

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.

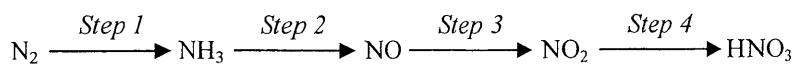
Choose the best answer for each question.

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

PART I

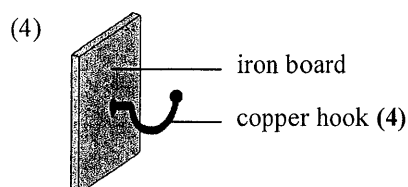
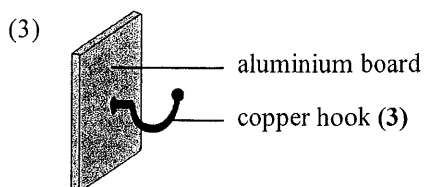
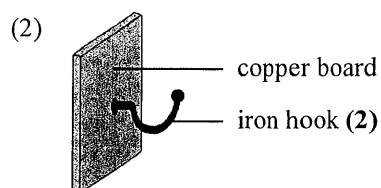
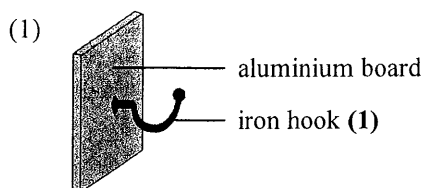
- Which of the following statements is correct ?
 - All aqueous solutions contain $H^+(aq)$ ions.
 - The pH of all acid solutions is greater than zero.
 - All acidic compounds contain hydrogen as their constituent elements.
 - A 'corrosive' hazard warning label must be displayed on all reagent bottles containing acid solution.
- Which of the following processes would NOT give oxygen ?
 - heating mercury(II) oxide strongly
 - electrolysis of dilute sulphuric acid
 - fractional distillation of liquefied air
 - passing steam over heated magnesium
- Element **Q** belongs to Group II of the Periodic Table. It combines with element **R** to give an ionic compound with chemical formula Q_3R_2 . Which group of the Periodic Table does **R** belong to ?
 - Group III
 - Group V
 - Group VI
 - Group VII
- Which of the following salts CANNOT be prepared from the reaction of a metal with a dilute acid ?
 - zinc sulphate
 - iron(II) chloride
 - calcium chloride
 - copper(II) sulphate
- A gel containing $NaCl(aq)$, $K_3Fe(CN)_6(aq)$ and phenolphthalein is yellow in colour. An iron nail is put into the gel and corrodes after a period of time. Which of the following colours would NOT be observed in the gel after the iron nail corrodes ?
 - blue
 - pink
 - grey
 - yellow

6. The conversion of nitrogen gas to nitric acid involves the following steps :



In which step is nitrogen reduced ?

- A. Step 1
 B. Step 2
 C. Step 3
 D. Step 4
7. Consider the following set-ups :



Which hook would corrode first ?

- A. iron hook (1)
 B. iron hook (2)
 C. copper hook (3)
 D. copper hook (4)
8. In an experiment, 25.0 cm³ of HCl(aq) is measured with apparatus X and is placed in apparatus Y. The HCl(aq) in Y is then titrated with a standard NaOH(aq). Which of the following combinations is correct ?

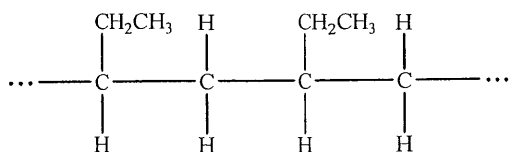
	<u>X</u>	<u>Y</u>
A.	measuring cylinder	beaker
B.	measuring cylinder	conical flask
C.	pipette	beaker
D.	pipette	conical flask

9. In an experiment to prepare calcium sulphate, excess dilute sulphuric acid is added to 10.0 cm³ of 1.0 mol dm⁻³ calcium nitrate solution. Which of the following is the theoretical mass of the calcium sulphate obtained ?

(Relative atomic masses: O = 16.0, S = 32.1, Ca = 40.1)

- A. 0.68 g
 B. 1.36 g
 C. 2.72 g
 D. 4.08 g

10. The structure of a certain polymer is shown below :

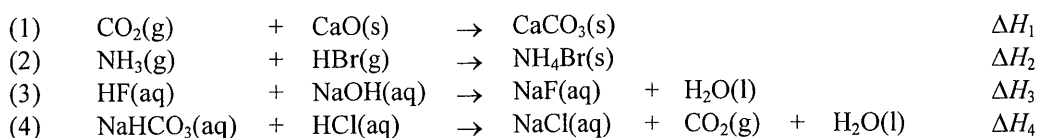


Which of the following is the systematic name of the monomer of this polymer ?

