

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 substances has delocalised electrons ?

☒ A. NaCl(s)
☐ B. Br₂(l)
☐ C. Hg(l)
☐ D. I₂(s)

2. