

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 mixtures can be separated by filtration ?

- A. a mixture of oil and water
- B. a mixture of ethanol and water
- C. a mixture of silver chloride and water
- D. a mixture of sodium chloride and water

2. Which of the following gases can cause acid rain ?

- A. $\text{CH}_4(\text{g})$
- B. $\text{CO}(\text{g})$
- C. $\text{N}_2(\text{g})$
- D. $\text{SO}_2(\text{g})$

3. Solid W dissolves in water to form an alkaline solution. What is W ?

- A. calcium oxide
- B. calcium chloride
- C. copper(II) oxide
- D. copper(II) chloride

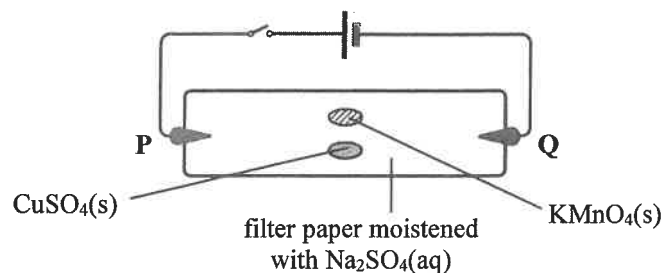
4. The table below shows the molar masses of four fertilisers. Which of the following fertilisers has the highest percentage by mass of nitrogen ?

Fertiliser	Molar mass / g
$(\text{NH}_2)_2\text{CO}$	60.0
NH_4NO_3	80.0
NaNO_3	85.0
$(\text{NH}_4)_2\text{SO}_4$	132.1

(Relative atomic mass : N = 14.0)

- A. $(\text{NH}_2)_2\text{CO}$
- B. NH_4NO_3
- C. NaNO_3
- D. $(\text{NH}_4)_2\text{SO}_4$

5. Consider the following experimental set-up :



What can be observed after the circuit is closed for a period of time ?

- A. A purple patch and a blue patch migrate towards P.
B. A purple patch and a blue patch migrate towards Q.
C. A purple patch migrates towards P while a blue patch migrates towards Q.
D. A purple patch migrates towards Q while a blue patch migrates towards P.
6. Metal X is less reactive than silver. 2.21 g of an oxide of X is heated strongly until no further reaction. The mass of the solid remaining is 1.97 g. What is the chemical formula of this oxide ?

(Relative atomic masses : O = 16.0, X = 197.0)

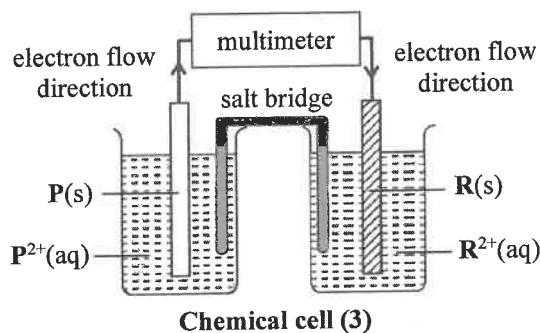
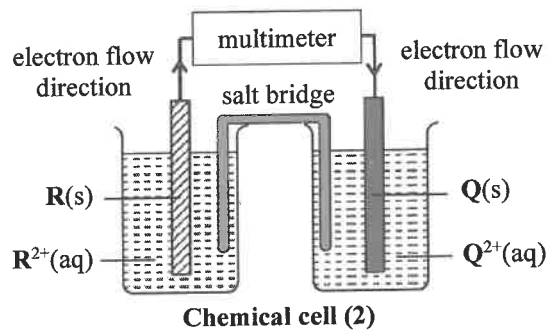
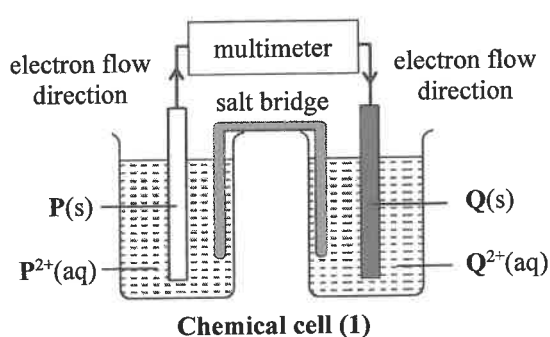
- A. XO
B. XO₂
C. X₂O
D. X₂O₃
7. Which of the following statements concerning aqueous ammonia is INCORRECT ?
- A. Aqueous ammonia is a weak alkali.
B. Concentrated aqueous ammonia is corrosive.
C. Aqueous ammonia can be used to distinguish between Pb(NO₃)₂(aq) and Al(NO₃)₃(aq).
D. When aqueous ammonia is added to CuSO₄(aq) until in excess, a deep blue solution is formed.
8. Which of the following is endothermic ?
- A. dilution of concentrated sulphuric acid with water
B. thermal decomposition of limestone
C. reaction of quicklime with water
D. combustion of ethanol
9. Which of the following equations can represent a possible reaction for the cracking of C₁₆H₃₄ to give propene and other organic products ?

- A. C₁₆H₃₄ → C₂H₄ + C₇H₁₄ + C₇H₁₆
B. C₁₆H₃₄ → C₃H₆ + C₆H₁₂ + C₇H₁₄
C. C₁₆H₃₄ → C₃H₆ + C₆H₁₄ + C₇H₁₄
D. C₁₆H₃₄ → C₃H₈ + C₅H₁₀ + C₈H₁₆

10. Petroleum can be separated into different fractions by fractional distillation in a fractionating tower. Fraction U is obtained from the upper part of the fractionating tower and fraction L is obtained from the lower part of the fractionating tower. Which of the following statements is correct ?

- A. Fraction U has a higher boiling range and a higher viscosity than fraction L.
 B. Fraction U has a higher boiling range and a lower viscosity than fraction L.
 C. Fraction U has a lower boiling range and a higher viscosity than fraction L.
 D. Fraction U has a lower boiling range and a lower viscosity than fraction L.

11. Consider the following three chemical cells :



Which of the following correctly shows the descending order of reactivity of the three metals P, Q and R ?

- A. $P > Q > R$
 B. $P > R > Q$
 C. $R > P > Q$
 D. $Q > R > P$
12. When 40 cm^3 of 0.5 M hydrochloric acid is mixed with 40 cm^3 of 0.5 M sodium hydroxide solution, there is a temperature rise of ΔT . What would be the temperature rise if 60 cm^3 of 1.0 M hydrochloric acid is mixed with 60 cm^3 of 0.5 M sodium hydroxide solution ?

- A. $0.75 \Delta T$
 B. ΔT
 C. $1.5 \Delta T$
 D. $2 \Delta T$

13. Which of the following combinations concerning the electrolysis of copper(II) sulphate solution is correct ?

	Anode	Cathode	Observation
A.	graphite	graphite	A reddish brown solid is deposited on the anode.
B.	graphite	copper	The mass of the cathode decreases.
C.	copper	copper	The blue colour of the solution fades out.
D.	copper	graphite	The mass of the anode decreases.

14. 0.729 g of magnesium ribbon reacts with 50.0 cm³ of 0.50 M sulphuric acid. What is the mass of magnesium ribbon remained after the reaction has completed ?

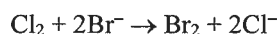
(Relative atomic mass : Mg = 24.3)

- A. 0.122 g
- B. 0.243 g
- C. 0.425 g
- D. 0.608 g

15. Argon is a gas at room temperature and pressure because

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

16. Consider the following reaction :



Which of the following statements concerning the oxidising agent in this reaction is correct ?

- A. It loses electrons and is reduced.
- B. It gains electrons and is reduced.
- C. It loses electrons and is oxidised.
- D. It gains electrons and is oxidised.

17. Which of the following statements concerning ice and water is / are correct ?

- (1) Ice has an open structure but water does not.
- (2) The number of hydrogen bonds formed between H₂O molecules in ice is double that in water.
- (3) The shape of a H₂O molecule in ice is tetrahedral while the shape of a H₂O molecule in water is V-shaped.

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

18. **X** and **Z** are two elements. The table below shows some physical properties of two bromides, **XBr** and **ZBr**.

	Melting point / °C	Boiling point / °C	Solubility in water
XBr	459	1325	soluble
ZBr	32	105	insoluble

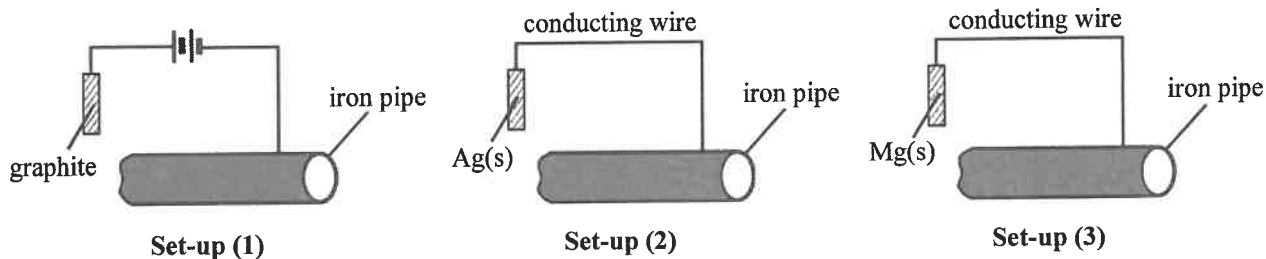
Which of the following statements is / are correct ?

