

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.

Please stick the barcode label here.

Candidate Number

FOR MARKER USE ONLY

| Question No. | Marks | Total marks |
|--------------|-------|-------------|
| 1 | | 8 |
| 2 | | 7 |
| 3 | | 12 |
| 4 | | 12 |
| 5 | | 7 |
| 6 | | 7 |
| 7 | | 5 |
| 8 | | 11 |
| 9 | | 8 |
| 10 | | 7 |
| MC | | 36 |
| Total | | 120 |

1. Tellurium (Te, atomic number = 52). Tellurium is commonly used in making solar cells.
- State the electronic arrangement of Tellurium (1 mark)
 - Explain why tellurium and sulphur exhibits similar chemical properties. (1 mark)
 - Hydrogen can form a compound with Tellurium (H_2Te), draw the electron diagram of this compound, showing electrons in the outermost shell only (1 mark)
 - Explain whether H_2Te has a higher or lower melting point than KNO_3 (2 marks)
 - Tellurium has the following naturally occurring isotopes, calculate the relative atomic mass of tellurium. (2 marks)

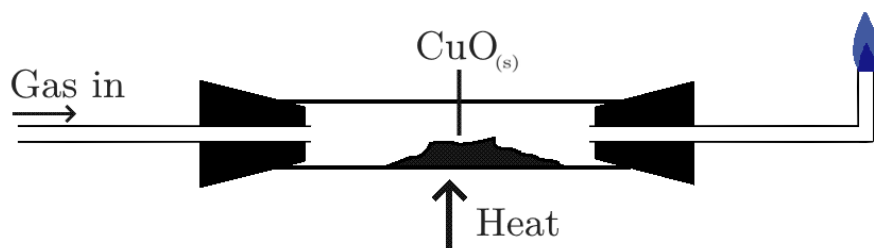
| Isotope | $^{122}_{52}\text{Te}$ | $^{124}_{52}\text{Te}$ | $^{126}_{52}\text{Te}$ | $^{128}_{52}\text{Te}$ | $^{130}_{52}\text{Te}$ |
|--------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Relative Abundance | 3.60% | 8.25% | 22.35% | 31.70% | 34.10% |

- $^{130}_{52}\text{Te}$ is used to form H_2Te , does this compound have different chemical properties compared to H_2Te formed from $^{122}_{52}\text{Te}$? Explain your answer. (1 mark)

2. A student uses the following setup to extract copper from a sample of copper(II) oxide.



- a. The student expected to see copper metal produced in the reaction, explain why he could not produce any copper metal. (1 mark)
- b. The student modified the setup as follows:



Suggest a gas that the student can use to extract copper from copper(II) oxide. (1 mark)

- c. The student ended up mixing carbon powder with the copper(II) oxide powder to extract copper with the setup in (b). Write a chemical equation for the reaction, state an observable change. (2 marks)
- d. The copper extracted was separated from the mixture. 5.69g of copper was obtained from 10.4g of copper(II) oxide, calculate the percentage yield of the reaction. (2 marks)
(Relative atomic mass: Cu = 63.5; O = 16)
- e. Why must the gas flowing out from the setup be burnt off? (1 mark)

3. To determine the identity of 3 metals, the following experiments were conducted with strips of the metals and the results are shown in the table below.

| | Metal A | Metal B | Metal C |
|--------------------------|---|----------------------|---|
| Reaction with steam | White powder is formed | No observable change | No observable change |
| Reaction with dilute HCl | The metal dissolves in the solution; Colourless gas bubbles are given out | No observable change | Colourless gas bubbles are given out but then quickly stop. |

- a. What is the colourless gas formed when A reacts with dilute $\text{HCl}_{(\text{aq})}$, write a chemical equation for the reaction, given that **A** can form A^{2+} ions only. You may use A to represent metal **A**. (2 marks)
- b. i. Arrange the three metals in ascending order of reactivity, support your answer with explanations. (3 marks)
- ii. Given that the three metals are Mg, Ag or Pb, determine the identity of the 3 metals. (1 mark)
- c. Hence, explain the observation when metal **C** reacts with dilute $\text{HCl}_{(\text{aq})}$ (2 marks)
- d. Tin (Sn) is another metal. Suggest a method, with observations to determine the order of reactivity of the four metals: **A**, **B**, **C** and Sn. (3 marks)
- e. Tin forms the nitrate compound $\text{Sn}(\text{NO}_3)_4$, state the oxidation number of tin in this compound. (1 mark)