- A. propene
 B. but-1-ene
 C. but-2-ene
 D. methylpropene
11. In the species below, the underlined atom is the central atom, and all non-central atoms have octet electronic arrangement. In which of them does the central atom NOT have octet electronic arrangement ?

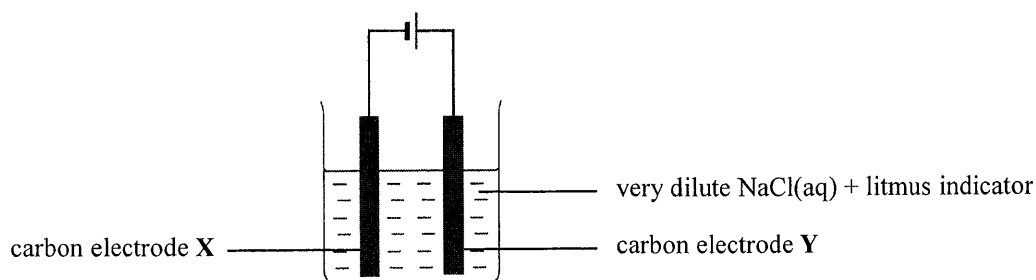
- A. SF₂
 B. CF₂
 C. CS₂
 D. NCl₃

12. Consider the following reactions :



Which of the following represents enthalpy change of neutralisation ?

- A. ΔH₁
 B. ΔH₂
 C. ΔH₃
 D. ΔH₄
13. An electrolysis experiment is conducted using the set-up shown below :



What are the expected colours around X and Y after the experiment has been conducted for some time ?

- | | | | |
|----|----------|--|----------|
| | <u>X</u> | | <u>Y</u> |
| A. | yellow | | red |
| B. | red | | blue |
| C. | blue | | red |
| D. | red | | yellow |

14. Consider the following information concerning metals **W**, **X**, **Y** and **Z** :

- (1) Heating oxide of **W** gives metal **W**.
- (2) Heating metal **X** in steam gives a colourless gas.
- (3) Putting metal **Y** in $\text{CH}_3\text{CO}_2\text{H}(\text{aq})$ gives a colourless gas.
- (4) Putting metal **Z** in $\text{CuSO}_4(\text{aq})$ gives a reddish-brown solid.

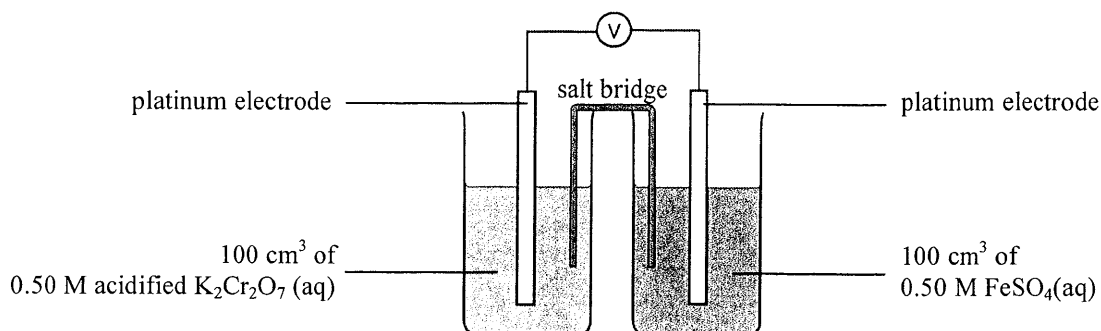
Which of these metals has the lowest reactivity ?

- A. **W**
- B. **X**
- C. **Y**
- D. **Z**

15. Which of the following statements concerning 'atom' is correct ?

- A. All atoms do not carry net charges.
- B. Mass is evenly distributed within an atom.
- C. All atoms consist of protons, neutrons and electrons.
- D. For all elements, atoms of the same element have the same mass number.

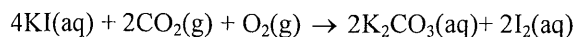
16. Consider the following set-up at the start of an experiment :



After a period of time, the concentration of $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq})$ drops to 0.47 M. What is the concentration of $\text{FeSO}_4(\text{aq})$ at that time ?

