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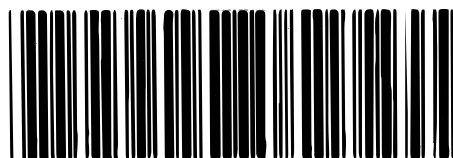
Candidate Number

CHEMISTRY PAPER 1
SECTION B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

- (1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.
- (2) Refer to the general instructions on the cover of the Question Paper for Section A.
- (3) This section consists of TWO parts, Parts I and II.
- (4) Answer ALL questions in both Parts I and II. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.
- (5) An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.
- (6) Supplementary answer sheets will be provided on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.
- (7) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.



PART I

Answer ALL questions. Write your answers in the spaces provided.

1. Barium (Ba) is an element in Group II of the Periodic Table. Its chemical properties are similar to those of calcium.

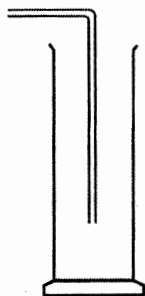
(a) Describe the bonding in barium.

(2 marks)

(b) A gas with a pungent smell is formed when $\text{Ba}(\text{OH})_2(\text{s})$ is heated with $\text{NH}_4\text{Cl}(\text{s})$. State the reason why the gas CANNOT be collected by each of the following methods.

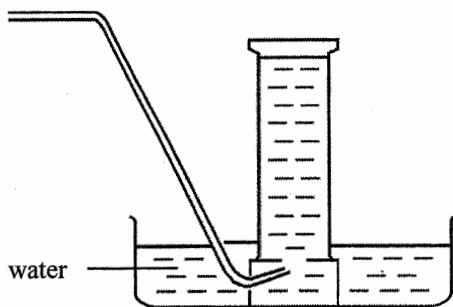
(i)

Reason :



(ii)

Reason :



(2 marks)

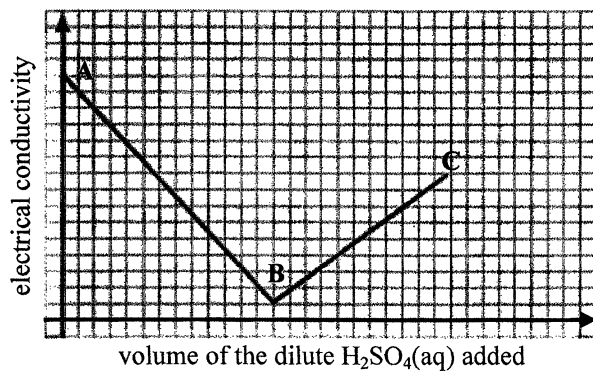
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1. (c) An experiment was carried out to study the change in electrical conductivity of the mixture formed when a dilute $\text{H}_2\text{SO}_4(\text{aq})$ was added gradually to a fixed volume of a dilute $\text{Ba}(\text{OH})_2(\text{aq})$. The graph below shows the results of the experiment.



- (i) State the expected observation when dilute $\text{H}_2\text{SO}_4(\text{aq})$ is added to dilute $\text{Ba}(\text{OH})_2(\text{aq})$.
- (ii) Explain the change of electrical conductivity in the following stages :
- (1) From **A** to **B**
- (2) From **B** to **C**

(3 marks)

Answers written in the margins will not be marked.

2. Water pipes used to carry drinking water are commonly made of copper instead of iron. Although lead-containing solder can be used to join these water pipes, such use is prohibited.

- (a) Suggest one chemical property of copper that makes it more suitable than iron for making water pipes. Explain your answer.

(2 marks)

- (b) (i) Suggest one reason of adding lead to soldering materials.

- (ii) Explain why lead-containing solder is prohibited in joining these water pipes.

(2 marks)

- (c) A city stipulates that the concentration of lead ions in drinking water should not exceed $1.0 \times 10^{-8} \text{ g cm}^{-3}$. Express this concentration in mol dm^{-3} .
(Relative atomic mass : Pb = 207.2)

(2 marks)

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3. Answer the following questions.

