

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.

Not to be taken away before the end of the examination session

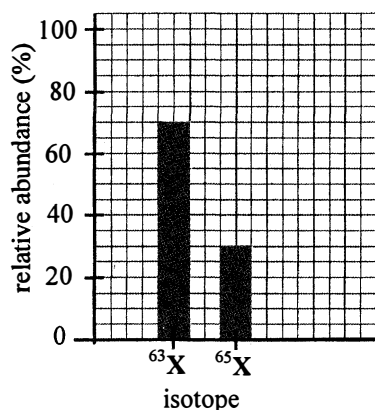
This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.

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. Silicon is an element in Group IV of the Periodic Table. The oxide of silicon has the chemical formula SiO_2 . Which of the following statements about silicon and its oxide is correct?
- A. Silicon is a good conductor of heat.
 - B. Silicon exists as simple molecules.
 - C. SiO_2 is a hard material at room temperature.
 - D. SiO_2 dissolves in water to give an acidic solution.
2. Suppose that element X has only two isotopes, ^{63}X and ^{65}X . The graph below shows the relative abundance of the two isotopes:



Which of the following is the relative atomic mass of X?

- A. 63.3
 - B. 63.5
 - C. 63.6
 - D. 64.0
3. Solid Y is soluble in cold water. When an aqueous solution of Y is added separately to sodium hydroxide solution and to acidified silver nitrate solution, a white precipitate is formed in both cases. Which of the following compounds might Y be?
- A. ammonium carbonate
 - B. zinc carbonate
 - C. lead(II) chloride
 - D. magnesium chloride

4. Scandium (Sc) is a metal. Scandium, in its compounds, exhibits only one oxidation number. The chemical formula of scandium nitrate is $\text{Sc}(\text{NO}_3)_3$. Which of the following is most likely to be the chemical formula of scandium phosphate?

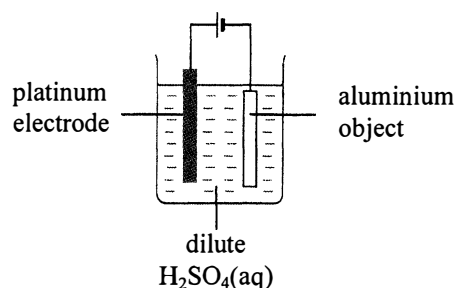
- A. $\text{Sc}_2(\text{PO}_4)_3$
- B. ScPO_4
- C. $\text{Sc}(\text{PO}_4)_2$
- D. $\text{Sc}(\text{PO}_4)_3$

5. Which of the following methods can be used to obtain magnesium from magnesium compounds?

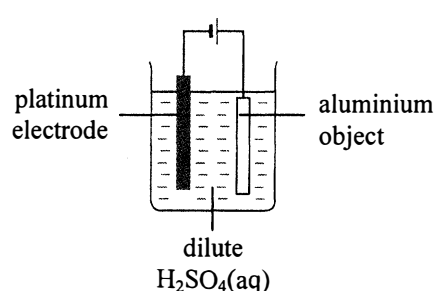
- A. electrolysis of a molten magnesium compound
- B. electrolysis of an aqueous solution of a magnesium compound
- C. heating magnesium oxide with carbon
- D. heating magnesium oxide strongly

6. Which of the set-ups shown below can best be used to anodise an aluminium object?

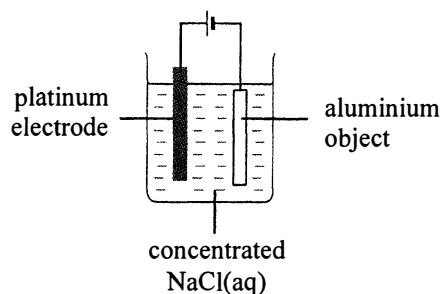
A.



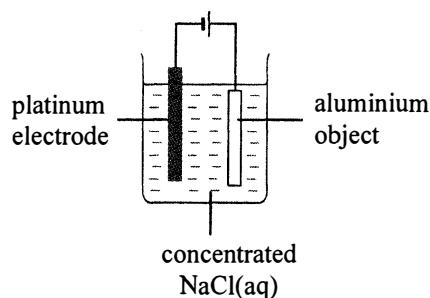
B.



