

CHEMISTRY PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)

This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 45 minutes.
2. Section A consists of multiple-choice questions in this question paper, while Section B contains conventional questions printed separately in Question-Answer Book B.
3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book B. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**
4. A Periodic Table is printed on page 20 of Question-Answer Book B. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.
2. When told to open this book, you should check that all the questions are there. Look for the words '**END OF SECTION A**' after the last question.
3. All questions carry equal marks.
4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.
5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.
6. No marks will be deducted for wrong answers.

This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.

Choose the best answer for each question.

Candidates may refer to the Periodic Table printed on page 20 of Question-Answer Book B.

PART I

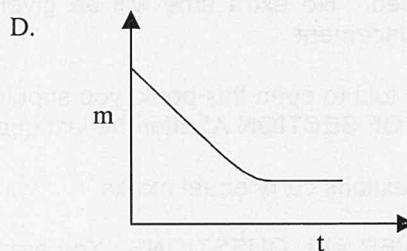
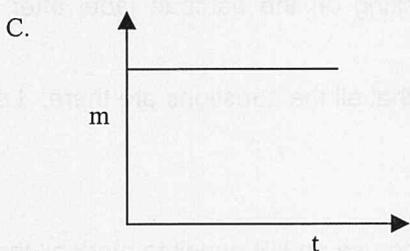
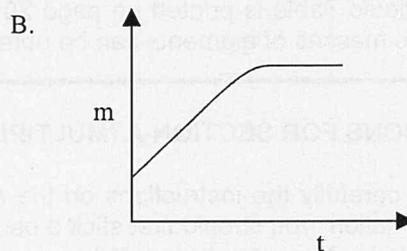
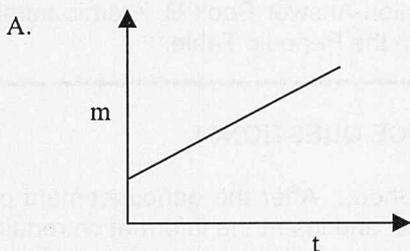
1. Which of the following processes is most suitable for extracting sodium chloride from sea water ?

- A. electrolysis
- B. crystallisation
- C. simple distillation
- D. fractional distillation

2. Neon exists as a gas at room temperature and pressure because

- A. neon is chemically inert.
- B. neon molecules are monoatomic.
- C. the attractive force between neon atoms is weak.
- D. the outermost electron shell of a neon atom has an octet structure.

3. A certain mass of a sample of $\text{Ag}_2\text{O}(\text{s})$ is strongly heated in a test tube. Which of the following shows the relationship of the mass of the contents (m) in the test tube with time (t) from the start of heating ?



4. If 8.0 g of sulphur dioxide gas contains n molecules, how many molecules does 2.0 g of oxygen gas contain ?

(Relative atomic masses : O = 16.0, S = 32.0)

- A. 2.0 n
- B. 4.0 n
- C. 0.25 n
- D. 0.50 n

5. Quartz (SiO_2) is harder than dry ice (CO_2) because
- the atomic size of silicon is larger than that of carbon.
 - a silicon atom has more electrons than a carbon atom has.
 - quartz has a giant network structure, but dry ice consists of discrete molecules.
 - the silicon–oxygen bond in quartz is strong, but the carbon–oxygen bond in dry ice is weak.
6. Dilute sodium hydroxide solution is added to a 0.1 M solution until in excess. Which of the following combinations is correct ?
- | | <u>Solution</u> | <u>Observation</u> |
|----|--------------------|--------------------------------|
| A. | zinc sulphate | white precipitate formed |
| B. | calcium nitrate | white precipitate formed |
| C. | lead(II) nitrate | yellow precipitate formed |
| D. | iron(III) sulphate | dirty green precipitate formed |
7. Which of the following statements concerning iron and magnesium is correct ?
- Iron is ductile but magnesium is not.
 - Iron corrodes less readily than magnesium.
 - The abundance of magnesium is higher than that of iron in the earth crust.
 - Both magnesium and iron can have more than one oxidation number in their oxides.
8. Which of the following molecular formulae can represent an alkanonic acid ?
- CH_2O
 - $\text{C}_2\text{H}_6\text{O}_2$
 - $\text{C}_4\text{H}_8\text{O}_2$
 - $\text{C}_4\text{H}_{10}\text{O}_2$
9. **X**, **Y** and **Z** are different metals. When they are placed separately in $\text{NaCl}(\text{aq})$, only **Y** gives colourless gas bubbles. When each of their oxides is heated strongly, only the oxide of **X** gives a colourless gas. Which of the following shows the decreasing order of reactivity of these three metals ?
- $\text{Y} > \text{Z} > \text{X}$
 - $\text{X} > \text{Y} > \text{Z}$
 - $\text{Y} > \text{X} > \text{Z}$
 - $\text{Z} > \text{Y} > \text{X}$
10. Which of the following reagents does NOT react with copper ?
- 2 M H_2SO_4
 - 2 M HNO_3
 - 16 M H_2SO_4
 - 16 M HNO_3

