PP-DSE
CHEM
PAPER 2

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PRACTICE PAPER

CHEMISTRY PAPER 2

(1 hour)

This paper must be answered in English

INSTRUCTIONS

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

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

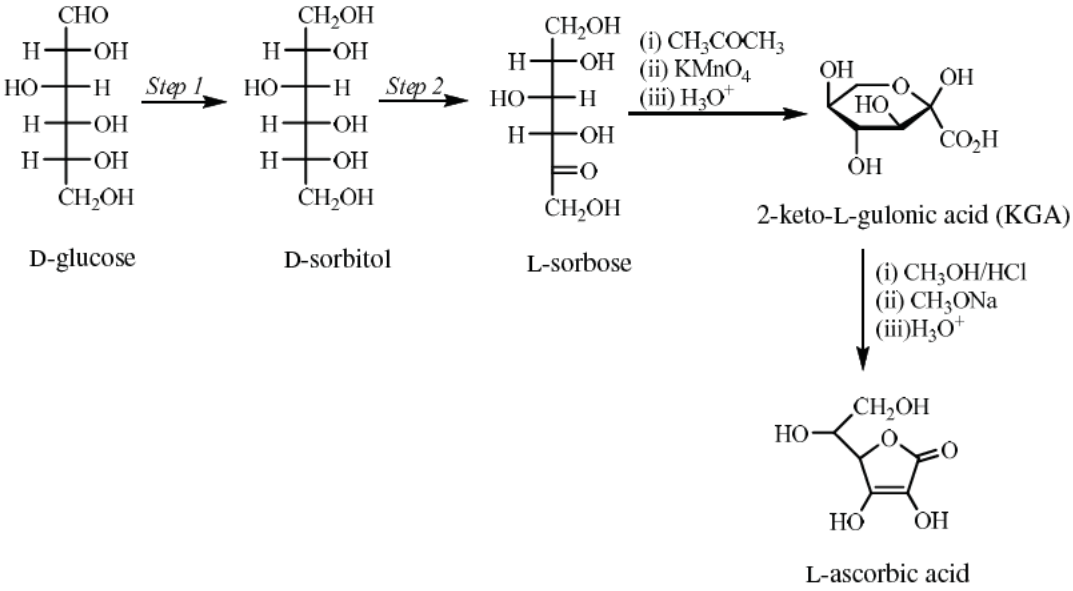
(3) A Periodic Table is printed on page 12 of this Question Paper. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

Not to be taken away before the end of the examination session

SECTION A Industrial Chemistry

Answer **ALL** parts of the question.

1. (a) L-Ascorbic acid, also known as vitamin C, is synthesised by the Reichstein process as shown below.



D-glucose D-sorbitol L-sorbose 2-keto-L-gulonic acid (KGA)

L-ascorbic acid

(i) State ONE importance of the Reichstein process.

(1 mark)

(ii) The reagents used in *Step 1* are $H_2(g)$ and Ni(s). Name the type of reaction involved.

(1 mark)

(iii) *Step 2* is an oxidation with the use of an enzyme, *sorbitol dehydrogenase*. This step is carried out at pH 4 to 6, and at about 30°C.

(I) Explain why this step is NOT carried out with commonly used oxidising agents.

(II) Suggest why this step is carried out at pH 4 to 6.

(2 marks)

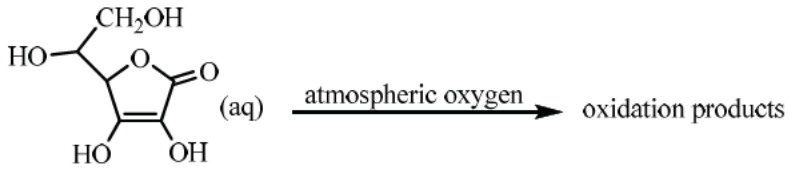
(iv) A method, with the use of a lactonase enzyme such as *gluconolactonase*, has been adopted for the conversion of KGA to L-ascorbic acid.

$$\text{KGA} \xrightarrow{\textit{gluconolactonase}} \text{L-ascorbic acid}$$

Suggest TWO reasons why this method is considered greener than the corresponding one in the above-shown Reichstein process.

(2 marks)

1. (b) The atmospheric oxidation of L-ascorbic acid is a first order reaction.



(i) What do you understand by the term 'first order reaction' ?