C.



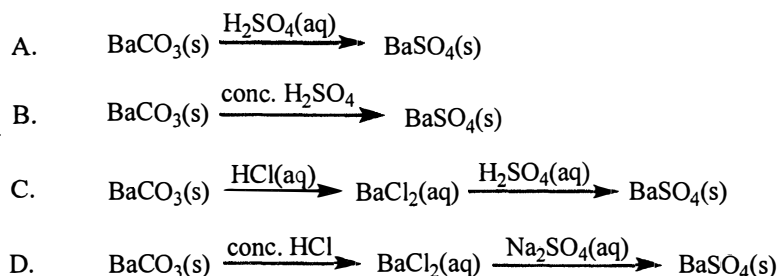
D.



7. Both the frame and gear system of a bicycle are made of steel. Which of the following combinations can be used to prevent these parts of the bicycle from rusting?

- | | <u>Frame</u> | <u>Gear system</u> |
|----|--------------|--------------------|
| A. | painting | greasing |
| B. | painting | galvanising |
| C. | tin-plating | greasing |
| D. | tin-plating | galvanising |

8. Which of the following reaction routes can best be used to prepare barium sulphate from barium carbonate?



9. Which of the following statements about potassium hydroxide solution is INCORRECT?

- A. When potassium hydroxide solution is added to iron(III) sulphate solution, a dirty green precipitate is formed.
- B. When potassium hydroxide solution is heated with ammonium chloride solution, ammonia gas is liberated.
- C. Dilute potassium hydroxide solution contains $\text{K}^+(\text{aq})$ ions, $\text{H}^+(\text{aq})$ ions and $\text{OH}^-(\text{aq})$ ions.
- D. Concentrated potassium hydroxide solution is corrosive.

10. Consider the four solutions **W**, **X**, **Y** and **Z** listed below:

W: $0.01 \text{ mol dm}^{-3} \text{HNO}_3(\text{aq})$

X: $0.01 \text{ mol dm}^{-3} \text{H}_2\text{SO}_4(\text{aq})$

Y: $0.01 \text{ mol dm}^{-3} \text{KOH}(\text{aq})$

Z: $0.10 \text{ mol dm}^{-3} \text{KOH}(\text{aq})$

Which of the following represents the four solutions arranged in increasing order of pH?

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

11. Which of the following pairs of aqueous solutions, when mixed, would give a precipitate?

- A. lead(II) nitrate and ammonia
- B. copper(II) sulphate and sodium nitrate
- C. calcium chloride and sodium nitrate
- D. iron(II) sulphate and acidified potassium dichromate

12. Both radium (Ra) and calcium (Ca) belong to the same group of the Periodic Table. Which of the following statements is INCORRECT?

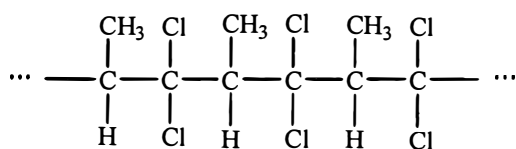
- A. Radium is a good conductor of electricity in the solid state.
- B. Radium atoms readily donate electrons to form Ra^{2+} ions.
- C. Both radium and calcium become tarnished after exposed to air for some time.
- D. Radium is less reactive than calcium.

13. Titanium (Ti) is a metal. 2.66 g of a sample of titanium powder is heated in excess oxygen until the metal is completely oxidised. The mass of the oxide formed is 4.44 g. Which of the following is the empirical formula of the oxide formed?

(Relative atomic masses: O = 16.0, Ti = 47.9)

- A. TiO
- B. Ti₂O₃
- C. Ti₃O₄
- D. TiO₂

14. A portion of the structure of an addition polymer X is shown below:



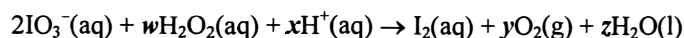
Which of the following is the systematic name of the monomer of X based on the given structure?

