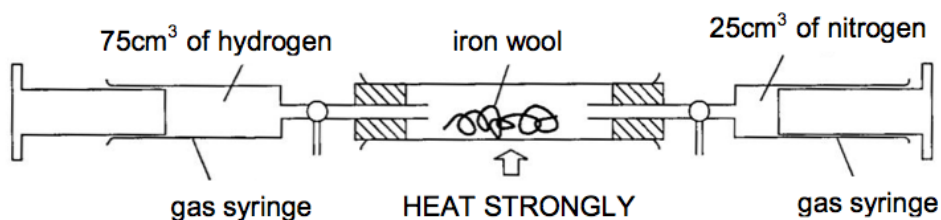
- (c) By comparing the datalogger and methyl orange indicator, explain why the use of methyl orange indicator is not advisable in the conduct of this experiment.

.....

 [2]

[Total : 6]

- A8** The reaction to produce ammonia can be demonstrated in the science laboratory by the method shown in the diagram below:



The mixture of nitrogen and hydrogen is passed backward and forward over the hot iron wool until there is no further reaction.

- (a) Explain, with the help of an equation, why nitrogen and hydrogen are mixed in a 1:3 ratio by volume.

.....

 [2]

- (b) Explain why air is not used in the above reaction, although it contains 78% of nitrogen.

.....
 [1]

- (c) State the source of nitrogen for the above reaction.

..... [1]

- (d) Assuming only 15% of the nitrogen and hydrogen react to produce ammonia, calculate the volume of ammonia produced at room temperature and pressure.

[2]

- (e) Explain why the use of expensive metals as catalyst does not increase the cost of production of ammonia in the Haber Process.

.....

..... [1]

[Total : 7]

END OF SECTION A

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	0	
		proton (atomic) number atomic symbol name relative atomic mass										1 H hydrogen 1						
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
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
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 -

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).