- (1) **XBr** is a hard but brittle solid at room temperature.
(2) **ZBr** has a giant covalent structure.
(3) **X** is a metal and **Z** is a non-metal.
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only
19. Members of the homologous series of alkenes have the same
- (1) structural formula.
(2) empirical formula.
(3) general formula.
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

20. Which of the following statements is / are correct ?

- (1) The standard enthalpy change of formation of liquid nitrogen is not equal to zero.
(2) The standard enthalpy change of formation of a compound must be a negative value.
(3) The standard enthalpy change of formation of CO(g) can be determined directly from experiment.
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

21. Which of the following set-ups can be used to prevent an underground iron pipe from rusting ?



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

22. Consider the following two solutions :

Solution A : 100 cm³ of 1.0 M nitric acid

Solution B : 100 cm³ of 0.5 M sulphuric acid

Which of the following statements are correct ?

- (1) Both solution A and solution B can react with iron.
- (2) Complete neutralisation of solution A and complete neutralisation of solution B require the same volume of 1.0 M potassium hydroxide solution.
- (3) When 0.05 mol of CaCO₃(s) is separately added to solution A and to solution B, the same number of moles of gas is evolved in both cases.

- 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 statements concerning ethanoic acid are correct ?

- (1) Ethanoic acid is present in vinegar.
- (2) Ethanoic acid changes phenolphthalein indicator from colourless to pink.
- (3) Ethanoic acid is an alkanic acid.

- 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

Butane and methylpropane have the same physical properties.

2nd statement

Butane and methylpropane have the same molecular formula.

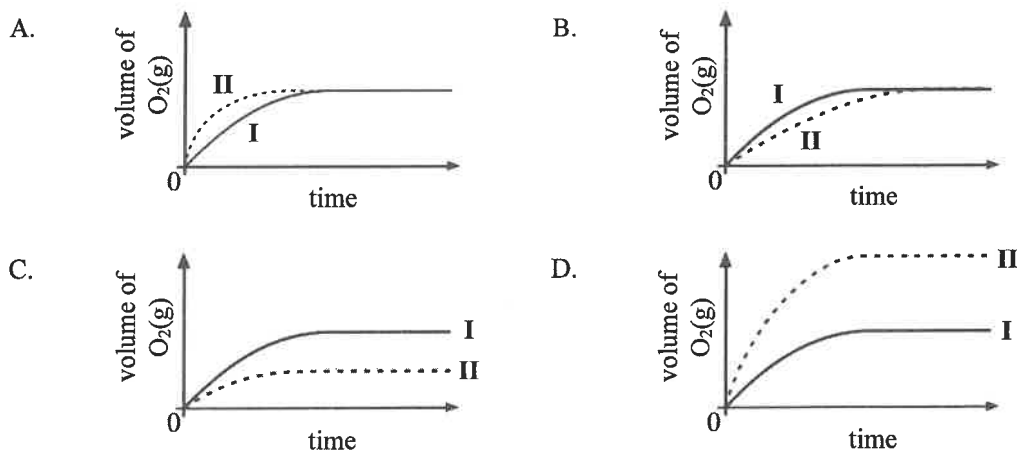
- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
- B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
- C. The 1st statement is false but the 2nd statement is true.
- D. Both statements are false.

PART II

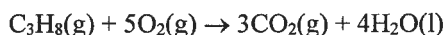
25. In order to investigate the decomposition of $\text{H}_2\text{O}_2(\text{aq})$ to form $\text{O}_2(\text{g})$, two experiments were carried out with $\text{H}_2\text{O}_2(\text{aq})$ in the presence of the same amount of a suitable catalyst at room conditions. The concentrations and volumes of $\text{H}_2\text{O}_2(\text{aq})$ used are shown below :

Experiment	Concentration of $\text{H}_2\text{O}_2(\text{aq})$ / M	Volume of $\text{H}_2\text{O}_2(\text{aq})$ / cm^3
I	1.0	25
II	0.5	50

Which of the following graphs correctly shows the variation in the volume of $\text{O}_2(\text{g})$ evolved with time in the above two experiments ?



