Name: _____ Index Number: _____ Class: _____

TEMASEK SECONDARY SCHOOL
Preliminary Examination 2020
Secondary 4 Express

CHEMISTRY 6092/02

Paper 2 (Section B) **Total duration for Sections A and B: 1 hour 45 minutes**

Question and Answer Booklet

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

Hand in this booklet at the end of the paper.

Write your name, index number and class in all the work you hand in.
Write in dark blue or black pen.

Answer **all three** questions, the last question is in the form either/or.

At the end of the examination, submit **Section A and B separately**.

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Data Sheet is printed on page 12.

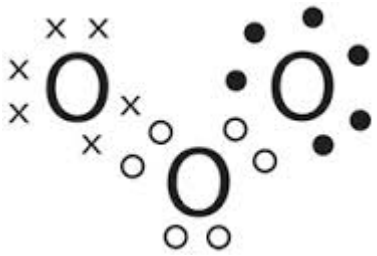
A copy of the Periodic Table is printed on page 13 of Section A.

FOR EXAMINER'S USE	
Section B	/30

Section B

Answer three questions from this section.
Question B9 is in the form of either/or and only one of the alternatives should be attempted.
Write your answers in the spaces provided.

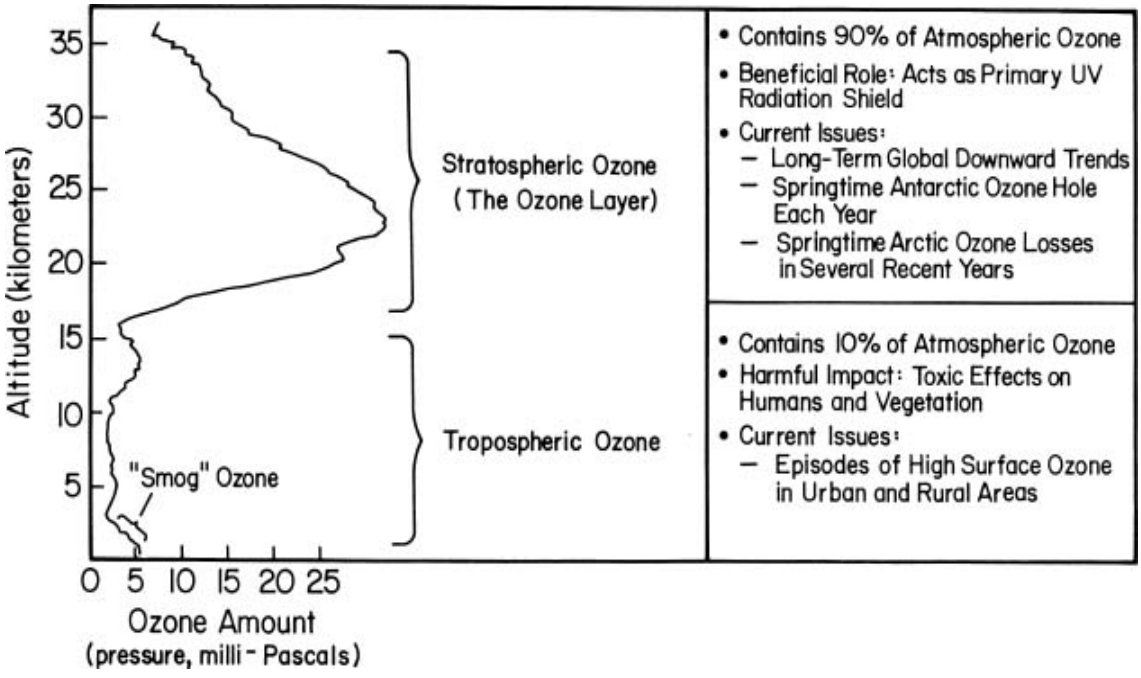
B7 Ozone, O_3 is a much less stable triatomic form of oxygen. The diagram below shows the bonding in ozone molecules.



It is a pale blue gas present at low concentrations throughout the atmosphere (around 0.375 parts per million for O_3 compared to 21% for O_2).

In the troposphere, ozone is an air pollutant which can damage the respiratory systems of humans and other animals. The ozone in the stratosphere however is beneficial.

The diagram below shows how the concentration of ozone varies in the troposphere and stratosphere.



(a) Draw the structural formula of ozone.

[1]

(b) Calculate the percentage of ozone in the atmosphere.

[1]

(c) Which altitude has the highest concentration of ozone?

……..... [1]

(d) Chlorofluorocarbons, CFCs, destroy ozone in the upper atmosphere by converting ozone to oxygen.

$$2O_3 \rightarrow 3O_2$$

With aid of equation(s), explain how CFCs destroy the ozone layer.

……..... [3]

(e) Explain in terms of reacting particles, how does pressure affects the rate of reaction for the conversion of ozone to form oxygen.

……

……

…… [2]

(f) Describe two harmful effects of destroying the ozone in the upper atmosphere.