11. Consider the solutions **W**, **X**, **Y** and **Z** below :

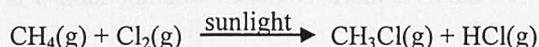
W	100 cm ³ of 0.20 M HNO ₃ (aq)
X	50 cm ³ of 0.20 M HCl(aq)
Y	100 cm ³ of 0.20 M CH ₃ CO ₂ H(aq)
Z	50 cm ³ of 0.10 M NaOH(aq)

Which of the following statements is correct ?

- A. The pH of **Y** equals $-\log 0.2$.
 B. Mixing **W** and **Z** gives a neutral solution.
 C. The pH of the mixture of **W** and **X** is lower than that of **W**.
 D. The pH of the mixture of **W** and **X** is lower than that of the mixture of **X** and **Y**.
12. Which of the following is NOT a redox reaction ?

- A. $2\text{Mg} + \text{SO}_2 \rightarrow 2\text{MgO} + \text{S}$
 B. $\text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2$
 C. $\text{Cu}_2\text{O} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{Cu} + \text{H}_2\text{O}$
 D. $3\text{CuS} + 8\text{HNO}_3 \rightarrow 3\text{CuSO}_4 + 8\text{NO} + 4\text{H}_2\text{O}$

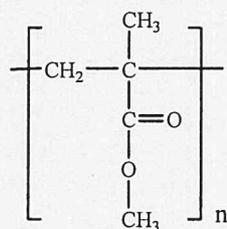
13. The reaction below involves several steps.



Which of the following steps can lead to a termination of the reaction ?



- A. $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
 B. $\text{CH}_3\cdot + \text{Cl}\cdot \rightarrow \text{CH}_3\text{Cl}$
 C. $\text{CH}_4 + \text{Cl}\cdot \rightarrow \text{CH}_3\cdot + \text{HCl}$
 D. $\text{CH}_3\cdot + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$
14. A polymer has the following structure :



Which of the following statements concerning the polymer is correct ?

- A. It is a polyester.
 B. It can be polymerised from $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_3$.
 C. Its monomer can decolourise acidified $\text{KMnO}_4(\text{aq})$.
 D. It can be made from its monomer through condensation.

15. The diagram below shows an apparatus :



- Which of the following mixtures can be separated by this apparatus ?
- A. rock salt and sand
 - B. propan-2-ol and water
 - C. hexane (C_6H_{14}) and water
 - D. methanoic acid and ethanoic acid
16. Which of the following molecules is / are non-polar ?
- (1) BCl_3
 - (2) PCl_3
 - (3) $CHCl_3$
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
17. Which of the following statements is / are correct ?
- (1) The density of $H_2O(l)$ is lower than that of $H_2O(g)$.
 - (2) When ice changes to water, the open structure of ice collapses.
 - (3) When the temperature of water rises from $10\text{ }^\circ\text{C}$ to $30\text{ }^\circ\text{C}$, the average distance between H_2O molecules increases.
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only

18. Consider the following information :



Which of the following statements is / are correct ?

- (1) The standard enthalpy change of formation of $\text{H}_2\text{O}(\text{l})$ is $-0.5x \text{ kJ mol}^{-1}$.
- (2) The standard enthalpy change of formation of $\text{H}_2\text{O}(\text{l})$ is $+0.5x \text{ kJ mol}^{-1}$.
- (3) The standard enthalpy change of combustion of $\text{H}_2(\text{g})$ is $-x \text{ kJ mol}^{-1}$.

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

19. In an experiment, marble is heated in a boiling tube and the gas evolved is passed into a test tube with limewater. Which of the following statements concerning the experiment is / are correct ?

- (1) The marble turns brick red upon heating.
- (2) The limewater turns milky initially but eventually becomes a colourless solution.
- (3) If marble is replaced by chalk, a similar observation would be obtained.