- A. 1,1-dichloro-2-methylethene
- B. 1,1-dichloropropene
- C. 1,2-dichloropropene
- D. 3,3-dichloropropene

15. For which of the following reactions must its enthalpy change be determined by INDIRECT methods?

- A. $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{Cu(s)}$
- B. $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$
- C. $\text{CH}_3\text{CH}_2\text{OH(l)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{CO}_2\text{(g)} + 3\text{H}_2\text{O(l)}$
- D. $\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$

16. Consider the following chemical equation:



Which of the following is the correct combination of the reaction coefficients y and z ?

- | | <u>y</u> | <u>z</u> |
|----|-----------------------|-----------------------|
| A. | 4 | 5 |
| B. | 5 | 4 |
| C. | 5 | 6 |
| D. | 6 | 5 |

17. Potassium peroxodisulphate ($\text{K}_2\text{S}_2\text{O}_8$) can be obtained from the electrolysis of a saturated solution of potassium hydrogensulphate (KHSO_4).

Which of the following correctly describes the oxidation number of sulphur in KHSO_4 , and the electrode at which $\text{K}_2\text{S}_2\text{O}_8$ is produced during the electrolysis ?

	<u>Oxidation number of S</u>	<u>Electrode at which $\text{K}_2\text{S}_2\text{O}_8$ is produced</u>
A.	+6	anode
B.	+6	cathode
C.	+4	anode
D.	+4	cathode

18. Under standard conditions, complete combustion of 0.050 mol of propane (C_3H_8) gives 111 kJ of heat. Which of the following is the standard enthalpy change of formation of propane ?

(Standard enthalpy change of formation of $\text{H}_2\text{O}(\text{l}) = -286 \text{ kJ mol}^{-1}$;
standard enthalpy change of formation of $\text{CO}_2(\text{g}) = -394 \text{ kJ mol}^{-1}$)

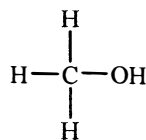
- A. -106 kJ mol^{-1}
B. $+106 \text{ kJ mol}^{-1}$
C. -569 kJ mol^{-1}
D. $+569 \text{ kJ mol}^{-1}$

19. Which of the following statements about limestone is/are correct ?

- (1) It gives a golden yellow flame in a flame test.
(2) It gives a colourless gas when heated strongly.
(3) It dissolves in dilute sulphuric acid to give a clear solution.

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

20. An organic compound has the following structure:



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

- (1) It is immiscible with water.
(2) It is neutral to litmus solution.
(3) It burns with a non-luminous flame.

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

21. Which of the following is/are secondary cell(s) ?
- (1) alkaline manganese cell
 - (2) lithium ion cell
 - (3) nickel metal hydride cell
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
22. Which of the following reagents can be used to distinguish between sodium sulphite and sodium sulphate ?
- (1) iron(II) chloride solution
 - (2) acidified potassium permanganate solution
 - (3) concentrated nitric acid
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
23. To which of the following molecules is/are the 'octet rule' NOT applicable ?
- (1) OF_2
 - (2) NO_2
 - (3) CS_2
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only

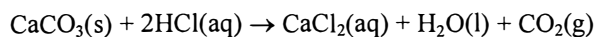
Directions : Question 24 consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following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

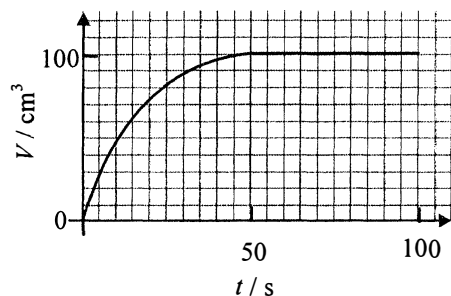
1st statement	2nd statement
24. The boiling point of hydrogen chloride is higher than that of hydrogen fluoride.	The molecular size of hydrogen chloride is greater than that of hydrogen fluoride.

