Class/ Index Number	Centre Number/ 'O' Level Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

CHEMISTRY **6092/02**

Paper 2 **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 B of the paper.
Answer all **three** questions, the last question is in the form either/or.
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 can be found on the last page of Section A booklet.
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	
Question B9	10
Question B10	10
Question B11	10
Total	30

Section B

Answer all **three** questions in this section.
The last question is in the form of an either/or and only one of the alternatives should be attempted.

B9 The transition metals form a block of metals in the middle of the Periodic Table.

The list below shows the complete range of oxidation states of the first row of transition metals in their compounds. Some of the oxidation states are uncommon and unstable. The common ones are underlined.

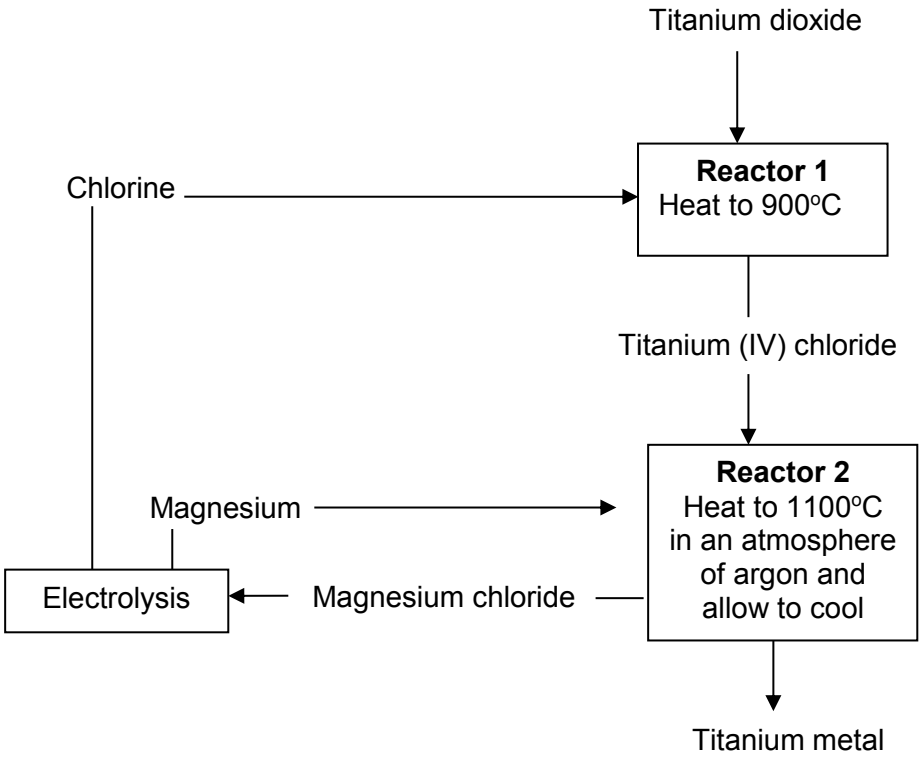
Ti	V	Cr	Mn	Fe	Co	Ni	Cu
							+1
+2	+2	<u>+2</u>	<u>+2</u>	<u>+2</u>	<u>+2</u>	<u>+2</u>	<u>+2</u>
<u>+3</u>	+3	<u>+3</u>	+3	<u>+3</u>	<u>+3</u>	+3	+3
<u>+4</u>	<u>+4</u>	+4	<u>+4</u>	+4	+4	+4	
	<u>+5</u>	+5	+5				
		<u>+6</u>	+6	+6			
			<u>+7</u>				

Chromium is a very shiny, silvery metal, whose name (from the Greek *chroma,* "colour") refers to its many colourful compounds. Chromium, like other transition metals forms a few oxides.

The table below gives some information of the common oxides of chromium.

formula of oxide	melting point /^{o}C	nature	colour
CrO	decomposes at 300^{o}C	basic	black
Cr_2O_3	2450	amphoteric	dark green
CrO_3	190	acidic	deep red

One example of a transition metal is titanium.
Most titanium is produced from its ore, rutile, which contains titanium dioxide. Titanium cannot be extracted by reducing the ore using carbon as a reducing agent. The problem is that titanium forms a carbide, TiC, when heated with carbon. The presence of carbide makes the metal brittle. Hence, titanium is extracted from its ore in two stages as shown in the flowchart on the next page.



(a) State **two** properties of transiton metals that are shown in the information given.

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…… [2]

(b) Just like chromium, manganese forms a few oxides. The chemistry of manganese resembles that of chromium. The names of two oxides of manganese are given below. Predict the nature of these oxides. [2]

name of oxide	nature of oxide
manganese (VII) oxide	
manganese (II) oxide	

(c) Using the information in the flow chart, identify and describe a process which helps to save cost in the extraction of titanium.

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(d) Suggest a reason why the reaction in reactor 2 needs to be carried out in an atmosphere of argon.

