福建中學

FUKIEN SECONDARY SCHOOL

S6 Mock Examination (2020-2021)
Chemistry
Paper 2
(1 hour)

Date：20th January 2021 Name：_____
Time：11:30a.m. - 12:30p.m. Class：_____ No.：_____

INSTRUCTIONS

1. Read carefully the instructions. Write your name, class and class number in the spaces provided.

2. This paper consists of **THREE** sections, Section A, Section B and Section C. Attempt **ALL** questions in any **TWO** sections.

3. Write your answers in the Answer Book provided. Start each question (not part of a question) on a new page.

4. A Periodic Table is printed on the back of this Question Book. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

Section A Industrial Chemistry

Answer **ALL** parts of the question.

1. (a) Bromoethane reacts with sodium hydroxide solution at differnet temperatures (T). The rate constant (k) of the reaction at different temperatures are shown below:

T (K)	320	500	620	800
k ($\times 10^{-5}$ s^{-1})	2.30	54.5	222	1007

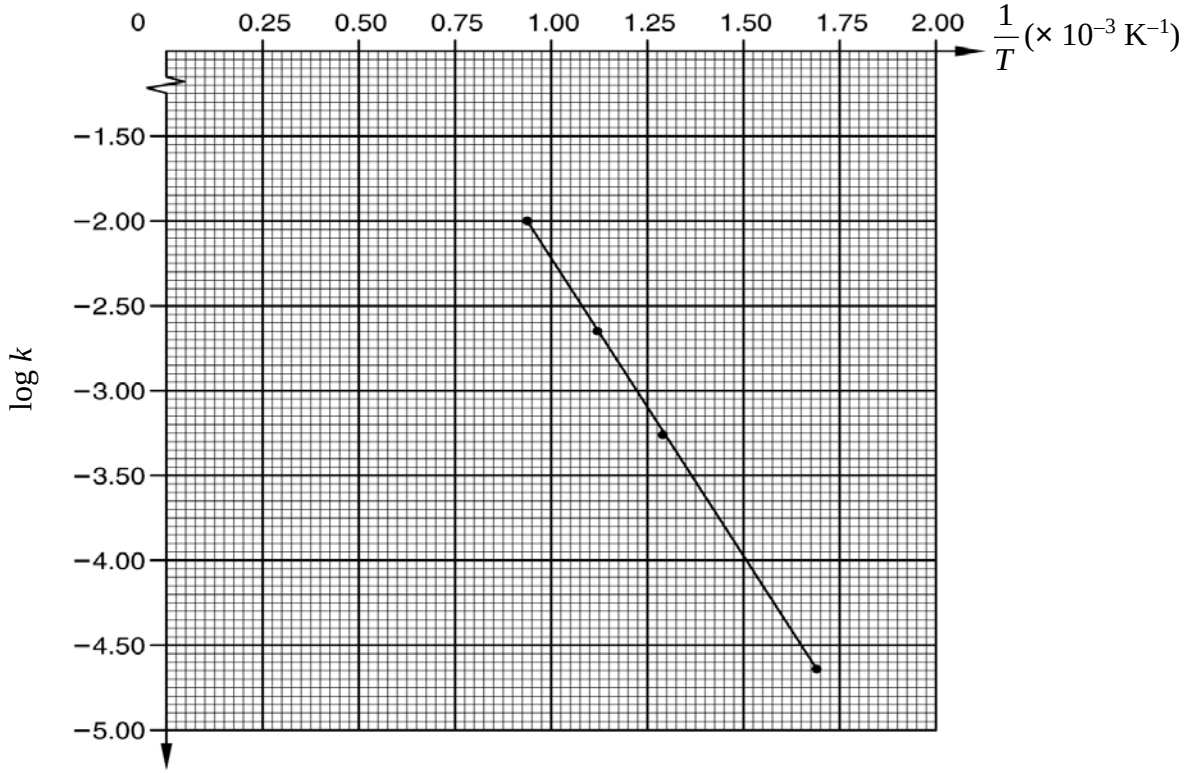
(i) Deduce the overall order of the reaction.

(1 mark)

(ii) Define the term "activation energy".