(a) Explain why propene can form a polymer, but propane cannot.

(1 mark)

(b) Explain why $\text{HO}_2\text{C}(\text{CH}_2)_4\text{CO}_2\text{H}$ can form a polymer with $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$, but $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$ cannot.

(2 marks)

(c) Describe the formation of dative covalent bond using H_3O^+ as example.

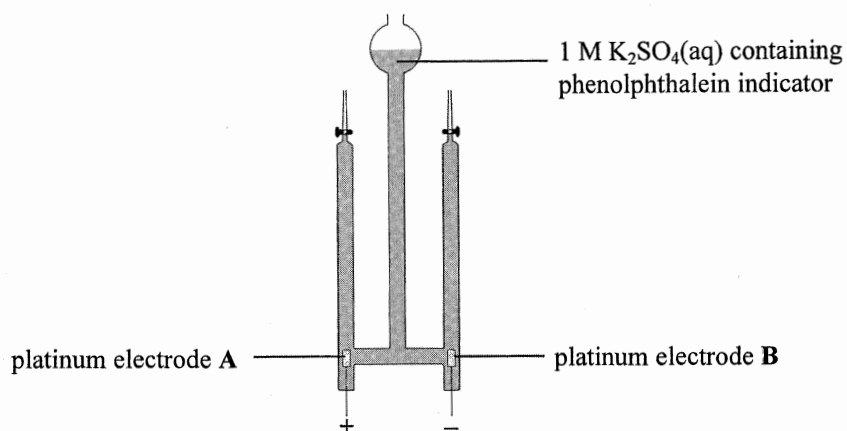
(3 marks)

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4. The diagram below shows a set-up for the electrolysis of a colourless solution of 1 M $\text{K}_2\text{SO}_4(\text{aq})$ containing phenolphthalein indicator.



- (a) State, with explanation, the expected observation around the following electrodes during the electrolysis :

(i) electrode A

(ii) electrode B

(3 marks)

- (b) Write the equation of the overall reaction in the electrolysis.

(1 mark)

- (c) Explain whether there are any changes in the expected observation around the following electrodes during the electrolysis if the 1 M $\text{K}_2\text{SO}_4(\text{aq})$ is replaced with 1 M $\text{H}_2\text{SO}_4(\text{aq})$:

(i) electrode A

(ii) electrode B

(3 marks)

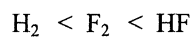
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5. Explain the following increasing order of the boiling points of three substances :



(3 marks)

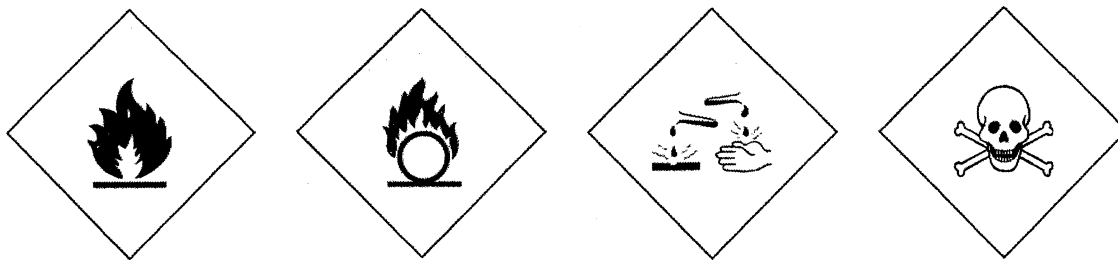
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6. Concentrated sulphuric acid is a reagent commonly found in laboratories.