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

20. Which of the following hazard warning labels should be displayed on a bottle containing propan-2-ol ?



(1)



(2)



(3)

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

21. Which of the following statements concerning a zinc-carbon cell is / are INCORRECT ?

- (1) The graphite rod is inserted in a mixture of graphite powder and MnO_2 .
- (2) Potassium hydroxide acts as an electrolyte.
- (3) Ammonia forms around the cathode.

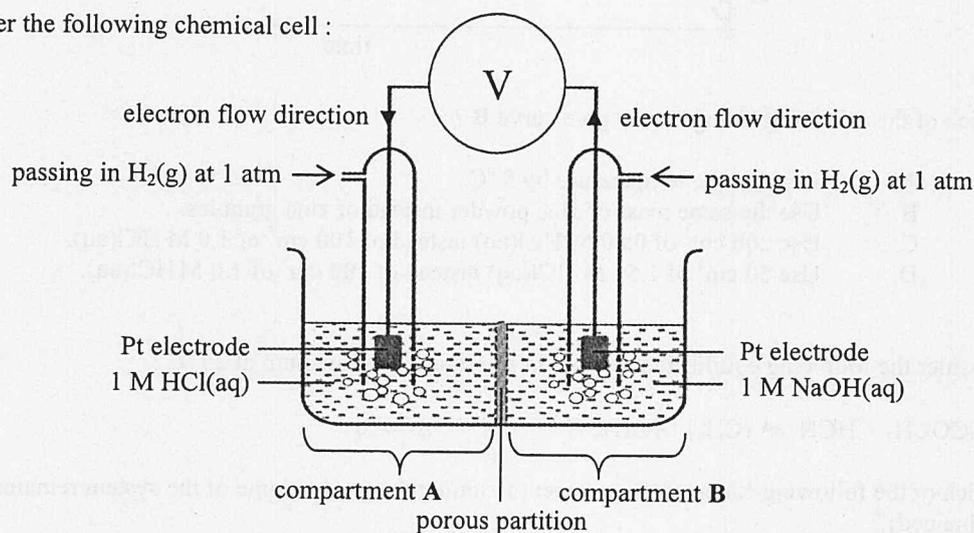
- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

22. Which of the following processes are endothermic ?

- (1) melting of wax
- (2) cracking of heavy oil
- (3) adding zinc powder to $\text{CuSO}_4(\text{aq})$

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

23. Consider the following chemical cell :



Which of the following statements are correct ?

- (1) The pH of the solution in compartment A decreases gradually.
- (2) Hydrogen gas in compartment B acts as a reducing agent.
- (3) The equation for the overall reaction is : $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

24. Consider the following statements and choose the best answer :

1st statement

To completely neutralise 1 mole of $\text{HCl}(\text{aq})$, the number of moles of $\text{NH}_3(\text{aq})$ needed is more than the number of moles of $\text{KOH}(\text{aq})$ needed.

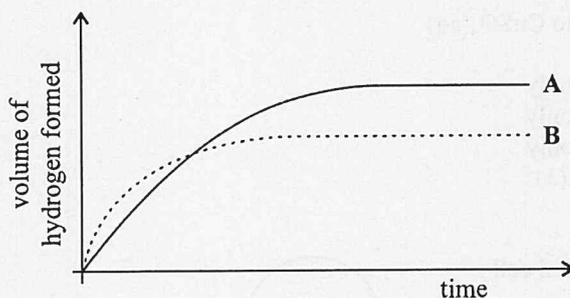
2nd statement

$\text{NH}_3(\text{aq})$ is a weaker alkali than $\text{KOH}(\text{aq})$.

- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
- B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
- C. The 1st statement is false but the 2nd statement is true.
- D. Both statements are false.

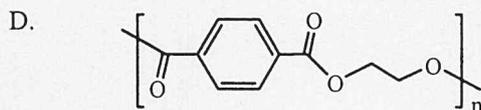
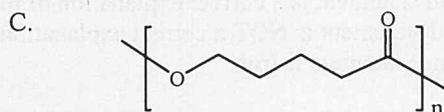
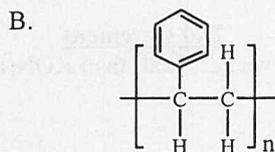
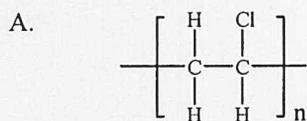
PART II

25. 100 cm³ of 1.0 M HCl(aq) reacts with excess zinc granules giving curve A in the graph below.



Which of the following changes may give curve B ?