PART II

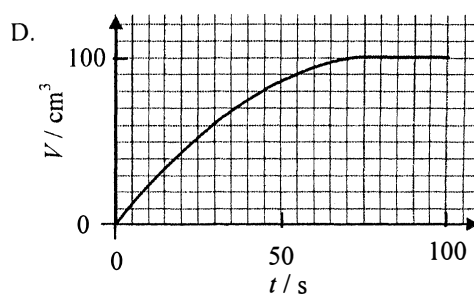
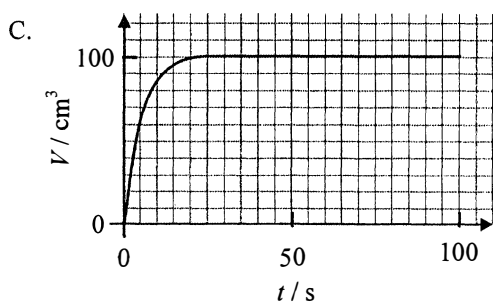
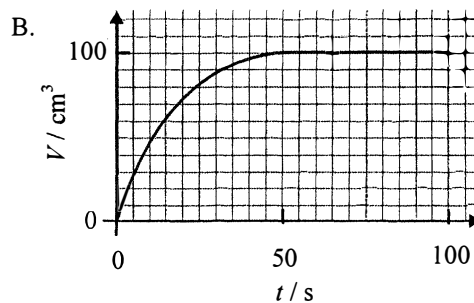
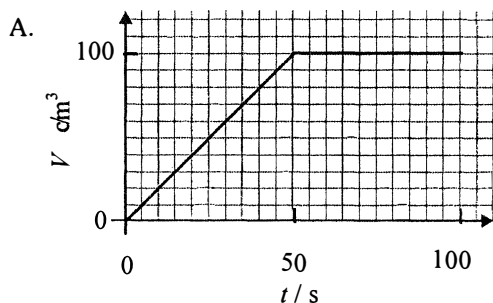
25. In an experiment to study the rate of the following reaction, a small amount of powdered calcium carbonate was added to excess hydrochloric acid and the volume of gas liberated was recorded.



The graph below shows the volumes of gas liberated (V) at different times (t) during the experiment:



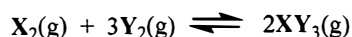
The experiment was repeated under the same conditions using the same mass of calcium carbonate granules instead of powdered calcium carbonate. Which of the following graphs would best represent the results obtained in the repeated experiment ?



26. Which of the following is NOT a characteristic property of transition metals ?

- A. They form coloured compounds.
- B. They exhibit variable oxidation numbers in their compounds.
- C. They react with dilute hydrochloric acid to give hydrogen gas.
- D. They exhibit catalytic property in elemental state or as compounds.

Directions: Q. 27 and Q.28 refer to the following reversible reaction:



27. A mixture of $\text{X}_2(\text{g})$ and $\text{Y}_2(\text{g})$ was introduced into a 2.0 dm^3 closed vessel kept at a fixed temperature. When the system attained equilibrium, the vessel contained 0.4 mol of $\text{X}_2(\text{g})$, 0.3 mol of $\text{Y}_2(\text{g})$ and 0.4 mol of $\text{XY}_3(\text{g})$.

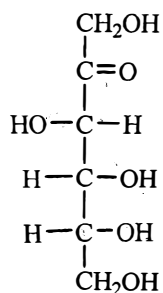
Which of the following is the numerical value of K_c for the above reaction at this temperature ?

- A. 3.3
- B. 6.7
- C. 14.8
- D. 59.3

28. Which of the following combinations shows the effects of a catalyst on the rate of forward reaction, rate of backward reaction and the yield of $\text{XY}_3(\text{g})$?