- A. 0.53 M
- B. 0.47 M
- C. 0.41 M
- D. 0.32 M

17. An aqueous solution of potassium iodide turns yellow with time due to the following reaction :



Which of the following statements concerning the above reaction is / are correct ?

- (1) $\text{KI}(\text{aq})$ is oxidised by $\text{O}_2(\text{g})$.
- (2) $\text{KI}(\text{aq})$ is oxidised by $\text{CO}_2(\text{g})$.
- (3) The yellow colour is due to the $\text{K}_2\text{CO}_3(\text{aq})$ formed.

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

18. Which of the following combinations is / are correct ?

	<u>Chemical reaction</u>	<u>Enthalpy change of reaction</u>
(1)	$2\text{H}_2\text{O}(l) \rightarrow 2\text{H}_2(g) + \text{O}_2(g)$	positive
(2)	$2\text{CO}(g) + \text{O}_2(g) \rightarrow 2\text{CO}_2(g)$	positive
(3)	$2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$	negative

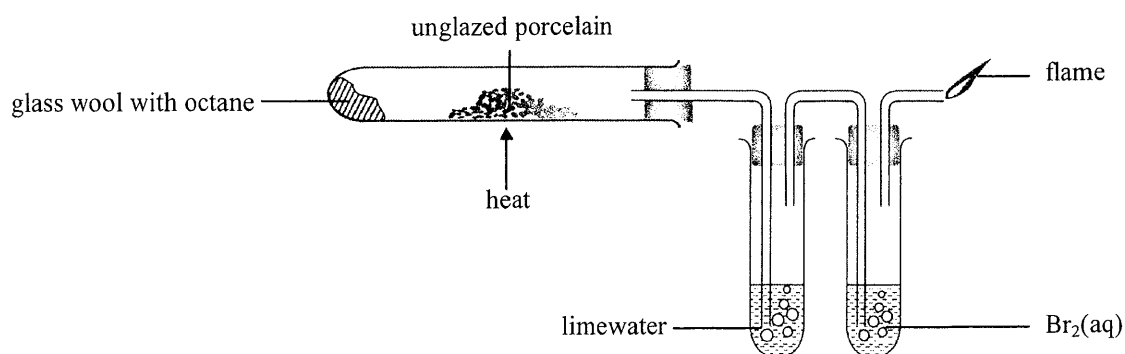
- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

19. Which of the following pairs of substances can be distinguished by using acidified $\text{KMnO}_4(\text{aq})$?

- (1) pent-1-ene and pent-2-ene
- (2) cyclohexane and cyclohexene
- (3) polyethene and poly(chloroethene)

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

20. The set-up of an experiment is shown below :



Which of the following observations would be expected ?

- (1) Limewater turns milky.
- (2) $\text{Br}_2(\text{aq})$ changes from brown to colourless.
- (3) The flame is brick red in colour.

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

21. Which of the following observations would be expected when some calcium granules are put in cold water inside a test tube ?
- (1) A cloudy mixture is formed.
 (2) The test tube becomes warm.
 (3) Colourless gas bubbles are formed.
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)
22. Which of the following are renewable energy sources ?
- (1) nuclear energy
 (2) tidal energy
 (3) biomass
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)
23. Which of the following can distinguish a sample of limestone powder from a sample of table salt ?
- (1) adding water
 (2) performing a flame test
 (3) adding dilute hydrochloric acid
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)

Directions : Question 24 consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table :

- 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.

- | 1st statement | 2nd statement |
|---|---|
| 24. The boiling point of H ₂ O is lower than that of HF. | The electronegativity of oxygen is lower than that of fluorine. |

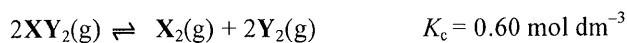
PART II

25. Which of the following statements concerning the Periodic Table is correct ?
- A. The melting point of the Group I elements increases down the group.
 - B. The boiling point of the Group VII elements increases down the group.
 - C. The elements are arranged in the order of increasing relative atomic mass.
 - D. The electrical conductivity of the third period elements increases from left to right.

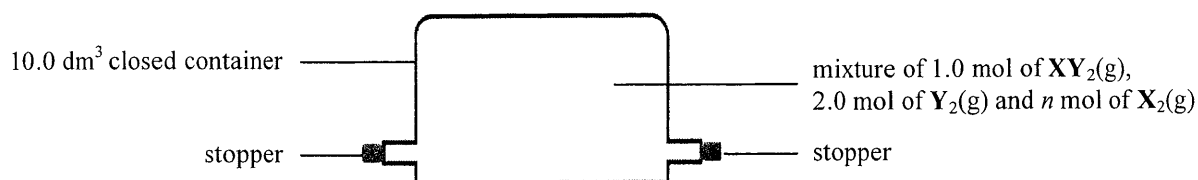
26. How many geometrical isomers does $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}_3$ have ?