(1 mark)

(iii) The Arrhenius equation can be represented as $k = Ae^{(-Ea / RT)}$. Using the data in the graph below, calculate the activation energy E_a.
(Universal gas constant, R = 8.314 JK^{-1} mol^{-1})

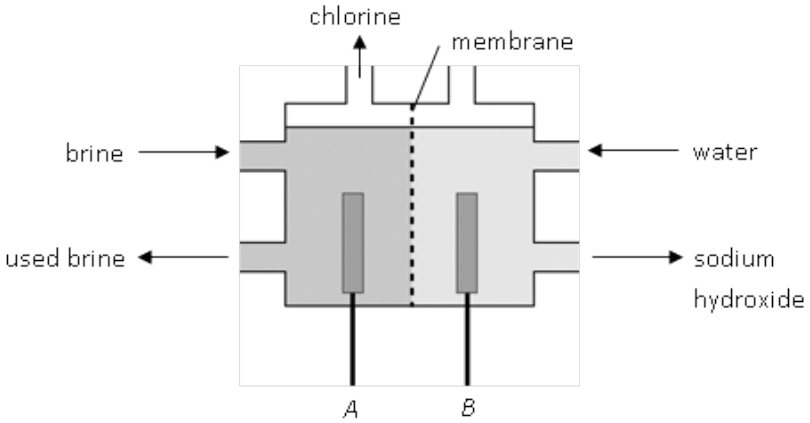


(4 marks)

(iv) Explain why the reaction with higher activation energy proceeds slower.

(2 marks)

(b) Sodium hydroxide, hydrogen and chlorine can be manufactured by the electrolysis of concentrated sodium chloride solution in a membrane cell. The cell is shown below.



(i) Using the concept of preferential discharge of ions, account for the formation on hydrogen and chlorine. Write the ionic half equations for the reactions.

(4 marks)

(ii) Explain why the concentrated sodium hydroxide solution obtained is in high purity.

(2 marks)

(iii) One of the products of the electrolysis can be used as fuel to replace the use of fossil fuel. Someone says this can help reduce air pollution. Give one reason FOR and one reason AGAINST this claim.

(2 marks)

(c) The reaction for the production of ethanoic acid from CH_3COCl is represented by the following equation:

$$CH_3COCl(aq)+H_2O(l) \rightarrow CH_3COOH(aq)+HCl(aq)$$

(i) Calculate the atom economy of the reaction.
(Relative atomic masses: H = 1.0, C = 12.0, O = 16.0, Cl = 35.5)

(2 marks)

(ii) State TWO other factors that should be considered in order to carry out green chemistry reaction.

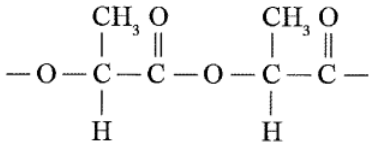
(2 marks)

END OF SECTION A

Section B Materials Chemistry

Answer **ALL** parts of the question.

2. (a) Polyactide (PLA) is a polymeric biomaterials. Part of its structure is shown below:



(i) (1) Draw the structure of the monomer for making PLA.

(1 mark)

(2) What is the systematic name of the monomer?

(1 mark)

(ii) (1) Usage of PLA is considered to be greener than that of polyethene. Suggest a reason.

(1 mark)

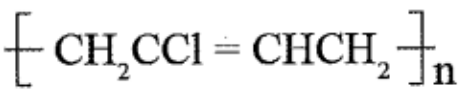
(2) In what aspect is usage of both PLA and polyethene considered as NOT green?

(1 mark)

(iii) A plastic bag made of PLA contains a bottle of vinegar. The bottle was accidently broken and the plastic bag dissolves gradually. Explain the phenomenon.

(1 mark)

(b) A part of the structure of synthetic rubber is shown below:



(i) The structure of the synthetic rubber can be improved after heating it with sulphur.

(1) Name this process.

(1 mark)

(2) Explain the underlying principle and how the strength of the rubber can be improved.

(2 marks)

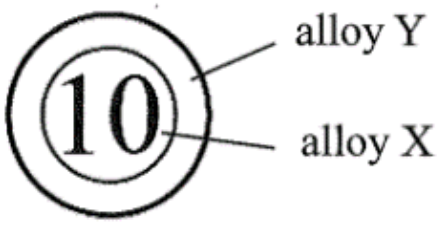
(ii) The synthetic rubber becomes brittle when immerse it into a beaker containing hydrogen bromide solution. Explain this phenomenon.

(2 marks)

(iii) State an application of the synthetic rubber after heating with sulphur.

(1 mark)

(c) The diagram below shows a ten dollar coin which is made of two alloys, X and Y.



(i) (1) State the meaning of an alloy.