- A. Increase the temperature by 5 °C.
 B. Use the same mass of zinc powder instead of zinc granules.
 C. Use 200 cm³ of 0.80 M HCl(aq) instead of 100 cm³ of 1.0 M HCl(aq).
 D. Use 50 cm³ of 1.50 M HCl(aq) instead of 100 cm³ of 1.0 M HCl(aq).
26. Consider the following equilibrium system in a certain liquid medium at 25 °C :
- $$\text{CH}_3\text{COCH}_3 + \text{HCN} \rightleftharpoons (\text{CH}_3)_2\text{C}(\text{OH})\text{CN} \quad \Delta H > 0$$
- Which of the following statements is correct (assuming the total volume of the system remains unchanged) ?
- A. Adding (CH₃)₂C(OH)CN would increase the equilibrium constant K_c .
 B. Increasing the temperature would increase the concentration of (CH₃)₂C(OH)CN.
 C. The concentration of CH₃COCH₃ must be equal to the concentration of (CH₃)₂C(OH)CN.
 D. After adding HCN and when a new equilibrium is attained, the concentration of HCN would be restored to the value before the addition of HCN.
27. Which of the following polymers is commonly used to make drainage pipes ?



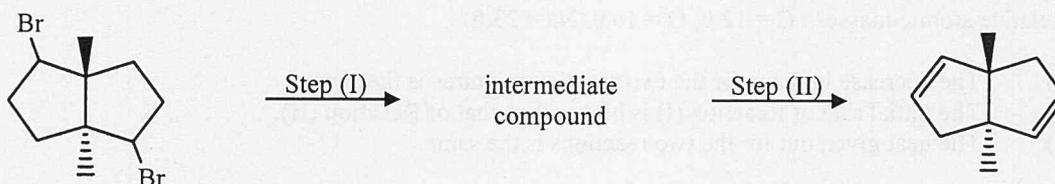
28. Which of the following statements is correct ?

- A. The boiling point of argon is lower than that of neon.
- B. The boiling point of nitrogen is lower than that of oxygen.
- C. The melting point of silicon is lower than that of sodium.
- D. The melting point of aluminium is lower than that of magnesium.

29. The equilibrium constant K_c for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at $70\text{ }^\circ\text{C}$ is 0.13 mol dm^{-3} . In a 5.0 dm^3 closed container kept at $70\text{ }^\circ\text{C}$, there is a mixture of 0.20 mol of $N_2O_4(g)$ and 0.30 mol of $NO_2(g)$ at a certain moment. Which of the following combinations is correct at that moment ?

	Reaction quotient $Q_c / \text{mol dm}^{-3}$	Rate of the reaction
A.	0.09	backward > forward
B.	0.09	forward > backward
C.	0.45	backward > forward
D.	0.45	forward > backward

30. Consider the following conversion :



Which of the following combinations can achieve the above conversion ?

	Reagent used in Step (I)	Reagent used in Step (II)
A.	aqueous ammonia	dilute sulphuric acid
B.	aqueous potassium hydroxide	dilute sulphuric acid
C.	aqueous ammonia	concentrated sulphuric acid
D.	aqueous potassium hydroxide	concentrated sulphuric acid

31. Which of the following compounds CANNOT form condensation polymers ?

- (1) $H_2N(CH_2)_5CO_2H$
- (2) $CH_3CO_2CH=CH_2$
- (3) $CH_3CH(OH)CO_2H$

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

32. Which of the following processes can illustrate the characteristics of transition metals ?

- (1) mixing $\text{AgNO}_3(\text{aq})$ and $\text{NaCl}(\text{aq})$
- (2) mixing $\text{FeSO}_4(\text{aq})$ and $\text{Br}_2(\text{aq})$
- (3) mixing $\text{CuSO}_4(\text{s})$ and $\text{H}_2\text{O}(\text{l})$

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

33. Consider the following two reactions :

Reaction	Reactants
(I)	1.0 g of $\text{Na}_2\text{CO}_3(\text{s})$ + 100.0 cm^3 of 1.0 M $\text{HCl}(\text{aq})$
(II)	1.0 g of $\text{Na}_2\text{CO}_3(\text{s})$ + 100.0 cm^3 of 1.0 M $\text{CH}_3\text{COOH}(\text{aq})$

Which of the following statements are correct if the two reactions are performed under the same experimental conditions ?

(Relative atomic masses : C = 12.0, O = 16.0, Na = 23.0)

- (1) The decrease in mass for the two reaction mixtures is the same.
- (2) The initial rate of Reaction (I) is higher than that of Reaction (II).
- (3) The heat given out for the two reactions is the same.