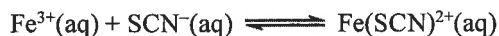
26. Consider the following reaction :



If 100 cm^3 of $\text{C}_3\text{H}_8(\text{g})$ burns in 600 cm^3 of $\text{O}_2(\text{g})$, what would be the volume of the resulting gaseous mixture at room conditions ?

(Molar volume of gas at room conditions = 24 dm^3)

- A. 800 cm^3
 B. 700 cm^3
 C. 400 cm^3
 D. 300 cm^3
27. Consider the following equilibrium system at room conditions :



A small amount of $\text{Fe}(\text{NO}_3)_3(\text{s})$ is added to the equilibrium mixture, and a new equilibrium is finally attained at the same conditions. In comparison with the original equilibrium, which of the following combinations concerning this new equilibrium is correct ?

	Rate of <i>backward</i> reaction	Concentration of $\text{Fe}(\text{SCN})^{2+}(\text{aq})$
A.	decreased	unchanged
B.	decreased	increased
C.	increased	unchanged
D.	increased	increased

28. Which of the following chemical reactions is the fastest at room conditions ?

- A. $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
- B. $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \longrightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$
- C. $4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \longrightarrow 2\text{Fe}_2\text{O}_3(\text{s})$
- D. $\text{CH}_4(\text{g}) + \text{Br}_2(\text{in organic solvent}) \xrightarrow{\text{light}} \text{CH}_3\text{Br}(\text{g}) + \text{HBr}(\text{g})$

29. Consider the information below :

Chemical reaction	Equilibrium constant at 500°C
$\text{HI}(\text{g}) \rightleftharpoons \frac{1}{2}\text{H}_2(\text{g}) + \frac{1}{2}\text{I}_2(\text{g})$	K_1
$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$	K_2

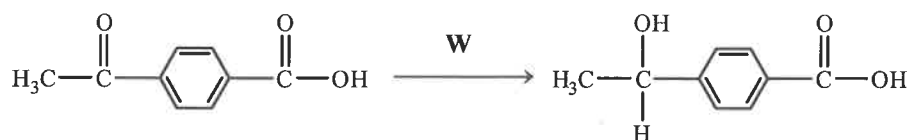
Which of the following mathematical relationships concerning K_1 and K_2 is correct ?

- A. $K_1 = \frac{1}{K_2}$
- B. $K_1 = \frac{1}{K_2^2}$
- C. $K_2 = \frac{1}{2K_1}$
- D. $K_2 = \frac{1}{K_1^2}$

30. Which of the following pairs of substances would NOT react with each other ?

- A. ethene and hydrogen chloride
- B. propan-1-ol and phosphorus trichloride
- C. propene and hydrogen in the presence of platinum
- D. methylpropan-2-ol and acidified potassium dichromate solution

31. What is **W** in the following conversion ?



- A. LiAlH_4 , dry ether; then $\text{H}^+(\text{aq})$
- B. concentrated H_2SO_4
- C. $\text{NaBH}_4(\text{aq})$
- D. $\text{KOH}(\text{aq})$

32. Consider the following reversible reaction :



At a fixed temperature, the system initially contains a small amount of X(aq) only. When the system attains chemical equilibrium, the mole ratio of X to Y in the mixture is 1 : 3. Which of the following statements is / are correct ?

- (1) The reaction quotient Q_c of the system at any moment before equilibrium is greater than the equilibrium constant K_c for the reaction.
- (2) If the experiment is repeated at the same temperature with the system initially containing a small amount of Y(aq) only, the mole ratio of X to Y in the equilibrium mixture is 1 : 3.
- (3) At equilibrium, the rate of backward reaction is 3 times the rate of forward reaction.

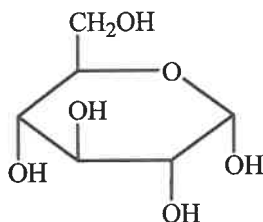
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

33. Which of the following statements concerning the elements across the second period of the Periodic Table going from left to right is / are correct ?

- (1) The melting point of carbon is the highest among these elements.
- (2) The electrical conductivity of lithium is the highest among these elements.
- (3) The bond type of these elements changes from ionic bonding to covalent bonding.

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

34. An organic compound has the following structure :



Which of the following statements concerning this compound is / are correct ?