……

…… [2]

B8 Aqueous chlorine dioxide, a yellow solution, reacts with an alkali according to the following equation:

$$2ClO_2\,(aq) + 2OH^-\,(aq) \rightarrow ClO_3^-\,(aq) + ClO_2^-\,(aq) + H_2O\,(l)$$

A student carried out different experiments to investigate the rate of reaction using different concentrations of aqueous chlorine dioxide and alkali. In each experiment, she measured how quickly the colour of aqueous chlorine dioxide disappeared.

Table 8 showed the results obtained.

experiment	concentration of ClO_2 / mol/dm^3	concentration of OH^- / mol/dm^3	rate of disappearance of ClO_2 / mol/dm^3/s
1	0.020	0.030	0.00276
2	0.040	0.030	0.01104
3	0.020	0.060	0.00552
4	0.040	0.060	0.02208
5	0.040	0.090	0.03312
6	0.120	0.030	0.09936

Table 8

(a) Using results from Table 8, describe the trends in the rate of disappearance of chlorine dioxide with respect to the concentration of each of the reagent used.

……

……

……

……

……

…… [3]

(b) Using collisions theory, explain the trend stated in **(a)**.

……

……

……

…… [2]

(c) Two students have different opinion about the results.

Student 1: I think that the rate of reaction depends on the concentration of aqueous chlorine dioxide to a greater extent.

Student 2: I think that the rate of reaction depends on the concentration of alkali to a greater extent.

Which student do you agree with? Explain your answer using results from Table 8.

……

……

……

……

…… [2]

(d) Predict the rate of the disappearance of $C\ell O_2$ if the experiment was conducted using 0.040 mol/dm^3 of $C\ell O_2$ and 0.120 mol/dm^3 of OH^-.

…… [1]

(e) Sketch the graph of the concentration of hydroxide ions against the speed of reaction.

[2]

B9 Either

Transition metals have unique properties such as exhibiting variable oxidation states in their compounds and forming coloured compounds.

They are also widely used as catalyst in industrial processes.

(a) In an experiment, small amounts of these transition metals, zinc, chromium and copper, were added to different aqueous metal nitrates solutions.

The results are shown in the table.

	metal nitrate solution		
metal	zinc nitrate	chromium(III) nitrate	copper(II) nitrate
zinc	no visible reaction	green solution turned colourless and grey metal coated with a silvery solid	blue solution turned colourless and grey metal coated with a pink solid
chromium		no visible reaction	
copper	no visible reaction	no visible reaction	no visible reaction

(i) Describe the observations for chromium metal in zinc nitrate and copper(II) nitrate.

……..……

……..……

……..……

……..…… [3]

(ii) Construct an ionic equation for the reaction between zinc and chromium(III) nitrate.

…… [1]

(iii) Identify the oxidising agent in **(a)(ii)**. Explain your answer.

……...

……...

……... [2]

(b) The main ore of copper is copper pyrite, $CuFeS_2$.

Copper ore contains the impurity, iron(II) oxide.

The following information shows the steps involved in the extraction of copper from copper pyrite.

Step 1: Roasting of copper pyrite

$$2CuFeS_2 + 4O_2 \rightarrow Cu_2S + 2FeO + 3SO_2$$

Step 2: Removal of iron(II) oxide

The reaction is heated strongly with sand (silica, SiO_2) in a furnace.

Iron(II) oxide reacts with silica to form iron(II) silicate as slag and is run off.

$$FeO + SiO_2 \rightarrow FeSiO_3$$

Step 3: Conversion of copper(I) sulfide to copper

As more air is blown into the furnace, the copper(I) sulfide produced is converted to copper.

$$Cu_2S + O_2 \rightarrow 2Cu + SO_2$$

(i) Calculate the percentage by mass of sulfur in copper pyrite.

[1]

(ii) Describe one possible environmental impact from the extraction of copper.

……...

……... [2]

(iii) Explain why the reaction between iron(II) oxide and silica is not a redox reaction.

……

…… [1]

B9 Or

In this reaction, 1.00 mol of ethanol, C_2H_5OH, undergoes complete combustion to produce carbon dioxide and water.

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O \qquad \Delta H = -1222 \text{ kJ/mol}$$

(a) Use ideas about bond breaking and bond making to explain why the combustion of ethanol is exothermic.

……

……

…… [2]

(b) The table below shows the bond energies for some of the bonds in ethanol.

bond	bond energy / kJ mol^{-1}
C – H	413
C – C	350
C – O	360
C = O	799
O – H	459

Calculate the bond energy of the O = O bond. Show your working clearly.

[4]

(c) Draw the energy profile diagram for the complete combustion of ethanol.

Your diagram should include
- the reaction pathway for the reaction
- the activation energy, E_a
- the enthalpy change for the reaction, ΔH

[2]

(d) Calculate the mass of ethanol required to produce 411 kJ of heat.

[2]

End of Section B

DATA SHEET

Colours of some common metal hydroxides

aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white