- A. 0
- B. 2
- C. 3
- D. 4

27. Consider the following reaction at a certain temperature :



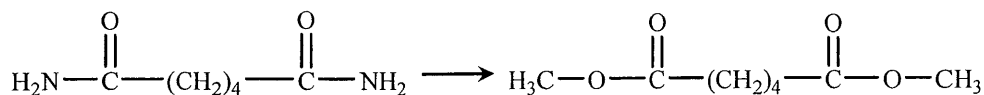
An equilibrium mixture was obtained at this temperature as shown below :



What is n ?

- A. 1.5
 - B. 3.0
 - C. 0.15
 - D. 0.30
28. Which of the following pairs of chemicals, upon mixing under the same temperature, has the highest rate of gas formation ?
- A. 0.10 g of Zn powder and 100 cm³ of 1.0 M HCl(aq)
 - B. 0.10 g of Zn granules and 200 cm³ of 1.0 M HCl(aq)
 - C. 0.10 g of Zn granules and 200 cm³ of 1.0 M H₂SO₄(aq)
 - D. 0.10 g of Zn powder and 100 cm³ of 1.0 M H₂SO₄(aq)

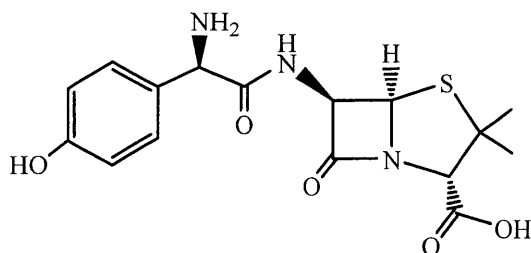
29. Consider the following conversion :



Which of the following combinations of reagents can achieve the above conversion ?

- A. NaOH(aq) and CH₃OH(l)
- B. CH₃OH(l) and CH₃COOH(l)
- C. NaOH(aq), H₂SO₄(aq) and CH₃OH(l)
- D. H₂SO₄(aq), NaOH(aq) and CH₃COOH(l)

30. The structure of the antibiotic 'amoxicillin' is shown below :



Which of the following functional groups is / are present in amoxicillin ?

- (1) ester
- (2) amide
- (3) hydroxyl

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

31. In a closed container and at a certain temperature, the following equilibrium was attained :

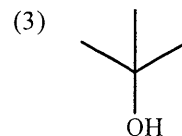
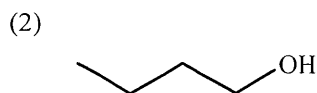
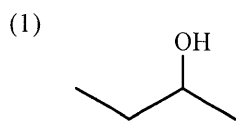


Which of the following statements is / are correct ?

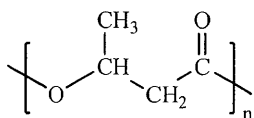
- (1) CO(g) and Cl₂(g) must be of the same concentration.
- (2) The rate of decomposition of COCl₂(g) is equal to the rate of formation of CO(g).
- (3) The equilibrium constant K_c for the reaction increases when the volume of the container increases.

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

32. Which of the following compounds can react with acidified potassium dichromate solution to form a ketone ?



- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only
33. Consider the following equilibrium reaction system in a closed container of fixed volume :
- $$\text{CO(g)} + \text{H}_2\text{O(g)} \rightleftharpoons \text{CO}_2\text{(g)} + \text{H}_2\text{(g)} \quad \Delta H < 0$$
- Which of the following, when applied to the system, would lead to an increase in the rate of formation of $\text{H}_2\text{(g)}$?
- (1) adding CO(g)
(2) increasing the temperature
(3) adding a suitable catalyst
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only
34. A polymer has the structure shown below :



Which of the following statements concerning the polymer is correct ?

- (1) Its intermolecular attraction is predominately hydrogen bond.
(2) The polymer chains can be broken in the presence of dilute hydrochloric acid.
(3) The polymer chains can be broken in the presence of dilute sodium hydroxide solution.
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Directions : Each question below (Questions 35 and 36) consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table :

- 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.