- (1) It is soluble in water.
- (2) It has an ester group.
- (3) Its empirical formula is CH_2O .

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

35. **P** and **Q** are polyesters made from the same monomers. The average number of repeating units in **P** is 5 000 and that in **Q** is 80 000. Which of the following statements are correct ?

- (1) **Q** melts at a higher temperature than **P**.
- (2) The average molecular mass of **Q** is greater than that of **P**.
- (3) The number of carbon atoms in a repeating unit of **Q** is greater than that of **P**.

- 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

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COO}^-\text{Na}^+$ is a soap.

2nd statement

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COO}^-\text{Na}^+$ contains a hydrophilic $-\text{COO}^-$ group.

- 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

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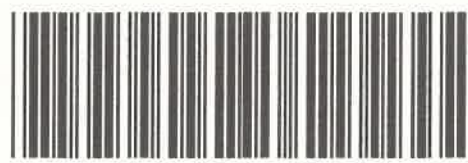
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CHEMISTRY PAPER 1
SECTION B : Question-Answer Book B

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. Both calcium (Ca) and strontium (Sr) are elements in Group II of the Periodic Table.

(a) What is the name of Group II ?

(1 mark)

(b) Limewater is a saturated solution of calcium hydroxide.

(i) Carbon dioxide gas is passed into limewater until the solution turns milky. Write the chemical equation for the reaction involved.

(1 mark)

(ii) When excess carbon dioxide gas is passed into the milky solution in (b)(i), a colourless solution is formed. What is the product of this reaction ?

(1 mark)

(c) The table below shows the abundance of each isotope in a sample of strontium :

Isotope	^{84}Sr	^{86}Sr	^{87}Sr	^{88}Sr
Abundance (%)	0.56	9.86	7.02	82.56

Calculate the relative atomic mass of strontium in the sample.

(2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

Please stick the barcode label here.

1. (d) Strontium reacts with chlorine to form strontium chloride.

(i) Draw the electron diagram for strontium chloride, showing ELECTRONS IN THE OUTERMOST SHELLS only.

(1 mark)

(ii) Complete the following sentences :

(1) The bonding in solid strontium is the electrostatic attraction between _____ and _____.

(2) The type of structure in solid strontium chloride is _____ structure.

(2 marks)

(iii) State and explain the difference between the electrical conductivity of solid strontium and that of solid strontium chloride.

(2 marks)

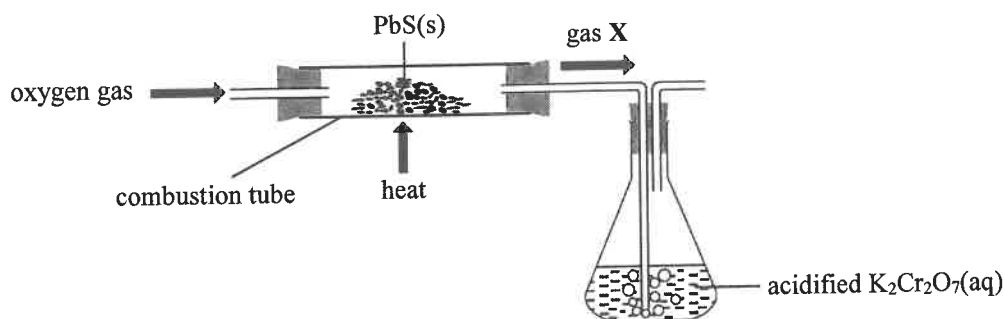
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2. The extraction of lead metal from lead(II) sulphide (PbS) involves two stages.

Stage I: PbS(s) and oxygen gas are strongly heated using the experimental set-up shown below. Lead(II) oxide and a gas X are formed in the combustion tube. Gas X is passed into acidified $K_2Cr_2O_7(aq)$.



(a) Suggest a method to obtain oxygen from air.

(1 mark)

(b) Gas X turns acidified $K_2Cr_2O_7(aq)$ from orange to green.

(i) What is gas X ?

(1 mark)

(ii) Write an ionic equation for the reaction between gas X and acidified $K_2Cr_2O_7(aq)$.

(1 mark)

(c) Write the chemical equation for the reaction that occurs in the combustion tube.

(1 mark)

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

(1 mark)

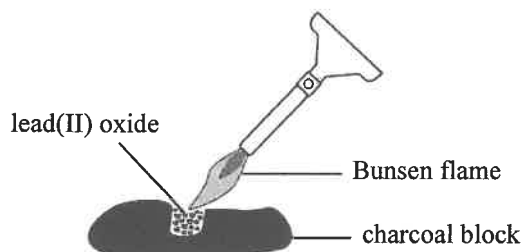
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2. **Stage II :** The lead(II) oxide formed in the combustion tube is separated and placed on a charcoal block. The oxide is then strongly heated as shown below.