(1 mark)

(ii) The table below lists the rate constants k for this reaction at four different temperatures T :

T / K	313	323	333	343
k / 10^{-3} h^{-1}	27.0	35.4	50.4	65.4

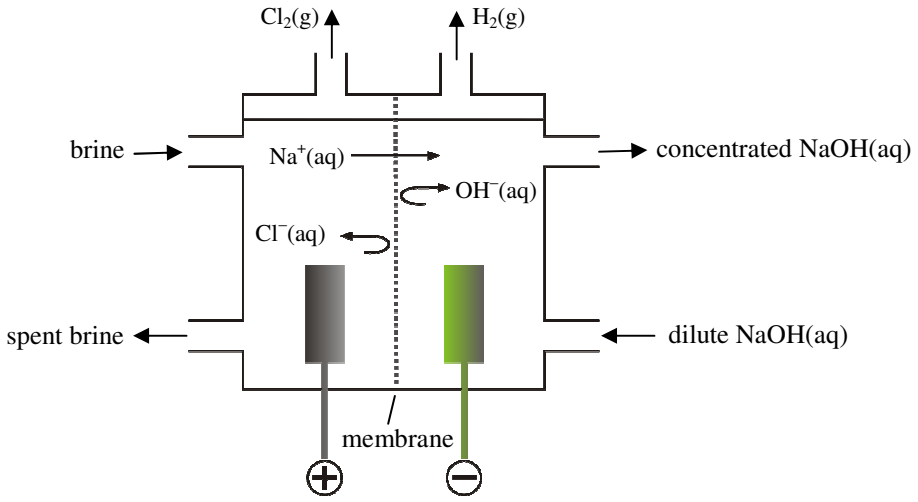
By plotting a suitable graph, determine the activation energy E_a of this reaction.

(Gas constant R = 8.31 J K^{-1} mol^{-1})

(5 marks)

(This question is continued on the next page.)

1. (c) The diagram below shows a membrane cell used in chloroalkali industry for the production of hydrogen, chlorine and concentrated sodium hydroxide.



(i) With the aid of chemical equations, account for the formation of hydrogen, chlorine and concentrated sodium hydroxide in the membrane cell.

(5 marks)

(ii) Chlorine bleach can be made by treating chlorine with dilute sodium hydroxide solution at room temperature. Write the chemical equation of the reaction involved.

(1 mark)

(iii) A student learnt that sodium chloride is highly abundant and that hydrogen is a non-polluting fuel. The student made the following remark:

'Electrolysis of brine can be used in large scale manufacture of hydrogen to help reduce air pollution problems.'

Do you agree with the student ? Explain.

(2 marks)

END OF SECTION A

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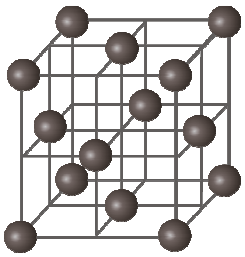
SECTION B Materials Chemistry

Answer **ALL** parts of the question.

2. (a) Aluminium is the most abundant metallic element in the earth's crust and is one of the most widely used metals.

(i) Solid aluminium exhibits a cubic crystalline structure, which is a repetition of the following unit cell:



(I) Name the type of unit cell of aluminium.

(II) Calculate the number of atoms in ONE unit cell of aluminium.

(III) The density of a substance is its mass to volume ratio. Given that the edge length of a unit cell of aluminium is 4.05×10^{-10} m, calculate the density of solid aluminium, in g cm^{-3}.

(Avogadro constant $L = 6.02 \times 10^{23}$ mol^{-1})

(5 marks)

(ii) (I) The strength of aluminium can be improved by alloying it with other metals. Explain why.

(II) Alloys of aluminium and lithium are used in making aircraft bodies. Apart from strength considerations, suggest ONE advantage of using aluminium-lithium alloys in making aircraft bodies.

(3 marks)

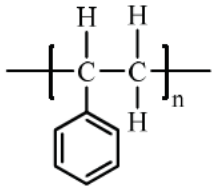
(iii) Biotite is a kind of aluminosilicate having a layered structure. It is widely used in the electronics industry.

(I) Explain why biotite can easily flake off.

(II) Suggest ONE application of biotite in the electronics industry.

(2 marks)

2. (b) Polystyrene (PS) is a commonly used plastic material. Solid PS is brittle and of limited flexibility. The properties of PS can be modified by copolymerisation with other chemicals. The structure of PS is represented as follows:



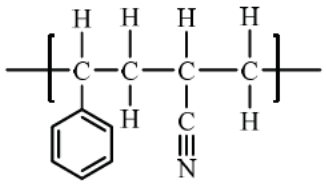
(i) (I) Draw the structure of the monomer of PS.

(II) The photograph below shows a plastic lid made from PS. Suggest a moulding method used in making the lid.

(2 marks)

(ii) Styrene acrylonitrile resin (SAN) is a plastic material made from copolymerisation of styrene with acrylonitrile ($H_2C=CHCN$). SAN can withstand higher temperatures than PS.

(I) Repetition of the following structure CANNOT represent the exact structure of SAN. Explain why.



(II) Suggest why SAN can withstand higher temperatures than PS.