(1 mark)

(2) Alloy is suitable for making a coinage metal. Explain why in terms of TWO properties of an alloy.

(2 marks)

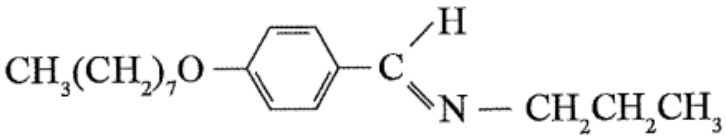
(ii) State ONE advantage and ONE disadvantage of using two alloys to manufacture coins.

(2 marks)

(iii) It is known that copper is present in alloy X. Suggest a method to prove the presence of copper. State the expected observation of the reaction.

(2 marks)

(d) State TWO structural features of the following substance that make it exhibit liquid-crystalline behavior.



(2 marks)

END OF SECTION B

Section C Analytical Chemistry

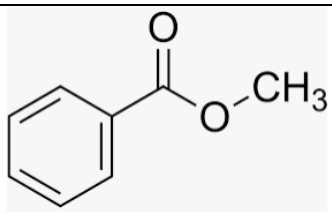
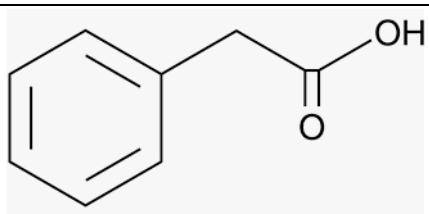
Answer **ALL** parts of the question.

3. (a) Answer the following short questions:

(i) Suggest a chemical test to distinguish $Ba(NO_3)_2(aq)$ and $Pb(NO_3)_2(aq)$.

(2 marks)

(ii) Consider a solution of compounds X and Y in dichloromethane.

	
X	Y

You are provided with dilute $Na_2CO_3(aq)$ and dilute $H_2SO_4(aq)$. Outline an experimental procedure, based on solvent extraction, to separate solid Y from a solution of X and Y in dichloromethane.

(4 marks)

(b) Some orange drinks contain the artificial food colourings Tartrazine and Sunset Yellow. These colourings are thought to cause hyperactivity in children.

A scientist working for a company making orange drink wants to show that the orange drink produced does not contain these two colourings by using thin layer chromatography. Samples of Tartrazine, Sunset Yellow and the orange drink are given to the scientist.

(i) Describe how the scientist could carry out the experiment.

(3 marks)

(ii) Describe how the scientist can show that the orange drink does NOT contain the two colourings. (Your answer may include a diagram of the chromatogram obtained.)

(1 mark)

(c) Compound X is an iodate salt of a Group I metal. An experiment was carried out to determine the chemical formula of compound X.

Step 1 2.480 g of compound X were dissolved in deionised water and made up to 250.0 cm^3 in a volumetric flask.

Step 2 25.00 cm^3 of the solution of compound X were placed in a conical flask, followed by 10 cm^3 of dilute sulphuric acid and an excess of KI(aq).

Step 3 The iodine formed in the conical flask was titrated with 0.240 mol dm^{-3} $Na_2S_2O_3$(aq). 23.75 cm^3 of $Na_2S_2O_3$(aq) were required to reach the end point.

(i) Briefly describe how the end point of the titration could be determined.

(2 marks)

(ii) The iodate ion is reduced to iodine in *Step 2*.