- (a) Circle TWO hazard warning labels that should be displayed on a bottle of concentrated sulphuric acid :



(1 mark)

- (b) In order to determine the concentration of a sample of concentrated sulphuric acid, 5.00 cm^3 of the sample was diluted to 1000.0 cm^3 with deionised water. Portions of 25.00 cm^3 of the diluted sample were titrated with $0.189 \text{ mol dm}^{-3}$ NaOH(aq) using methyl orange as an indicator. An average of 22.20 cm^3 of NaOH(aq) was used to reach the end point.

- (i) Explain why concentrated sulphuric acid should NOT be titrated directly with NaOH(aq).

- (ii) State the colour change at the end point of the titration.

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6. (b) (iii) Calculate the concentration of the sample of concentrated sulphuric acid, in mol dm^{-3} .

(5 marks)

(c) With the help of a chemical equation, state the observation when hot concentrated sulphuric acid reacts with copper.

(2 marks)

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7. Ethyne is a gaseous hydrocarbon with molecular formula C_2H_2 .

- (a) Suggest why the enthalpy change of formation of $C_2H_2(g)$ CANNOT be determined directly by experiment.

(1 mark)

- (b) Hess's law can be used to find enthalpy changes which CANNOT be determined directly by experiment. State Hess's law.

(1 mark)

- (c) Based on the enthalpy changes of combustion ΔH_c of $C_2H_2(g)$, C(graphite) and $H_2(g)$ to construct an enthalpy change cycle and applying Hess's law can give the enthalpy change of formation of $C_2H_2(g)$.

- (i) Draw, with labels, this enthalpy change cycle.

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7. (c) (ii) The standard enthalpy changes of combustion ΔH_c° of $C_2H_2(g)$, $C(\text{graphite})$ and $H_2(g)$ are given below :

| | $\Delta H_c^\circ / \text{kJ mol}^{-1}$ |
|----------------------|---|
| $C_2H_2(g)$ | -1300 |
| $C(\text{graphite})$ | -394 |
| $H_2(g)$ | -286 |

(1) State the standard conditions for 'standard enthalpy change'.

(2) Calculate the standard enthalpy change of formation of $C_2H_2(g)$.

(5 marks)

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8. Combustion of petrol increases the concentration of carbon dioxide in the atmosphere, and may contribute to global warming. Combustion of petrol also emits poisonous air pollutants.

(a) Write a chemical equation for the complete combustion of octane (C_8H_{18}), a component in petrol.

(1 mark)

(b) Draw the electron diagram for a molecule of carbon dioxide, showing *electrons in the outermost shells* only.

(1 mark)

(c) Give one reason FOR and one reason AGAINST the following statement :

'Switching from using petrol-driven cars to using electric cars can help alleviate global warming.'

FOR :

AGAINST :

(2 marks)

(d) Carbon monoxide is one of the poisonous air pollutants emitted from the combustion of petrol. Under what condition would carbon monoxide be formed during the combustion of petrol ?

(1 mark)

(e) (i) Name a device that can be installed in petrol-driven cars so as to reduce the emission of carbon monoxide.

(ii) Suggest one air pollutant in car exhaust which cannot be removed by the device in (i).

(2 marks)

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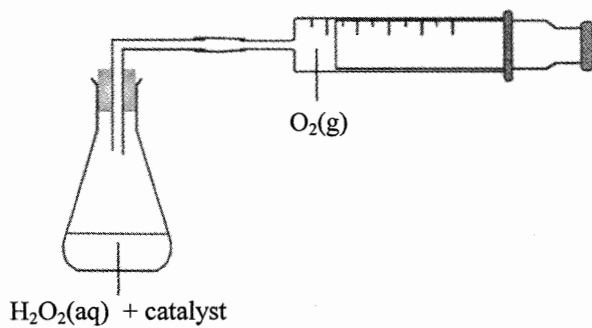
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PART II

Answer **ALL** questions. Write your answers in the spaces provided.