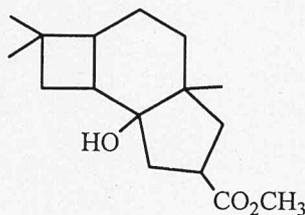
- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

34. Which of the following statements concerning soap are correct ?

- (1) Soap is an ester.
- (2) Soap can reduce the surface tension of water.
- (3) Soap particles consist of both hydrophobic and hydrophilic parts.

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

35. An organic compound has the following structure :



Which of the following statements concerning this compound are correct ?

- (1) It has an ester group.
- (2) It contains at least one chiral centre.
- (3) It reacts with acidified sodium dichromate solution to form a ketone.

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

36. Consider the following statements and choose the best answer :

1st statement

The molar volume of bromine is larger than that of fluorine at room temperature and pressure.

2nd statement

The molecular size of bromine is larger than that of fluorine.

- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
- B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
- C. The 1st statement is false but the 2nd statement is true.
- D. Both statements are false.

END OF SECTION A

Please stick the barcode label here.

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. Lithium occurs naturally in two isotopes, ${}^6\text{Li}$ and ${}^7\text{Li}$. It can form lithium nitride (Li_3N) when burnt in air.

(a) (i) Calculate the percentage abundance of ${}^6\text{Li}$ in nature.
(Relative atomic mass: $\text{Li} = 6.9$)

(ii) Draw the electron diagram for lithium nitride, *showing electrons in the outermost shells only.*

(3 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

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1. (b) In an experiment, 1.25 g of lithium nitride is formed when a piece of lithium is burnt in air.

(i) Write a chemical equation for the reaction involved.

(ii) Calculate the mass of lithium that reacted with nitrogen.
(Relative atomic masses: Li = 6.9, N = 14.0)

(3 marks)

(c) Name another compound which will also be formed when lithium is burnt in air.

(1 mark)

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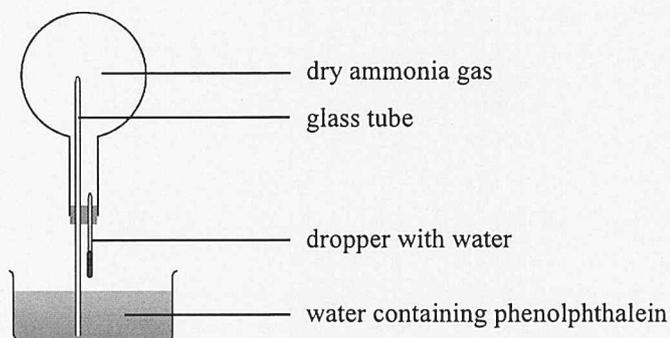
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2. This question involves the preparation of ammonia gas and the investigation of the properties of ammonia gas in a laboratory.

- (a) Solid calcium hydroxide reacts with solid ammonium chloride to form ammonia gas. Draw a labelled diagram to show the set-up involved and how ammonia gas is collected.

(2 marks)

- (b) An experiment was performed to investigate the properties of ammonia gas with the set-up shown below :



The round-bottomed flask was initially full of dry ammonia gas. Several drops of water were injected into the flask from the dropper. The water containing phenolphthalein was then automatically sucked into the flask through the glass tube.

- (i) Briefly explain why the water containing phenolphthalein was sucked into the flask.

- (ii) State, with explanation, an observation related to phenolphthalein in the flask.

(4 marks)

Answers written in the margins will not be marked.

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3. (a) Explain whether BaCl_2 or OCl_2 would have a higher melting point.

(2 marks)

(b) Explain the following decreasing order of the boiling points of three substances :



(3 marks)

(c) Draw a three-dimensional diagram to represent the molecular shape of SF_6 .

(1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

4. Petroleum is an important source of hydrocarbons.

(a) Describe the origin of petroleum.

(2 marks)

(b) **D**, **E** and **F** are isomeric alkenes containing four carbon atoms. **D** and **E** are *cis-trans* isomers.

(i) Draw the structure of **E** (*trans*-isomer).

(ii) State the systematic name of one possible structure of **F**.

(2 marks)

(c) Ethene and ethane are hydrocarbons.

(i) Suggest how ethene can be converted to ethane.

(ii) Suggest a chemical test to distinguish between ethane and ethene.

