Name: _____ Index Number: _____ Class: _____

TEMASEK SECONDARY SCHOOL
Preliminary Examination 2022
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 **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.

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 Periodic Table is printed on **page 14** of **Section A**.

FOR EXAMINER'S USE	
Section B	**/30**

This document consists of **10** printed pages.

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 Read the information about the history of the Periodic Table.

Chemists spent many years trying to arrange elements in a sensible order.

Johann Döbereiner was one of the first chemists to organise elements by their properties. He found out that some sets of three elements seem to fit together because they have similar properties. He called these sets of elements 'triads'.

Table 7.1 shows some elements that could be considered to be triads.

Table 7.1

Triad A	lithium	sodium	potassium
Triad B	calcium	strontium	barium
Triad C	chlorine	bromine	iodine
Triad D	carbon	nitrogen	oxygen

Döbereiner looked at the relative atomic masses of the elements in some triads. He noticed that the relative atomic mass of the 'middle' element was close to the mean (average) relative atomic mass of the first and third element.

This was a step forward but did not help with all of the other elements that Döbereiner had not put into groups of three. It was left to others to build on Döbereiner's work.

In 1864, a chemist called John Newlands had an idea of arranging the elements in order, depending on their chemical properties. He called his idea the 'Law of Octaves'.

Table 7.2 shows Newlands' arrangement of some of the elements.
He put elements with similar properties into the same row of his table.

Table 7.2

Row	Elements		
1	^{1}H	^{19}F	$^{35.5}Cl$
2	^{7}Li	^{23}Na	^{39}K
3	^{9}Gl	^{24}Mg	^{40}Ca
4	^{11}Bo	^{27}Al	^{52}Cr
5	^{12}C	^{28}Si	^{48}Ti
6	^{14}N	^{31}P	^{55}Mn
7	^{16}O	^{32}S	^{56}Fe

Newlands based the order of the elements on their relative atomic masses.

The Periodic Table that is used today was developed after Newlands' table.
The symbols that Newlands used for some of the elements are different to those on the Periodic Table today.

(a) Using the triads in **Table 7.1** for this question.

(i) Three of the four triads now fit into Groups in the modern Periodic Table.
Which triad, A, B, C or D does not? Explain your answer.

……..

……..

……..…..…[2]

(ii) Use calculations to show that the elements in any one of the four triads obey the atomic mass pattern observed by Döbereiner.
Show your working.

..……..…[2]

(b) Use the data in **Table 7.2** for this question.

(i) Describe the trend in relative atomic masses across Row 1 in Newlands' table.

……..……..…[1]

(ii) The numbers shown with each symbol give the atomic mass of each element.

What symbols do we use today for the elements ^{9}G*l* and ^{11}Bo in Newlands' table?

^{9}G*l* …… ^{11}Bo …… [2]

(iii) In Newlands' table, the elements in the rows may or may not be all together in the same groups in the modern Periodic Table.

Use elements in different rows to support this statement.

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……..

……..

……..

……..…[3]

(iv) Newlands' table does not include any elements from one of the groups in the modern Periodic Table.

Identify the missing group and suggest why Newlands could not include these elements in his table.

……..

..……..…[2]

B8 (a) Esters are compounds which give fruits their flavours. They also provide the scent in flowers.

(i) The ester $CH_3(CH_2)_2COOCH_3$ contributes to the aroma of apples.
Draw the full structural formulae of the two starting materials needed to produce this ester.

starting material 1	starting material 2

[2]

(ii) Describe a chemical test to distinguish the two starting materials.

……..…….

……..……...…..[2]

(iii) One of the starting materials used for esterification must be freshly prepared and cannot be left to stand in air before the reaction.

State the functional group of this starting material and explain why.

……..…….

……..……...……..[2]

(b) Other than esters, leaf alcohol is also commonly used in fragrances as it is responsible for the aroma of freshly cut grass.

Fig. 8.1 shows the structural formula of leaf alcohol.