10. In an experiment performed under room conditions as shown below, 5.00 cm^3 of $\text{H}_2\text{O}_2(\text{aq})$ decomposed into $\text{O}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ in the presence of a catalyst. $\text{O}_2(\text{g})$ was continuously released from the start of the experiment until the third minute when a total of 60 cm^3 of gas was collected. After that, no more gas was collected.



- (a) Calculate the initial concentration of the $\text{H}_2\text{O}_2(\text{aq})$, in mol dm^{-3} .
(Molar volume of gas at room conditions = 24 dm^3)

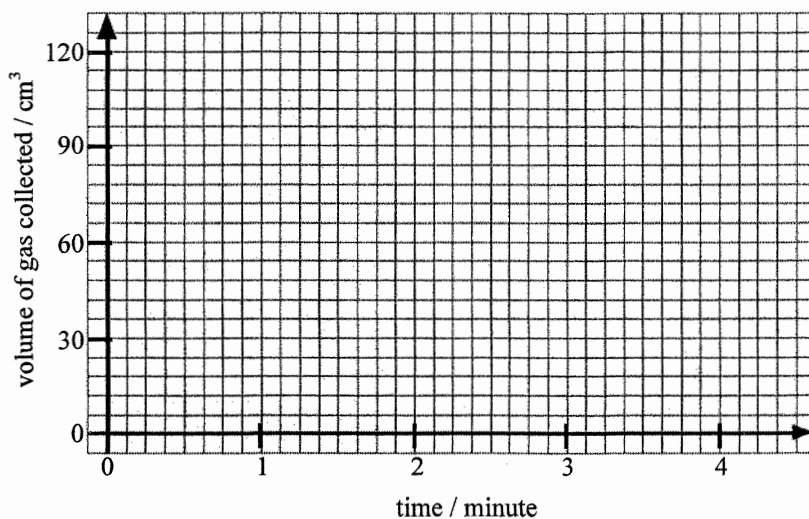
(2 marks)

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10. (b) In the graph below, sketch the variation of the volume of gas collected with time in the first 4 minutes.



(2 marks)

- (c) The experiment is repeated using a $\text{H}_2\text{O}_2(\text{aq})$ at a higher temperature but other conditions remain unchanged. Explain whether the total volume of gas obtained would still be 60 cm^3 . (The volume of gas is measured at room conditions.)

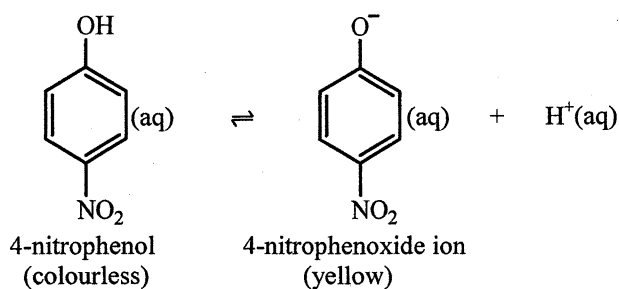
(1 mark)

- (d) Suggest another method that can be used to follow the progress of this reaction.

(1 mark)

Answers written in the margins will not be marked.

11. The equation below shows the ionisation of 4-nitrophenol in water :



At 25°C, the equilibrium constant K_c for the ionisation is $8.0 \times 10^{-8} \text{ mol dm}^{-3}$.

- (a) Write an expression for K_c .
(You may use **HA** to represent 4-nitrophenol and **A⁻** to represent 4-nitrophenoxide ion.)

(1 mark)

- (b) When the above ionisation attains equilibrium at 25°C, the pH of an aqueous solution of 4-nitrophenol is 2.4. Calculate the ratio of the concentration of 4-nitrophenol to the concentration of 4-nitrophenoxide ions in this solution.

(2 marks)

- (c) Suggest if there is any colour change when NaOH(aq) is added gradually into the solution in (b). Explain your answer.

(2 marks)

- (d) Suggest one possible use of 4-nitrophenol in acid-base titration experiments.