(3 marks)

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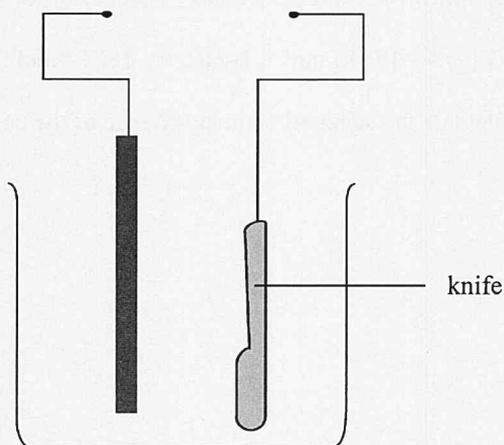
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5. Electroplating and rust prevention are common applications of electrochemistry.

- (a) The diagram below shows an incomplete set-up. Add suitable drawings and labels to the diagram for electroplating of silver onto the knife.



(2 marks)

- (b) Suggest a method, besides painting or electroplating, that can prevent underground iron-made pipelines from rusting. Explain your answer.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

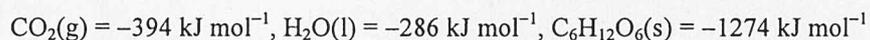
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6. Energy exists in various forms.

(a) Glucose ($C_6H_{12}O_6$) is one important energy source for living things.

(i) Write a chemical equation for the conversion of carbon dioxide gas and liquid water to solid glucose and oxygen gas.

(ii) The following standard enthalpy changes of formation are given :



Calculate the standard enthalpy change of the conversion in (i) above.

(iii) Green plants can convert carbon dioxide and water to glucose and oxygen. State the transformation of energy in this conversion.

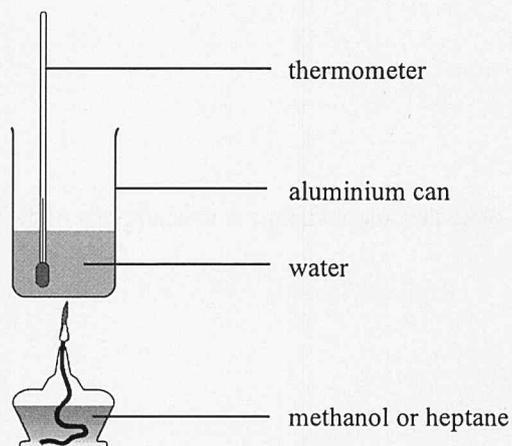
(4 marks)

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Answers written in the margins will not be marked.

6. (b) Burning heptane (C_7H_{16}) releases energy. The enthalpy change of combustion of heptane was determined using the set-up shown below :



Step (I) : The aluminium can with a fixed mass of water was heated by burning methanol. The temperature of water increased by $18.5\text{ }^{\circ}\text{C}$ after 1.58 g of methanol was burnt.

Step (II) : The aluminium can with the same mass of water in Step (I) was heated by burning heptane. The temperature of water increased by $25.8\text{ }^{\circ}\text{C}$ after 1.02 g of heptane was burnt.

- (i) Given that, under the conditions of experiment, the enthalpy change of combustion of methanol is -715 kJ mol^{-1} , calculate the enthalpy change of combustion of heptane, in kJ mol^{-1} , under the same conditions.
(Relative molecular masses: methanol = 32.0, heptane = 100.0)

- (ii) Besides heat loss, suggest another source of error in the experiment.

(4 marks)

Answers written in the margins will not be marked.

7. An experiment was performed to determine the number of water of crystallisation, n , in a sample of hydrated sodium tetraborate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot n\text{H}_2\text{O}$). 0.452 g of the sample was dissolved completely in about 50 cm^3 of deionised water in an apparatus **X**. The solution obtained was alkaline and was immediately titrated in **X** with 0.125 M $\text{HCl}(\text{aq})$ using methyl orange as an indicator. It required 18.98 cm^3 of the acid to reach the end point.

(a) Name **X**.

(1 mark)

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

(1 mark)

(c) It is known that in the reaction during the titration, the mole ratio of $\text{B}_4\text{O}_7^{2-}(\text{aq})$ to $\text{H}^+(\text{aq})$ is 1 : 2. Calculate the number of water of crystallisation, n .
(Relative atomic masses: $\text{H} = 1.0$, $\text{B} = 10.8$, $\text{O} = 16.0$, $\text{Na} = 23.0$)

(3 marks)

7. (d) It is known that hydrated sodium tetraborate can be used to prepare standard solutions.

(i) What is meant by the term 'standard solutions' ?

(ii) Suggest one use of standard solutions.