- (e) (i) A solid product is formed from the reaction in Stage II. Describe the appearance of the solid product.

(1 mark)

- (ii) In terms of oxidation number, explain whether the reaction in Stage II is a redox 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.

3. The following table shows the results of some experiments carried out on three metals **A**, **B** and **C**.

Experiment \ Metal	A	B	C
Reaction with water	no observable change	no observable change	reacts vigorously
Reaction with dilute hydrochloric acid	a colourless gas Y evolves moderately	no observable change	(This experiment is dangerous and should NOT be carried out.)
Strong heating in air	a white solid is obtained after cooling	no observable change	burns with a lilac flame

- (a) According to the above experimental results, arrange these three metals in descending order of reactivity.

(1 mark)

- (b) Suggest a test for gas **Y**.

(1 mark)

- (c) (i) State an expected observation when metal **C** reacts vigorously with water.

(1 mark)

- (ii) Explain why it is dangerous to carry out the reaction of metal **C** with dilute hydrochloric acid.

(1 mark)

Answers written in the margins will not be marked.

Please stick the barcode label here.

3. (d) Using the following items ONLY, outline the experimental procedure and state an expected observation to confirm the relative reactivities of metal **A** and metal **B**.

a strip of metal **A**, a strip of metal **B**, $\text{A}(\text{NO}_3)_2(\text{aq})$, $\text{BNO}_3(\text{aq})$, test tubes

(2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

4. Tartronic acid ($C_3H_4O_5$) is an organic acid found in cucumbers.

(a) 24.62 cm^3 of 0.207 M NaOH(aq) can completely neutralise 25.00 cm^3 of 0.102 M tartronic acid.

(i) Calculate the basicity of tartronic acid.

(2 marks)

(ii) A molecule of tartronic acid contains a hydroxyl group. Write the structural formula of tartronic acid.

(1 mark)

(b) Under certain conditions, the pH of 0.102 M tartronic acid is 1.87. By calculation, show that tartronic acid is NOT completely ionised in water.

(2 marks)

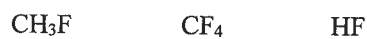
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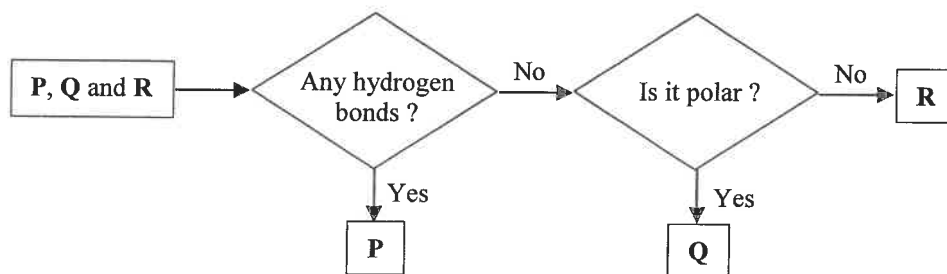
Answers written in the margins will not be marked.

Please stick the barcode label here.

5. **P, Q and R**, each represents one of the following compounds :



The following flowchart can be used to identify **P, Q and R**.



(a) With the aid of a diagram, describe and explain the formation of hydrogen bonding between **P** molecules.

(3 marks)

(b) (i) What is **Q** ?

(1 mark)

(ii) Explain, from molecular level, why **Q** is polar.

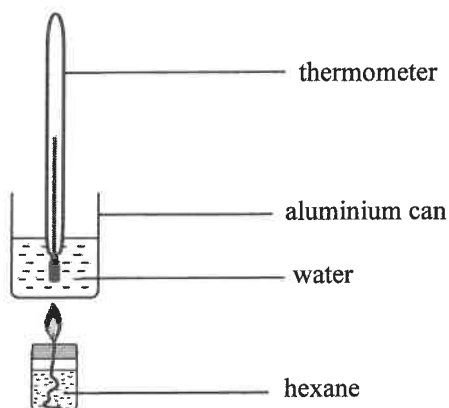
(1 mark)

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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

6. Hexane (C_6H_{14}) is a liquid fuel. Under certain experimental conditions, the enthalpy change of combustion of hexane was determined using the following set-up. The combustion of 0.120 g of hexane increased the temperature of 100.0 g of water by 13.4 °C.