4. Most commercial window cleaners contain ammonia (NH_3). NH_3 is a weak alkali.

a. What is meant by 'weak alkali' (1 mark)

b. A solution of window cleaner is exposed to air for a while, explain whether the concentration of ammonia in the solution will be lower, the same, or higher than original. (1 mark)

c. A student decides to determine the concentration of NH_3 in a window cleaner for her SBA by titration. She takes a 25cm^3 sample of the window cleaner and dilutes it to a 250cm^3 solution. She then titrates 25cm^3 samples of the diluted solution against $0.02\text{M HNO}_{3(\text{aq})}$.

i. State why she must keep the windows of the laboratory open during the titration process. (1 mark)

ii. State the procedures of diluting the window cleaner to a 250cm^3 diluted sample. (3 marks)

d. The results of the titration process are as follows:

| Trial | 1 | 2 | 3 | 4 | 5 | 6 |
|---|-------|-------|-------|-------|-------|-------|
| $0.02\text{M HNO}_{3(\text{aq})}$ used. | 19.10 | 18.70 | 19.00 | 18.80 | 18.80 | 18.70 |

i. Calculate a reasonable average for the titration process. (1 mark)

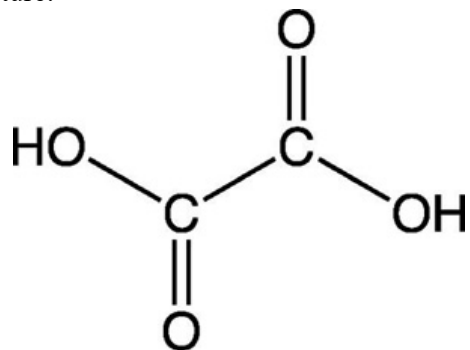
ii. Write the chemical equation for the reaction. (1 mark)

iii. State an indicator that can be used to indicate the endpoint of the reaction, state the corresponding colour change of the indicator at the end point (2 marks)

iv. Calculate the concentration in mol dm^{-3} of NH_3 in the window cleaner. (2 marks)

e. Will the actual concentration of $\text{NH}_{3(\text{aq})}$ in the window cleaner be higher or lower than that determined in d(iv)? Explain your answer. (1 mark)

5. Oxalic acid has the following structure:

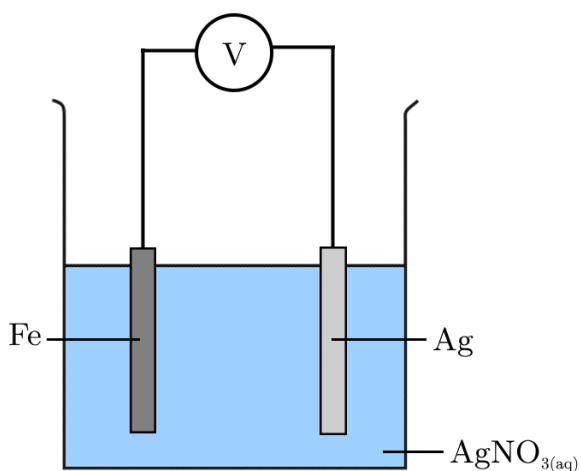


- a. State the molecular formula of oxalic acid. (1 mark)
- b. What is the basicity of oxalic acid? (1 mark)
- c. A 0.30M solution of oxalic acid was found to have a pH value of 0.347, determine whether oxalic acid is a strong or weak acid by calculation. (2 marks)
- d. 50cm³ of 0.30M oxalic acid is added to a suitable amount of 0.20M sodium hydroxide such that oxalic acid is neutralized.
 - i. Calculate the volume of 0.20M sodium hydroxide solution needed. (2 marks)
 - ii. A student claims, 'The resulting solution will have a pH of 7 since it is neutralized', is he correct? Explain your answer. (1 mark)

6. Carbon compound **K** was burnt completely in oxygen. 17.0g of the carbon compound was completely burnt to form 23.3g of carbon dioxide and 19.1g of water.
- Determine the molecular formula of the compound, given that it has a relative atomic mass of 32.0
(2 marks)
 - K** exists as a liquid at room temperature while butane ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$) exists as a gas at room temperature despite having a larger molecular size. Explain the discrepancy.
(2 marks)
 - With the aid of a diagram, show why **K** is miscible with water. Indicate partial charges in your diagram.
(3 marks)