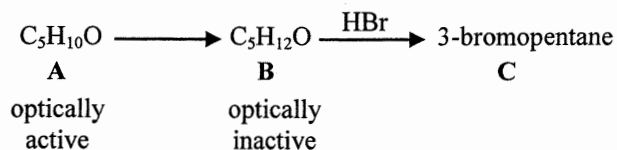
(1 mark)

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12. Consider the following conversions :



(a) Write the structural formula of **C**.

(1 mark)

(b) (i) Deduce the structural formula of **B**.

(ii) Name the type of reaction for the conversion of **B** to **C**.

(3 marks)

(c) (i) Deduce the structural formula of **A**. Label on this structural formula all chiral centre(s), if any, by using ‘*’.

(ii) State the reagent(s) required for the conversion of **A** to **B**.

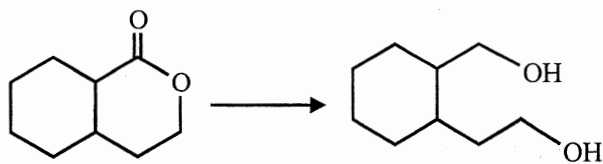
(3 marks)

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13. Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and the structure of the organic product.



(3 marks)

Answers written in the margins will not be marked.

PERIODIC TABLE 周期表

GROUP 族

| | | | | | | | | | | | | | | | | | | | | |
|-------------|-------------|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|--|---|
| | | atomic number 原子序 | | | | | | | | | | | | | | | | 0 | | |
| | | relative atomic mass 相對原子質量 | | | | | | | | | | | | | | | | | | |
| I | II | 3 | 4 | | | | | | | | | | | | | | | | | 2 |
| Li 6.9 | Be 9.0 | | | | | | | | | | | | | | | | | He 4.0 | | |
| 11 | 12 | | | | | | | | | | | | | | | | | 10 | | |
| Na 23.0 | Mg 24.3 | | | | | | | | | | | | | | | | | Ne 20.2 | | |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | 35 | 36 | | | |
| K 39.1 | Ca 40.1 | Sc 45.0 | Ti 47.9 | V 50.9 | Cr 52.0 | Mn 54.9 | Fe 55.8 | Co 58.9 | Ni 58.7 | Cu 63.5 | Zn 65.4 | | | | | Br 79.9 | Kr 83.8 | | | |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | | | | | 53 | 54 | | | |
| Rb 85.5 | Sr 87.6 | Y 88.9 | Zr 91.2 | Nb 92.9 | Mo 95.9 | Tc (98) | Ru 101.1 | Rh 102.9 | Pd 106.4 | Ag 107.9 | Cd 112.4 | | | | | I 126.9 | Xe 131.3 | | | |
| 55 | 56 | 57 * | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | | | | | 85 | 86 | | | |
| Cs 132.9 | Ba 137.3 | La 138.9 | Hf 178.5 | Ta 180.9 | W 183.9 | Re 186.2 | Os 190.2 | Ir 192.2 | Pt 195.1 | Au 197.0 | Hg 200.6 | | | | | At (210) | Rn (222) | | | |
| 87 | 88 | 89 ** | 104 | 105 | | | | | | | | | | | | | | | | |
| Fr (223) | Ra (226) | Ac (227) | Rf (261) | Db (262) | | | | | | | | | | | | | | | | |
| | | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | | | | | |
| | | Ce 140.1 | Pr 140.9 | Nd 144.2 | Pm (145) | Sm 150.4 | Eu 152.0 | Gd 157.3 | Tb 158.9 | Dy 162.5 | Ho 164.9 | Er 167.3 | Tm 168.9 | Yb 173.0 | Lu 175.0 | | | | | |
| | | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | | | | | |
| | | Th 232.0 | Pa (231) | U 238.0 | Np (237) | Pu (244) | Am (243) | Cm (247) | Bk (247) | Cf (251) | Es (252) | Fm (257) | Md (258) | No (259) | Lr (260) | | | | | |

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