- (a) Calculate the enthalpy change of combustion of hexane, in kJ mol^{-1} , under these experimental conditions.
(Assume that the heat capacity of the aluminium can is negligible and the specific heat capacity of water is $4.20 \text{ J g}^{-1} \text{ K}^{-1}$.)
(Relative atomic masses : H = 1.0, C = 12.0)

(2 marks)

Answers written in the margins will not be marked.

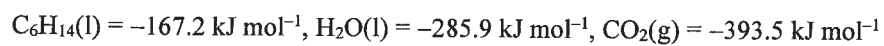
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Answers written in the margins will not be marked.

6. (b) (i) Write the chemical equation for the complete combustion of hexane, showing all state symbols.

(1 mark)

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



Calculate the standard enthalpy change of combustion of hexane.

(2 marks)

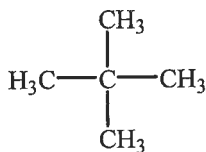
- (c) Besides heat loss, suggest one reason why the answers obtained from (a) and (b)(ii) are different.

(1 mark)

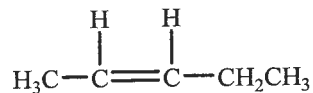
Answers written in the margins will not be marked.

7. X and Y are hydrocarbons. Their structural formulae are shown below :

X :



Y :



(a) Write the systematic name of X.

(1 mark)

(b) Suggest one difference between the burning characteristics of X and Y.

(1 mark)

(c) Besides burning, suggest a chemical test to distinguish between X and Y.

(2 marks)

(d) Y can form a polymer. Draw the repeating unit of this polymer.

(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.

Answers written in the margins will not be marked.

8. Using the following items ONLY, design an experiment to electroplate nickel (Ni) on an iron rod.
d.c. power supply, a nickel strip, an iron rod, nickel(II) sulphate solution, connecting wires, a beaker

(a) Draw a labelled diagram to show the experimental set-up.

(2 marks)

(b) State one function of nickel(II) sulphate solution in this experiment.

(1 mark)

(c) Write the half equation for the formation of nickel on the iron rod.

(1 mark)

(d) Ni(s) is a stronger reducing agent than $\text{OH}^-(\text{aq})$ ions and $\text{SO}_4^{2-}(\text{aq})$ ions. Nickel(II) sulphate solution is green in colour. Would there be any expected observable change in the solution in this experiment? Explain your answer.

(2 marks)

(e) State one purpose of electroplating nickel on iron objects.

(1 mark)

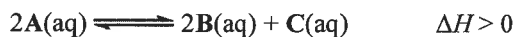
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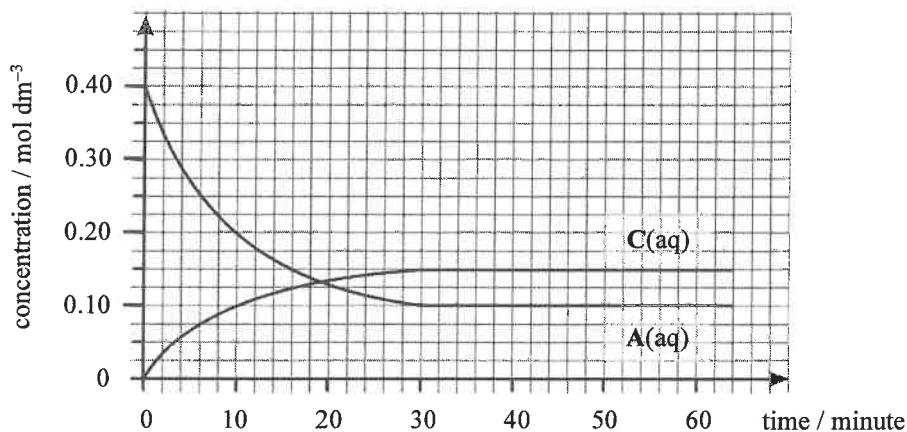
PART II

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

10. Consider the reaction represented by the equation below :



In an experiment, a certain volume of 0.40 mol dm^{-3} $\text{A}(\text{aq})$ was initially placed in a container, and this system was allowed to attain chemical equilibrium at constant temperature T_1 . The following graph shows the variation of the concentrations of $\text{A}(\text{aq})$ and $\text{C}(\text{aq})$ with time.