1st statement	2nd statement
35. The melting point of silicon is higher than that of aluminium.	The number of electrons in a silicon atom is greater than that in an aluminium atom.
36. At room conditions, the volume of 1 mol of SO ₂ (g) is larger than that of 1 mol of N ₂ (g).	The number of atoms constituting 1 mol of SO ₂ (g) is greater than that constituting 1 mol of N ₂ (g).

END OF SECTION A

CHEMISTRY PAPER 1
SECTION B : Question-Answer Book B

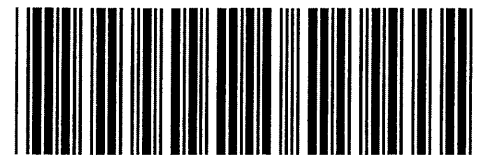
This paper must be answered in English

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



PART I

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

1. Argon and chlorine are elements in the same period of the Periodic Table.

(a) Draw the electron diagram for a molecule of argon, showing *electrons in all shells*.

(1 mark)

(b) What is the type of intermolecular force in chlorine gas ?

(1 mark)

(c) Complete the table below by stating the natural source and the method of extraction from the source for each element.

Element	Natural source	Method of extraction
Argon		
Chlorine		

(4 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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2. For each of the following experiments, state the expected observation, and write the chemical equation(s) for the reaction(s) involved.

(a) passing carbon dioxide gas into limewater until in excess

(3 marks)

(b) adding sodium sulphite solution to acidified potassium dichromate solution until in excess

(2 marks)

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.

3. Aluminium and iron are commonly used construction materials.

(a) Suggest why iron was used earlier than aluminium in history.

(1 mark)

(b) A compound contains iron and oxygen only. In an experiment for determining the empirical formula of this compound, 2.31 g of the compound was heated with carbon monoxide. Upon complete reaction, carbon dioxide and 1.67 g of iron were formed.

(i) Calculate the empirical formula of this compound.

(ii) Write the chemical equation for the reaction involved in the experiment.

(iii) As carbon monoxide is poisonous, suggest one necessary safety precaution in carrying out the experiment.

(4 marks)

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3. (c) Explain why a galvanised iron object does not easily rust even if the zinc layer is broken.

(2 marks)

(d) Explain why anodisation can prevent aluminium objects from corrosion.

(2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

4. Lead-acid accumulator is a secondary cell containing sulphuric acid. It is commonly used in starting up motor vehicle engines.

(a) What is meant by the term 'secondary cell' ?

(1 mark)

(b) Suggest why a lead-acid accumulator is suitable for starting up motor vehicle engines.

(1 mark)

(c) State one environmental impact that would be imposed from the disposal of lead-acid accumulators.

(1 mark)

(d) A student diluted a sample of concentrated sulphuric acid for making a lead-acid accumulator.

(i) Describe how concentrated sulphuric acid can be diluted in a laboratory. State a safety precaution needed during the dilution process.

(ii) 5.00 cm^3 of the solution in the lead-acid accumulator made contains 2.48 g of sulphuric acid. Calculate the molarity of the sulphuric acid in the solution.
(Molar mass of sulphuric acid = 98.1 g)

(5 marks)

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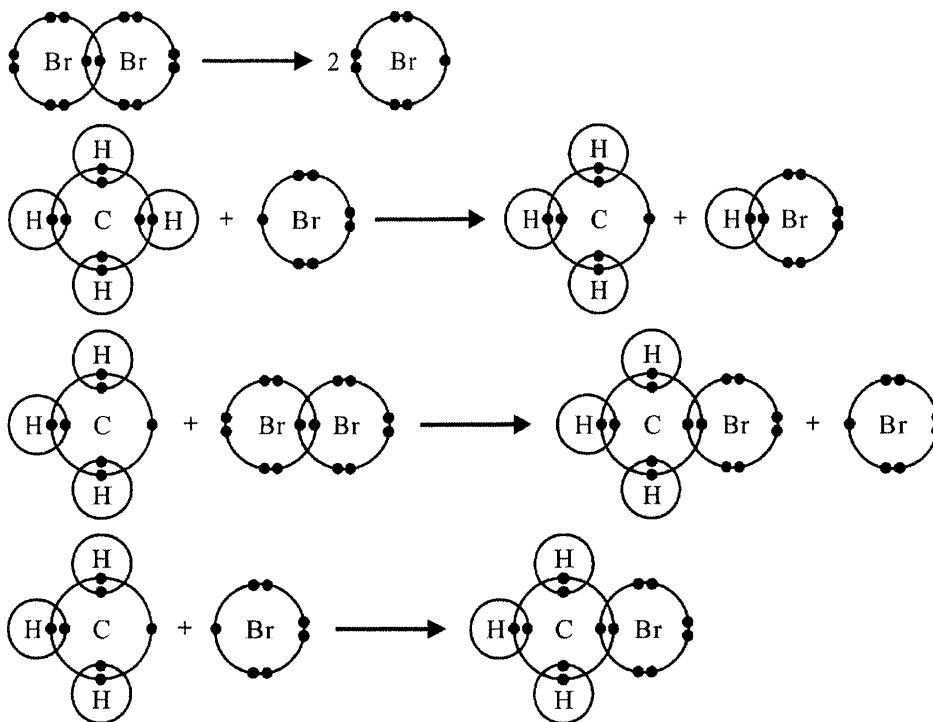
- *5. Explain, with the aid of a chemical equation, why $\text{NH}_3(\text{aq})$ is regarded as a weak alkali. Suggest how you would show that $\text{NH}_3(\text{aq})$ is a weaker alkali than $\text{NaOH}(\text{aq})$ through an experiment. (6 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