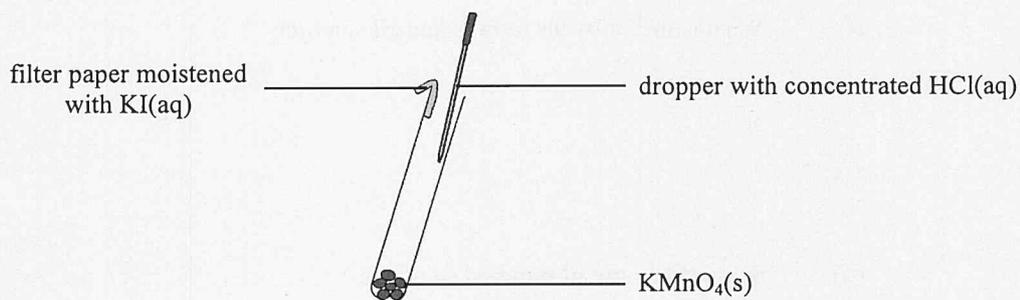
(2 marks)

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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

8. Refer to the experimental set-up as shown below.



(a) HCl is a strong acid. What is meant by the term 'strong acid' ?

(1 mark)

(b) When concentrated HCl(aq) is dropped into KMnO₄(s), a yellowish green gas is formed.

(i) What is the yellowish green gas ?

(ii) Explain whether the reaction forming the yellowish green gas is a redox reaction.

(2 marks)

(c) With the aid of an ionic equation, state the expected observation when the yellowish green gas reaches the filter paper.

(2 marks)

(d) In consideration of laboratory safety, explain where the experiment should be performed.

(1 mark)

Answers written in the margins will not be marked.

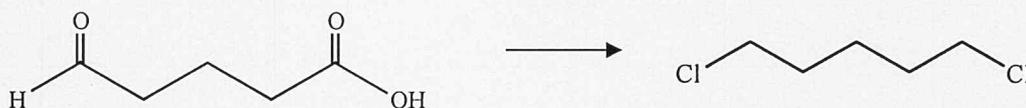
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PART II

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

10. 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 structure of the organic product.



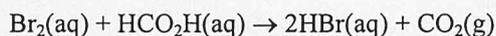
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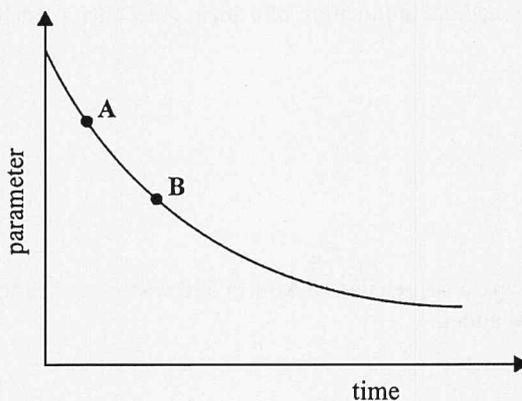
(3 marks)

Answers written in the margins will not be marked.

11. Consider the following reaction :



In an experiment to study the rate of consumption of $\text{Br}_2(\text{aq})$, equal volumes of 0.01 M $\text{Br}_2(\text{aq})$ and 1.0 M $\text{HCO}_2\text{H}(\text{aq})$ were mixed. The progress of the reaction was followed by measuring a certain parameter of the reaction system using a colorimeter. The graph below shows the results from the start of the reaction.



- (a) Assume that the rate of change of the parameter with time can represent the rate of reaction.
- (i) According to the shape of the curve above, suggest what the parameter should be.
- (ii) The initial rate of the reaction can be determined by a suitable sketch on the above graph. Draw the suitable sketch on the above graph, and describe how the initial rate of the reaction can be obtained from the sketch.
- (iii) According to the graph above, the rate of reaction at A is higher than that at B. Explain this at molecular level.

(5 marks)

- (b) Suggest another method that can follow the progress of the reaction.

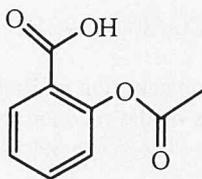
(1 mark)

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12. Aspirin is a pain-killer. Its structure is shown below :



(a) State one medical application of aspirin other than pain-killing.

(1 mark)

(b) Explain why a suspension of aspirin and water can become clear when sodium hydrogencarbonate powder is added.

(2 marks)

(c) Heating aspirin with excess dilute aqueous acid under reflux will give two organic products.

(i) Draw the structures of these two organic products.

Answers written in the margins will not be marked.