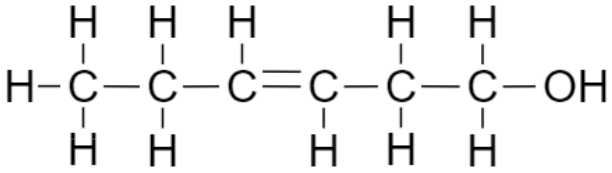

Fig. 8.1

(i) Circle the functional group(s) of leaf alcohol in Figure 8.1 [1]

(ii) When heated at 60 atm and 300°C, in presence of an acid, leaf alcohol reacts to form a product. This molecular mass of this product increased by 18.

Draw the deduced structure of this product.

[1]

(iii) Draw two repeat units of the polymer formed by polymerisation of leaf alcohol.

[2]

Either

B9 **(a)** Fig. 9.1 shows the reaction between di-acyl chloride and diamine to form a polymer.

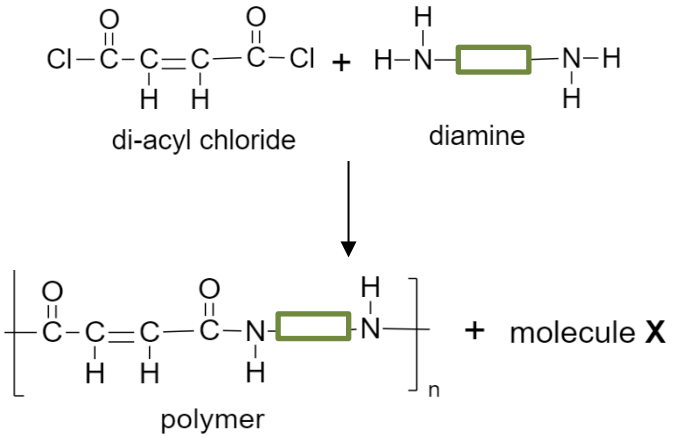

Fig. 9.1

Acyl chlorides reacts with amines in a similar manner as carboxylic acids.

(i) Identify molecule **X** in Figure 9.1.

……..……..[1]

(ii) State the type of polymerisation shown in Figure 9.1. Explain your answer.

……

……..……..[1]

(iii) Name type of linkage present in the polymer formed in Figure 9.1

……..……..[1]

(iv) Explain why polymers such as that shown in Figure 9.1 are increasingly being used in place of natural materials.

……..……..[1]

(v) Some polymers are non-biodegradable in nature.

Explain what is meant by “non-biodegradable” and how improper disposal of these polymers affects the environment.

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……..[1]

(b) An example of a naturally occurring polymer is proteins. Proteins are made up of amino acids.

Fig. 9.2 shows a type of amino acid called alanine.

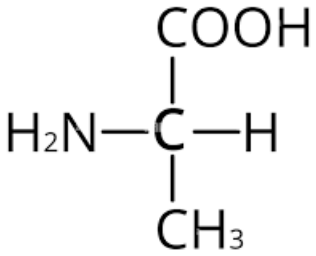

Fig. 9.2

(i) Draw the polymer formed by alanine.

[2]

(ii) With reference to the structure drawn in **(b)(i)**, explain why alanine can undergo polymerization.

……

……..[1]

Or

B9 Both carbon (graphite) and copper are useful elements.

(a) Compare the **bonding** and **structure** of these two elements.

…….

…….

…….

…….

…….

…….[3]

(b) Describe briefly how you could show that carbon is more reactive than copper and less reactive than magnesium.

…….

…….

…….

…….

…….

…….

…….[2]

(c) When graphite is heated in air, it reacts with oxygen to produce carbon dioxide.
When copper is heated in air, it reacts with oxygen to produce copper(II) oxide.

Compare the physical and chemical properties of the two **oxides**.
Your answer should include a discussion of their

- melting and boiling points,
- electrical conductivity,
- reactions with acids and alkalis.

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……[3]

End of Paper