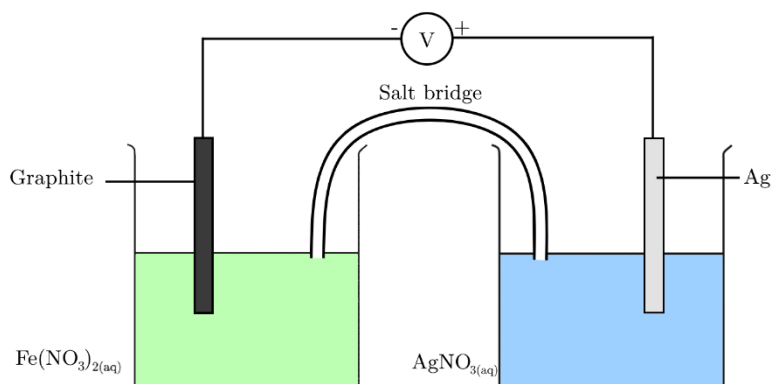
7. *Outline the procedures of preparing dry magnesium carbonate powder from magnesium hydroxide powder. You should name all reagents to be used. (5 marks)

8. A student tries to create a chemical cell from iron and silver strips with $\text{AgNO}_{3(\text{aq})}$ as the electrolyte. The setup is shown as follows:



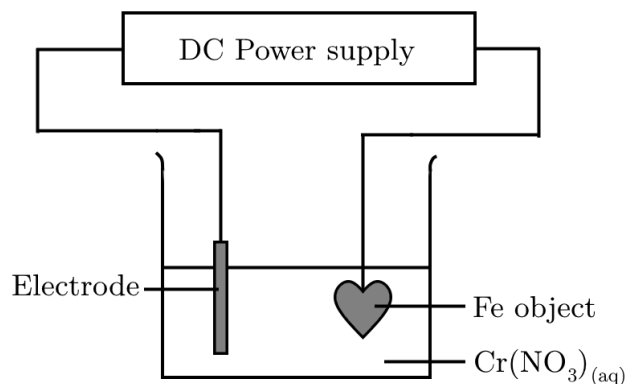
- Label the two terminals of the voltmeter in the above figure with + and – such that the student can observe a positive voltmeter reading. (1 mark)
- State the oxidizing agent and reducing agent in the chemical cell. (1 mark)
- With the aid of a half equation, state one observable change seen at the cathode. (2 marks)
- The chemical cell quickly stops after a short while, why? (2 marks)

e. The student modifies the cell to the following half-cell setup:



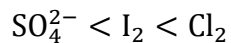
- Why does the voltmeter still display a positive reading even if the Fe electrode is replaced with a graphite electrode? Write the half equation for the half-cell on the left which accounts for the phenomenon. (2 mark)
- Write the overall equation for the reaction in the chemical cell. (1 mark)
- What is the function of the salt bridge? (1 mark)
- State a criterion for selecting the electrolyte used in the salt bridge. (1 mark)

9. Electroplating is a common application for electroplating. In the following diagram, a setup used for electroplating chromium on an iron object is shown.



- a. Complete the diagram above by indicating the positive and negative electrodes of the DC power supply. (1 mark)
- b. Given that Cr^{3+} is a weaker oxidizing agent than H^+ . Explain how chromium can be plated on the iron object. (2 marks)
- c. Suggest and explain a material which should be used for the electrode. (2 marks)
- d. A graphite electrode was eventually chosen. Explain why colourless gas bubbles are evolved at the Fe object after a while. Write the half equation for the reaction. (3 marks)

10. You would like to verify the oxidizing power of the three chemical species are as follows:



You are provided with the following chemicals:

Aqueous magnesium bromide solution, aqueous magnesium chloride solution, aqueous bromine, aqueous chlorine, aqueous magnesium sulphite solution, Aqueous magnesium sulphate solution, basic laboratory equipment.

Design an experiment to verify the order, your answer should state and explain relevant observations of the chemical reactions.

(7 marks)

END OF SECTION 1B
END OF PAPER

atomic number

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----|-------------|----|-------------|-----------------------------|-------------|-----|-------------|-----|-------------|----|------------|----|------------|----|------------|----|-----------|----|------------|----|------------|-----|------------|-----------|------------|----|------------|----|------------|-----------|------------|----|------------|----|------------|-----|-----------|------------|------------|------------|------------|------------|------------|-----------|------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|------------|----|-------------|----|-------------|----|-------------|------|-------------|----|-------------|----|-------------|----|------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|
| I | | II | | relative atomic mass 相對原子質量 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Li 6.9 | 4 | Be 9.0 | 11 | Na 23.0 | 12 | Mg 24.3 | 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 | 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) | | | | | | | | | | | | | III | 5 | B 10.8 | IV | 6 | C 12.0 | V | 7 | N 14.0 | VI | 8 | O 16.0 | 9 | F 19.0 | VII | 10 | Ne 20.2 | 17 | Cl 35.5 | 18 | Ar 40.0 | 2 | He 4.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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