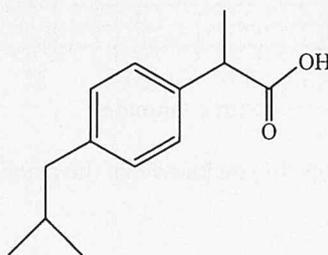
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12. (c) (ii) Explain why the conversion of aspirin to these two organic products can hardly reach 100% even though the mixture of aspirin and dilute acid is heated under reflux for a long time.

(3 marks)

- (d) Ibuprofen is also a pain-killer. Its structure is shown below :



There exists enantiomerism in ibuprofen. Draw the three-dimensional structures for the pair of enantiomers.

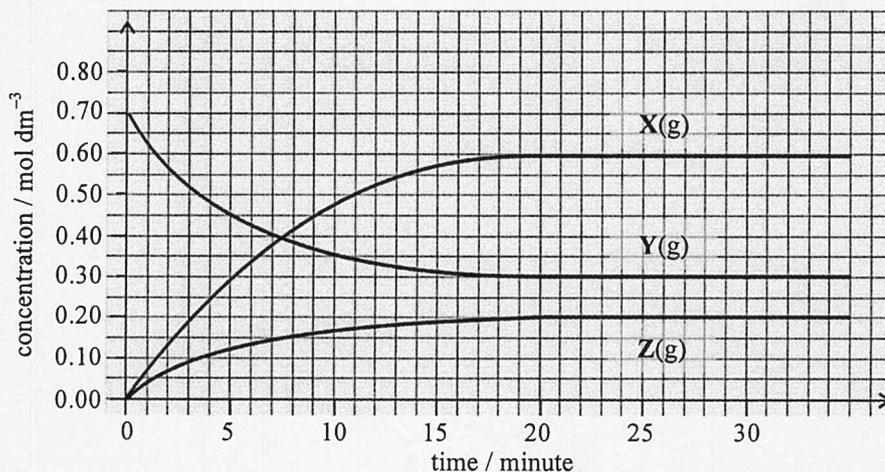
(2 marks)

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13. An experiment was performed for a reversible reaction involving X(g), Y(g) and Z(g) in a closed container of 2.0 dm³ at a constant temperature. The graph below shows the relevant experimental data.



- (a) According to the graph, how do you know that the reaction is reversible ?

(1 mark)

- (b) Calculate the equilibrium constant K_c for the reaction at the temperature of the experiment.

(3 marks)

- (c) Comment on the following statement :

'The rate of the forward reaction is zero at the 25th minute after the start of the reaction.'

(1 mark)

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Answers written in the margins will not be marked.

PERIODIC TABLE 周期表

GROUP 族

		atomic number 原子序		relative atomic mass 相對原子質量																	
		1		2		3		4		5		6		7		8		9		10	
		H 1.0		He 4.0		Li 6.9		Be 9.0		B 10.8		C 12.0		N 14.0		O 16.0		F 19.0		Ne 20.2	
		11		12		13		14		15		16		17		18		19		20	
		Na 23.0		Mg 24.3		Al 27.0		Si 28.1		P 31.0		S 32.1		Cl 35.5		Ar 40.0		K 39.1		Ca 40.1	
		19		20		21		22		23		24		25		26		27		28	
		K		Ca		Sc		Ti		V		Cr		Mn		Fe		Co		Ni	
		37		38		39		40		41		42		43		44		45		46	
		Rb		Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh		Pd	
		85.5		87.6		88.9		91.2		92.9		95.9		(98)		101.1		102.9		106.4	
		55		56		57 *		72		73		74		75		76		77		78	
		Cs		Ba		La		Hf		Ta		W		Re		Os		Ir		Pt	
		132.9		137.3		138.9		178.5		180.9		183.9		186.2		190.2		192.2		195.1	
		87		88		89 **		104		105											
		Fr		Ra		Ac		Rf		Db											
		(223)		(226)		(227)		(261)		(262)											

		68		69		70		71	
		Er		Tm		Yb		Lu	
		167.3		168.9		173.0		175.0	
		67		66		65		64	
		Ho		Dy		Tb		Gd	
		164.9		162.5		158.9		157.3	
		99		98		97		96	
		Es		Cf		Bk		Cm	
		(252)		(251)		(247)		(247)	
		63		62		61		60	
		Eu		Sm		Pm		Nd	
		152.0		150.4		(145)		144.2	
		95		94		93		92	
		Am		Pu		Np		U	
		(243)		(244)		(237)		238.0	
		58		59		58		57	
		Ce		Pr		Ce		La	
		140.1		140.9		140.1		138.9	
		90		91		90		89	
		Th		Pa		Th		Ac	
		232.0		(231)		232.0		(227)	

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