	<u>Rate of forward reaction</u>	<u>Rate of backward reaction</u>	<u>Yield of $\text{XY}_3(\text{g})$</u>
A.	increased	increased	unchanged
B.	unchanged	unchanged	unchanged
C.	increased	decreased	increased
D.	decreased	increased	decreased

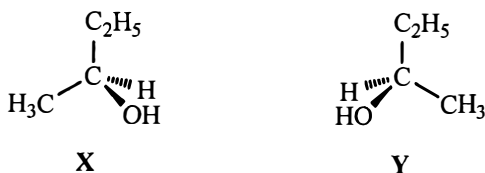
29. The structure of fructose is shown below:



Which of the following statements about fructose is correct ?

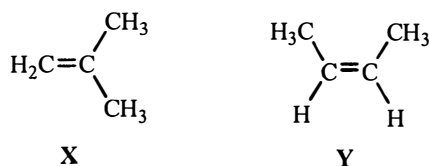
- A. Its empirical formula is $\text{C}_6\text{H}_{12}\text{O}_6$.
- B. It can turn acidified potassium dichromate solution from orange to green.
- C. It is insoluble in water.
- D. Its molecule has five chiral carbon centres.

30. The three-dimensional structure of a molecule of compound **X** and that of compound **Y** are shown below:



Which of the following statements about **X** and **Y** is correct ?

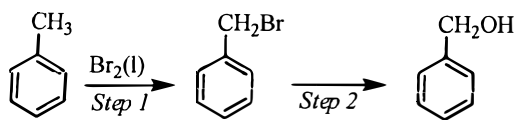
- A. **X** and **Y** are identical.
 B. **X** and **Y** are a pair of structural isomers.
 C. A mixture of **X** and **Y** can be separated by fractional distillation.
 D. **X** and **Y** have the same standard enthalpy change of combustion.
31. Consider the compounds **X** and **Y** shown below:



Which of the following statements about **X** and **Y** is correct ?

- A. **X** and **Y** are a pair of geometrical isomers.
 B. Both **X** and **Y** react with $\text{H}_2(\text{g})$ in the presence of $\text{Ni}(\text{s})$.
 C. **X** and **Y** react separately with Br_2 in CH_2Cl_2 to give the same organic product.
 D. Both the polymerisation of **X** and that of **Y** give the same addition polymer.
32. Which of the following statements about the action of sodium hydroxide solution on ethanamide is/are correct ?
- (1) Sodium ethanoate is formed in the reaction.
 (2) In the reaction, sodium hydroxide acts as a catalyst.
 (3) The reaction attains equilibrium if the reaction mixture is heated under reflux.
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only
33. For which of the following can their progress of reaction be followed by colorimetry ?
- (1) $2\text{MnO}_4^-(\text{aq}) + 5\text{C}_2\text{O}_4^{2-}(\text{aq}) + 16\text{H}^+(\text{aq}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + 10\text{CO}_2(\text{g}) + 8\text{H}_2\text{O}(\text{l})$
 (2) $\text{SO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{SO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 (3) $\text{Br}_2(\text{aq}) + \text{HCO}_2\text{H}(\text{aq}) \rightarrow 2\text{Br}^-(\text{aq}) + \text{CO}_2(\text{g}) + 2\text{H}^+(\text{aq})$
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)

34. Consider the following conversion of organic compounds:

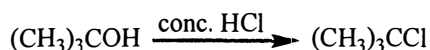


Which of the following statements about the above conversion are correct ?

- (1) Excess $\text{Br}_2(\text{l})$ should be used in *Step 1*.
- (2) Light is needed in *Step 1*.
- (3) The reagent used in *Step 2* can be $\text{KOH}(\text{aq})$.

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

35. In order to prepare 2-chloro-2-methylpropane, a mixture of 2-methylpropan-2-ol and concentrated hydrochloric acid is shaken vigorously.



Which of the following statements about this preparation are correct ?

- (1) Two layers of liquids can be observed in the reaction mixture after shaking.
- (2) The crude product should be washed with sodium carbonate solution.
- (3) The unreacted 2-methylpropan-2-ol can be removed by simple distillation.

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

Directions : Question 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

- | | |
|--|--|
| 36. Both aluminium oxide and magnesium oxide exhibit similar acid-base properties. | Both aluminium oxide and magnesium oxide are ionic oxides. |
|--|--|

END OF SECTION A