(5 marks)

(This question is continued on the next page.)

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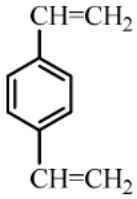
2. (b) (iii) Copolymerisation of styrene with 1,4-divinylbenzene produces a plastic material which is hard, rigid and does not melt upon heating.



1,4-divinylbenzene

Explain, in terms of structure and bonding, why this plastic material possesses the above-mentioned physical properties.

(3 marks)

END OF SECTION B

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SECTION C Analytical Chemistry

Answer **ALL** parts of the question.

3. (a) A colourless compound **X** ($C_9H_8O_2$) is obtainable from cinnamon. **X** has a melting point of 134°C and is insoluble in water.

An experiment to extract **X** from an impure sample, which contains non-polar organic impurities, involves the following five steps:

Step 1: Dissolve the sample in excess NaOH(aq).

Step 2: Shake the solution from Step 1 with hexane and discard the organic layer.

Step 3: Add HCl(aq) to the aqueous layer obtained until a white precipitate forms and the solution becomes acidic.

Step 4: Collect the white precipitate by filtration.

Step 5: Using ethanol as solvent, recrystallise the precipitate collected to obtain **X**.

(i) From the above experimental steps, suggest ONE functional group present in **X**.

(1 mark)

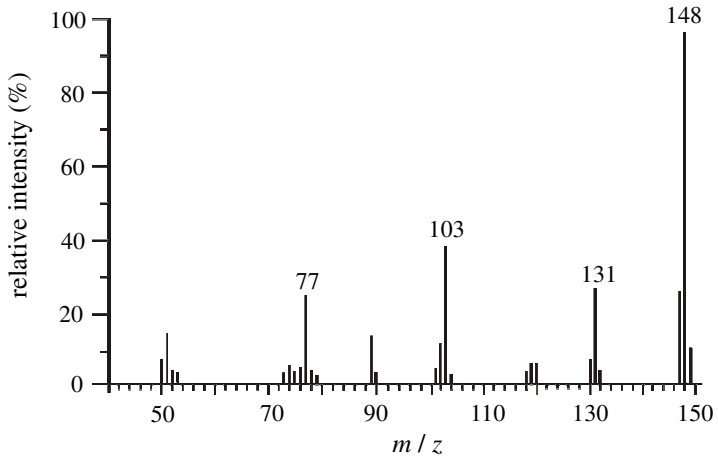
(ii) Name the apparatus used in Step 2.

(1 mark)

(iii) Briefly explain the purpose of carrying out Steps 1, 2 and 3 respectively.

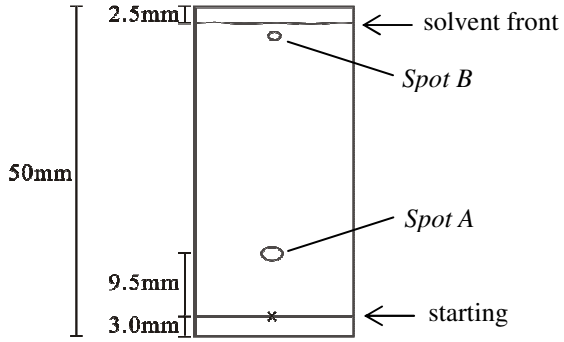
(3 marks)

(iv) **X** can decolourise Br_2 in CH_3CCl_3. It displays the following mass spectrum. Deduce ONE possible structure of **X**.



(5 marks)

3. (a) (v) Another sample of **X** is contaminated with a colourless organic compound. The sample is analysed by thin-layer chromatography (TLC), and the result is shown below:



(I) Suggest ONE method that can be used to make the two spots on the chromatographic plate become visible.

(II) Given that *Spot A* corresponds to **X**, calculate the R_f of **X**.

(III) Based on the TLC results, suggest ONE method to separate **X** from the contaminated sample.

(3 marks)

(b) The percentage by mass of barium (Ba) in a barium salt can be determined by gravimetric method. In one such experiment, 0.305 g of a sample of a barium salt was dissolved completely in about 100 cm^3 of deionised water. Excess dilute sulphuric acid was then added to the solution to precipitate out barium sulphate. After filtration and appropriate treatments, the barium sulphate was found to have a mass of 0.291 g.

(i) State TWO necessary treatments on the filtered barium sulphate precipitate before its mass is determined.

(2 marks)

(ii) Calculate the percentage by mass of barium in the sample.

(3 marks)

(iii) State TWO conditions under which gravimetric method is suitable for quantitative analysis.

(2 marks)

END OF SECTION C

END OF PAPER

PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

relative atomic mass 相對原子質量

I	II											III	IV	V	VI	VII	0
				1 **H** 1.0													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	83 **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)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)