6. The steps involved in the reaction of methane with bromine forming CH_3Br can be shown by the following diagram. Only electrons in the outermost shells are shown.



- (a) Name the type of the reaction for the formation of CH_3Br from methane and bromine.

(1 mark)

- (b) State the condition needed for the reaction to occur.

(1 mark)

- (c) State the expected observation for the reaction.


(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.

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6. (d) With reference to its electronic structure, explain why the species  has a high reactivity.

(1 mark)

(e) The reaction of methane with bromine can also form other single-carbon-containing organic compounds.

(i) Suggest one such compound.

(ii) Suggest a condition so that the reaction of methane with bromine can form more CH_3Br but less other organic compounds.

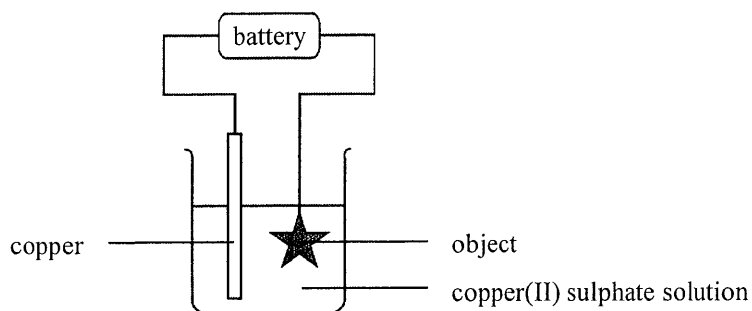
(2 marks)

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Answers written in the margins will not be marked.

7. Refer to the set-up for electroplating an object shown in the diagram below.



(a) Explain why oily dirt on the object should be removed before electroplating.

(1 mark)

(b) Copper(II) sulphate is an electrolyte. What is meant by the term 'electrolyte' ?

(1 mark)

(c) List ALL the ions existing in the solution.

(1 mark)

(d) Explain why copper(II) ions are preferentially discharged during the electroplating process.

(1 mark)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

7. (e) Write the half equation of the change that occurs at the anode.

(1 mark)

(f) State the observable change, if any, in the solution during the electroplating process.

(1 mark)

(g) It is known that 2.28×10^{22} electrons have passed through the external circuit during the electroplating process. Calculate the mass of copper that would theoretically be plated on the object.

(Relative atomic mass: Cu = 63.5; Avogadro's constant = $6.02 \times 10^{23} \text{ mol}^{-1}$)

(2 marks)

Answers written in the margins will not be marked.

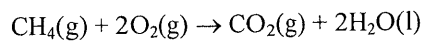
Answers written in the margins will not be marked.

8. Natural gas is an important energy source for electricity generation. It contains mainly methane (CH₄).

(a) Write the general formula of the molecules in the homologous series that methane belongs to.

(1 mark)

(b) The combustion of methane is an exothermic reaction. Its chemical equation is shown below :



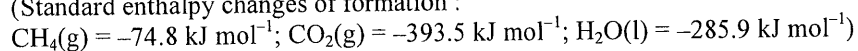
(i) Complete the table below by stating all the covalent bond(s) that are broken and formed during the combustion of methane.

Covalent bond(s) broken	
Covalent bond(s) formed	

(ii) Suggest why the combustion is exothermic in terms of the breaking and forming of covalent bonds.