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(e) With reference to the reducing agents used in the extraction of titanium and iron, explain why extracting titanium is more costly than extracting iron.

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[Total : 10]

B10 A series of experiments **A**, **B** and **C** were carried out at room temperature by a student to investigate the factors affecting the rate of reaction between magnesium carbonate and acid.
The results of the experiments are shown in the table below.

experiment	reactants	time taken to complete reaction / s
A	excess magnesium carbonate 25 cm^3 of 1 mol/dm^3 hydrochloric acid	50
B	excess magnesium carbonate 25 cm^3 of 1 mol/dm^3 sulfuric acid	32
C	excess magnesium carbonate 25 cm^3 of 1 mol/dm^3 sulfuric acid 3 – 4 drops of solution **S**	22

(a) Explain, in terms of collision of particles, why the time taken for experiment **A** is longer than that for experiment **B**.

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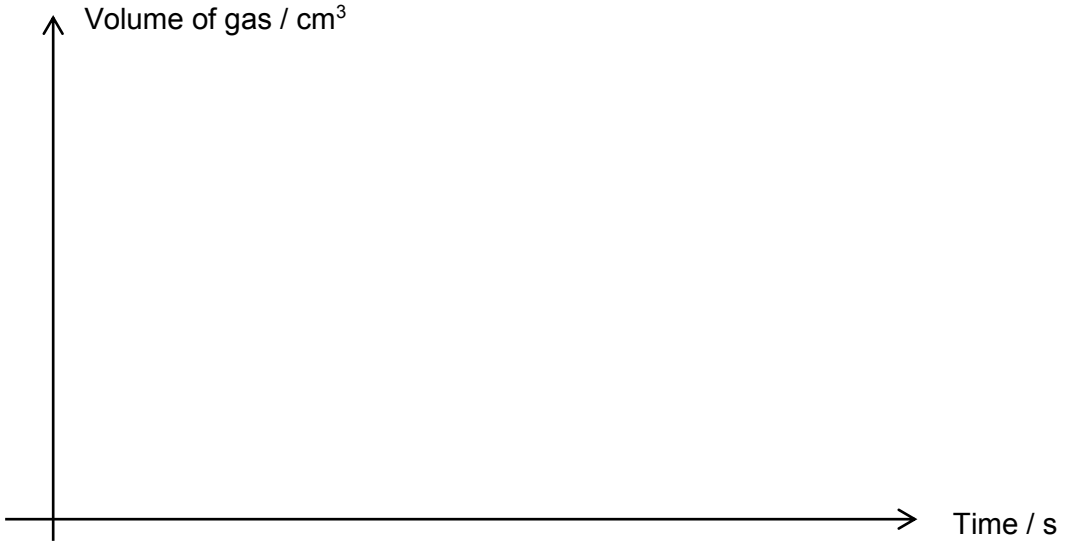
(b) In the space below, sketch the graphs to show how the volume of gas collected varied with time for experiments **A** and **B** on the same axes.
Label the graphs as **experiment A** and **experiment B**.



[2]

(c) Comparing the data in experiments **B** and **C**, suggest how solution **S** decreases the time taken for the reaction to complete.

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(d) Temperature is another factor that affects the speed of reaction.

(i) Describe and explain, in terms of collision of particles, how a higher temperature affects the speed of a reaction.

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(ii) Describe how you would carry out an experiment, and compare your data with one of the above experiments, to show the effect of temperature on speed of reaction.

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[Total : 10]

EITHER

B11 The Earth's atmosphere is made up of several layers. Ozone is an allotrope of oxygen found in both the middle layer (stratosphere) as a layer, as well as the lower layer (troposphere) closer to the surface of the earth.

In the stratosphere, chlorofluorocarbons (CFCs) can cause the destruction of the ozone layer.
$CFCl_3$ is an example of chlorofluorocarbons (CFCs). The series of reactions below show how the ozone layer is being destroyed by $CFCl_3$.

Step 1 (slow): $CFCl_3 \rightarrow CFCl_2 + Cl$

Step 2 (fast): $Cl + O_3 \rightarrow ClO + O_2$

Step 3 (fast): $ClO + O \rightarrow Cl + O_2$

(a) A website states that 'a single CFC molecule can destroy up to 100 000 ozone molecules'. Using the above equations, comment on whether this statement is true.

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(b) Explain why ozone is beneficial to mankind in the stratosphere, but harmful in the troposphere.

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(c) One example of a CFC compound is CFC-113 with the formula $C_2F_3Cl_3$. Some data on bond energy are given below:

Bond	Bond energy / $kJmol^{-1}$
C-Cl	340
C-C	346
C-F	450
H-F	568
H-Cl	412

(i) The energy of UV light is equivalent to 400 kJ.