- (a) According to the above graph, give one reason to support the following statement :
 'The system just attained chemical equilibrium at the 30th minute.'
- (1 mark)
- (b) Draw a curve on the graph to show the variation of the concentration of $\text{B}(\text{aq})$ with time. (1 mark)
- (c) Calculate the equilibrium constant K_c for the reaction at temperature T_1 .
- (2 marks)
- (d) When the temperature of the equilibrium mixture changed from T_1 to T_2 , a new chemical equilibrium was attained. The concentration of $\text{A}(\text{aq})$ was found to be 0.14 mol dm^{-3} in the new chemical equilibrium. Deduce whether T_1 or T_2 is the higher temperature.

(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.

11. Compounds **X** and **Y** are *cis-trans* isomers with the same molecular formula C_4H_8 .

(a) **X** is polar but **Y** is non-polar.

(i) Give the systematic name of **X**.

(1 mark)

(ii) Write the structural formula of **Y**.

(1 mark)

(b) A mixture of **X** and **Y** can be formed from the dehydration of an optically active alcohol **Z**.

(i) Suggest a reagent and a reaction condition needed for this reaction.

(1 mark)

(ii) Write the structural formula of **Z**.

(1 mark)

(iii) Draw the three-dimensional diagrams for the structures of the pair of enantiomers of **Z**.

(2 marks)

(iv) Describe the difference in the optical activity between the pair of enantiomers of **Z**.

(1 mark)

Answers written in the margins will not be marked.

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12. 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.



Answers written in the margins will not be marked.

(3 marks)

Answers written in the margins will not be marked.

13. (a) In terms of bonding and structure, account for the difference in the melting points of the following oxides.

	SiO₂	P₄O₁₀	SO₂
Melting point (°C)	1 710	340	-72

(3 marks)

- (b) Fe²⁺(aq) reacts with H₂O₂(aq) in an acidic medium to form Fe³⁺(aq) and H₂O(l).

- (i) Write the chemical equation for the reaction.

(1 mark)

- (ii) State how this reaction can demonstrate that iron exhibits TWO characteristics of transition metals.

(2 marks)

Answers written in the margins will not be marked.

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PERIODIC TABLE 周期表

GROUP 族

		atomic number 原子序				relative atomic mass 相對原子質量																														
	1	H 1.0						2	He 4.0																											
I	3	Li 6.9	II	4	Be 9.0	III	5	6	7	8	9	VII	10																							
						B 10.8	C 12.0	N 14.0	O 16.0	F 19.0	Ne 20.2																									
	11	Na 23.0	12	Mg 24.3	13	Al 27.0	14	Si 28.1	15	P 31.0	16	S 32.1	17	Cl 35.5	18	Ar 40.0																				
	19	K 39.1	20	Ca 40.1	21	Sc 45.0	22	Ti 47.9	23	V 50.9	24	Cr 52.0	25	Mn 54.9	26	Fe 55.8	27	Co 58.9	28	Ni 58.7	29	Cu 63.5	30	Zn 65.4												
	37	Rb 85.5	38	Sr 87.6	39	Y 88.9	40	Zr 91.2	41	Nb 92.9	42	Mo 95.9	43	Tc (98)	44	Ru 101.1	45	Rh 102.9	46	Pd 106.4	47	Ag 107.9	48	Cd 112.4	49	In 114.8	50	Sn 118.7	51	Sb 121.8	52	Te 127.6	53	I 126.9	54	Xe 131.3
	55	Cs 132.9	56	Ba 137.3	57 *	La 138.9	72	Hf 178.5	73	Ta 180.9	74	W 183.9	75	Re 186.2	76	Os 190.2	77	Ir 192.2	78	Pt 195.1	79	Au 197.0	80	Hg 200.6	81	Tl 204.4	82	Pb 207.2	83	Bi 209.0	84	Po (209)	85	At (210)	86	Rn (222)
	87	Fr (223)	88	Ra (226)	89 **	Ac (227)	104	Rf (261)	105	Db (262)																										

*	58	Ce 140.1	59	Pr 140.9	60	Nd 144.2	61	Pm (145)	62	Sm 150.4	63	Eu 152.0	64	Gd 157.3	65	Tb 158.9	66	Dy 162.5	67	Ho 164.9	68	Er 167.3	69	Tm 168.9	70	Yb 173.0	71	Lu 175.0
**	90	Th 232.0	91	Pa (231)	92	U 238.0	93	Np (237)	94	Pu (244)	95	Am (243)	96	Cm (247)	97	Bk (247)	98	Cf (251)	99	Es (252)	100	Fm (257)	101	Md (258)	102	No (259)	103	Lr (260)