(iii) Calculate the standard enthalpy change of combustion of methane.

(Standard enthalpy changes of formation :



(5 marks)

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.

Answers written in the margins will not be marked.

8. (c) Some regions tend to generate electricity more by natural gas but less by coal. Give TWO reasons from environmental protection consideration.

(2 marks)

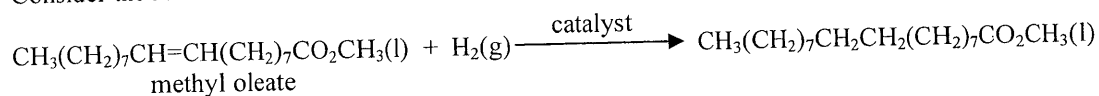
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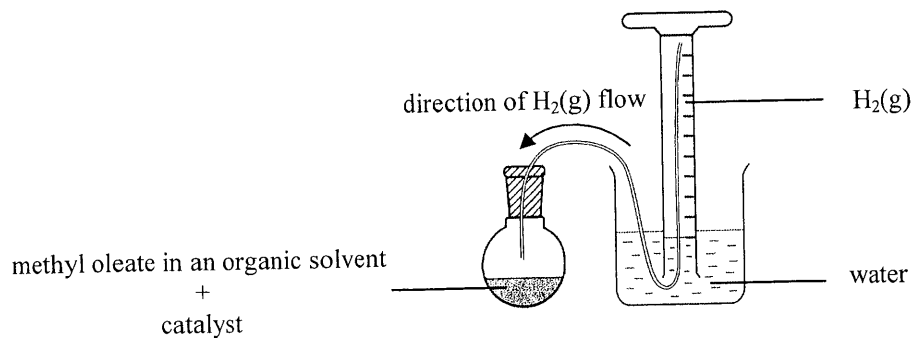
PART II

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

9. Consider the reaction below :



At room temperature and pressure, a micro-scale experiment was performed using the set-up shown below in which 0.080 g of methyl oleate in an organic solvent was allowed to react with excess $\text{H}_2(\text{g})$. The $\text{H}_2(\text{g})$ flowed from the inverted measuring cylinder to the reacting flask through the tubing.



(a) State one advantage of conducting this reaction in a micro-scale experiment.

(1 mark)

(b) Explain why the right end of the tubing was placed at the uppermost position of the inverted measuring cylinder.

(1 mark)

(c) State an expected observation in the inverted measuring cylinder during the reaction.

(1 mark)

Answers written in the margins will not be marked.

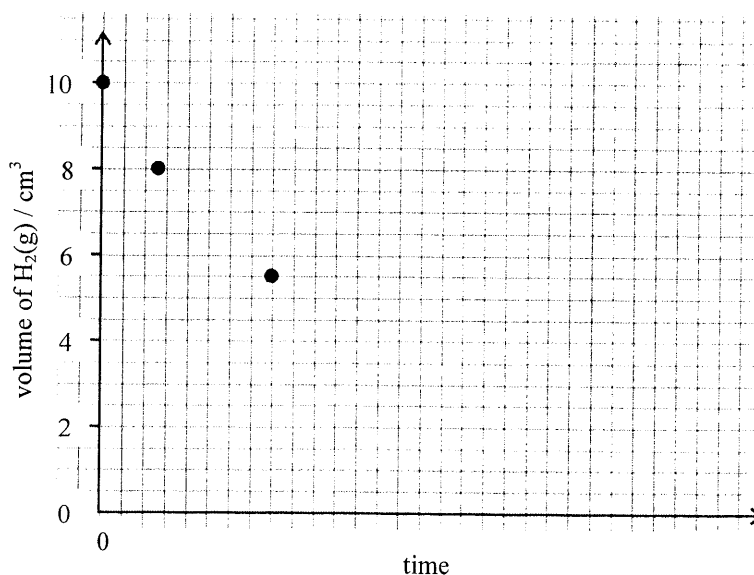
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Answers written in the margins will not be marked.

9. (d) Calculate the theoretical volume of $\text{H}_2(\text{g})$ needed for the reaction to complete at room temperature and pressure.
(Molar volume of gas at room temperature and pressure = 24 dm^3 ;
Relative molecular mass: methyl oleate = 296.0)

(3 marks)

- (e) (i) Sketch, in the graph below, the variation of the volume of $\text{H}_2(\text{g})$ in the measuring cylinder with time from start until the completion of the reaction. You should label this sketch as 'A'. (The measuring cylinder initially contained 10.0 cm^3 of $\text{H}_2(\text{g})$. The first few points have been given in the graph to facilitate the sketch.)