Suggest a possible reason to explain why CFC-113 is decomposed by UV light to form chlorine atoms rather than fluorine atoms.

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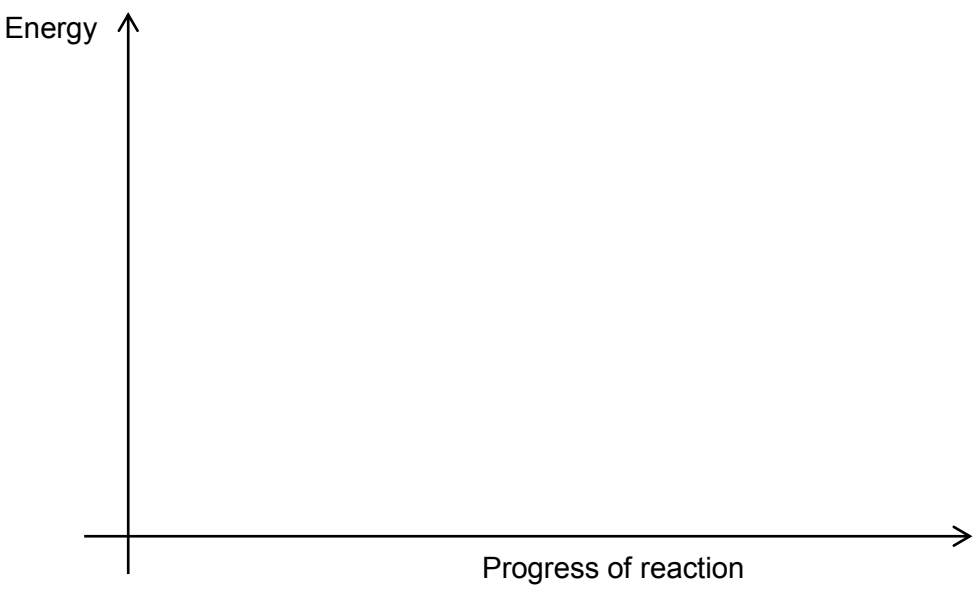
(ii) CFC-12 has the molecular formula CF_2Cl_2. It can be made by reacting tetrachloromethane, CCl_4, with hydrogen fluoride, HF.

$$CCl_4 + 2HF \rightarrow CF_2Cl_2 + 2HCl$$

Show, using appropriate calculations, that the above reaction is an endothermic reaction.

[2]

(iii) Draw a fully labelled energy profile diagram for the above reaction.



[2]

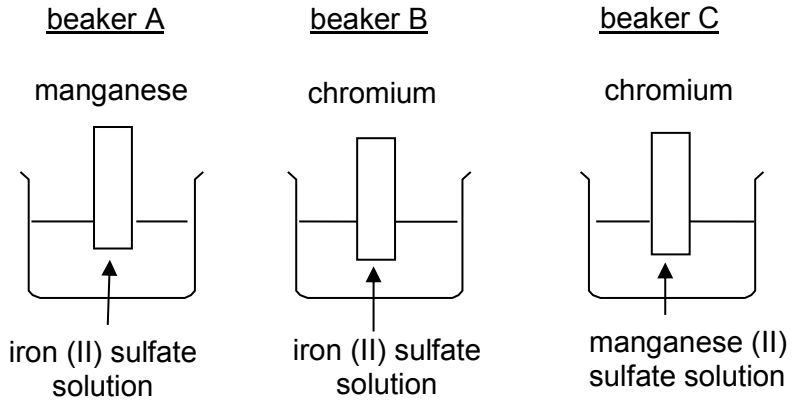
[Total : 10]

OR

B11 (a) The table below gives some information about three metals, iron, manganese and chromium.

	iron	manganese	chromium
reaction with dilute sulfuric acid	metal dissolves slowly	metal dissolves rapidly	metal dissolves readily
colour of aqueous solution of metal sulfate	green	pink	violet

A student performed an experiment by placing the metals in different metal sulfate solutions using the set up as shown below.



(i) State the observation(s) that you would expect to see in each solution during the experiment.

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(ii) Chromium metal is used to electroplate metals like iron because of its anti-corrosion properties.

Explain why using chromium to electroplate iron is more effective than tin-plating.

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(b) Displacement reactions are used to extract elements from their compounds.

Zinc can be extracted from the solution by adding magnesium.
The ionic equation for the reaction is

$$Mg(s) + Zn^{2+}(aq) \rightarrow Zn(s) + Mg^{2+}(aq)$$

Bromine is extracted from seawater. Bromine compounds in the seawater react with chlorine gas to make an orange solution of aqueous bromine.

(i) Write an ionic equation, with state symbols, for the reaction between bromide ions and chlorine gas.

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(ii) The techniques for extracting both zinc and bromine involve displacement reactions.

Describe the **similarities** and **differences** between what happens during each displacement reaction.

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[Total : 10]

END OF SECTION B