$$IO_3^-(aq) + 6H^+(aq) + 5I^-(aq) \longrightarrow 3I_2(aq) + 3H_2O\ (l)$$

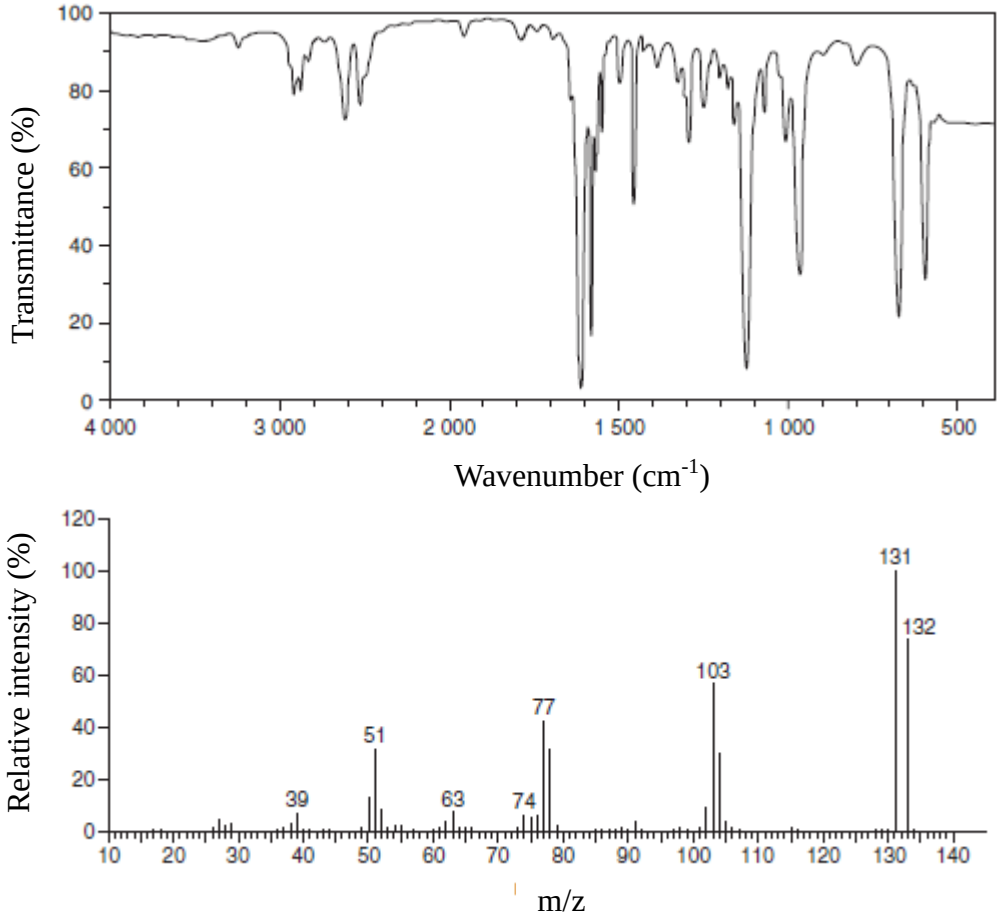
The iodine reacted with $Na_2S_2O_3$(aq) in *Step 3*.

$$I_2(aq) + 2S_2O_3^{2-}(aq) \longrightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$$

Determine the molar mass and chemical formula of the Group I iodate, compound X.
(Relative atomic masses: O = 16.0, I = 126.9)

(4 marks)

(d) Compound X (C_9H_8O) is a mono-substituted aromatic compound. It is a *trans* stereoisomer. X gives the following infrared spectrum and mass spectrum:



(i) By referring to the infrared spectrum and the information given in the table below, deduce one functional group that may be present in X.

Characteristic Infrared Absorption Wavenumber Ranges (Stretching modes)

Bond	**Compound type**	**Wavenumber range (cm^{-1})**
C=C	Alkenes	1 610 to 1 680
C=O	Aldehydes, ketones, carboxylic acids and derivatives	1 680 to 1 800
C≡C	Alkynes	2 070 to 2 250
C≡N	Nitriles	2 200 to 2 280
O–H	Acids (hydrogen-bonded)	2 500 to 3 300
C–H	Alkanes, alkenes, arenes	2 840 to 3 095
O–H	Alcohols, phenols (hydrogen-bonded)	3 230 to 3 670
N–H	Amines	3 350 to 3 500

(1 mark)

(ii) In the mass spectrum, suggest one chemical species corresponding to each of the signals at m/z = 77 and 103.
(Relative atomic mass: H = 1.0, C = 12.0, O = 16.0)

(2 marks)

(iii) According to (i) and (ii) above, draw a possible structure of X.

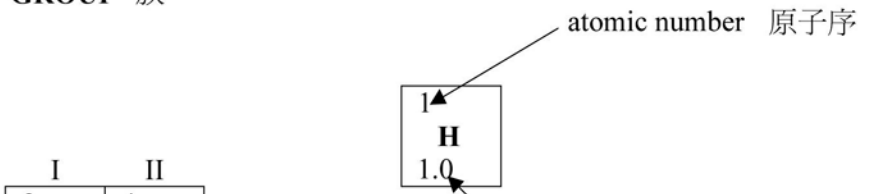
(1 mark)

END OF SECTION C

END OF PAPER

PERIODIC TABLE　周期表

GROUP 族



I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	82 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	100 **Md** (258)	102 **No** (259)	103 **Lr** (260)