- (ii) In the same graph above, give another sketch as required in (i) but only using 0.040 g of methyl oleate for the reaction while the other conditions remain unchanged. You should label this sketch as 'B'.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

10. (a) For each of the oxides below, draw its electron diagram (*showing electrons in the outermost shells only*), and state its behaviour in water.

(i) Na_2O

(ii) Cl_2O

(4 marks)

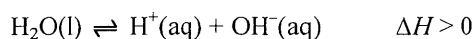
(b) Using iron as an example, illustrate TWO characteristics of transition metals.

(2 marks)

Answers written in the margins will not be marked.

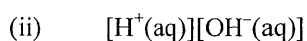
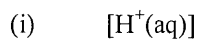
Answers written in the margins will not be marked.

11. Refer to the following chemical equation :



Under fixed conditions, $[\text{H}_2\text{O}(\text{l})]$ is considered as a constant. In consideration of the definition of K_c , $[\text{H}^+(\text{aq})][\text{OH}^-(\text{aq})]$ would also be a constant.

(a) The pH of an aqueous solution is defined as $-\log[\text{H}^+(\text{aq})]$. The pH of water equals 7.0 at 298 K. Find, at this temperature, the :



(3 marks)

(b) $[\text{H}_2\text{O}(\text{l})]$ equals 55.6 mol dm^{-3} at 298 K. Suggest why $[\text{H}_2\text{O}(\text{l})]$ is considered as a constant with reference to the values of $[\text{H}^+(\text{aq})]$ and $[\text{OH}^-(\text{aq})]$.

(1 mark)

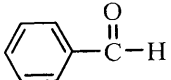
(c) Explain whether the pH of water at 328 K would be less than 7.0, equal to 7.0, or greater than 7.0.

(2 marks)

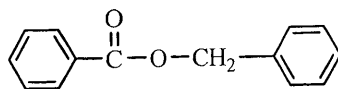
Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

12. You are provided with , inorganic reagents and organic solvents.

Outline a synthetic route, *with no more than three steps*, to obtain the following compound :



For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

(3 marks)

Answers written in the margins will not be marked.

- *13. Using $C_2H_5CH(OH)CH_3$ as an example, write a paragraph to illustrate 'enantiomerism'. Suitable diagram(s) should be included in your answer.

(5 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

END OF SECTION B

END OF PAPER

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										0									
		H 1.0										He 4.0									
I	II																				
3	4																				
Li 6.9	Be 9.0																				
11	12																				
Na 23.0	Mg 24.3																				
19	20																				
K 39.1	Ca 40.1																				
37	38																				
Rb 85.5	Sr 87.6																				
55	56																				
Cs 132.9	Ba 137.3																				
87	88																				
Fr (223)	Ra (226)																				
21	22																				
Sc 45.0	Ti 47.9																				
39	40																				
Y 88.9	Zr 91.2																				
57 *	72																				
La 138.9	Hf 178.5																				
89 **	104																				
Ac (227)	Rf (261)																				
23	24																				
V 50.9	Cr 52.0																				
41	42																				
Nb 92.9	Mo 95.9																				
73	74																				
Ta 180.9	W 183.9																				
25	26																				
Mn 54.9	Fe 55.8																				
43	44																				
Tc (98)	Ru 101.1																				
75	76																				
Re 186.2	Os 190.2																				
27	28																				
Co 58.9	Ni 58.7																				
45	46																				
Rh 102.9	Pd 106.4																				
77	78																				
Ir 192.2	Pt 195.1																				
29	30																				
Cu 63.5	Zn 65.4																				
47	48																				
Ag 107.9	Cd 112.4																				
79	80																				
Au 197.0	Hg 200.6																				
31	32																				
Ga 69.7	Ge 72.6																				
49	50																				
In 114.8	Sn 118.7																				
81	82																				
Tl 204.4	Pb 207.2																				
51	52																				
Sb 121.8	Te 127.6																				
83	84																				
Bi 209.0	Po (209)																				
33	34																				
As 74.9	Se 79.0																				
53	54																				
I 126.9	Xe 131.3																				
35	36																				
Br 79.9	Kr 83.8																				
15	16																				
P 31.0	S 32.1																				
17	18																				
Cl 35.5	Ar 40.0																				
7	8																				
N 14.0	O 16.0																				
9	10																				
F 19.0	Ne 20.2																				

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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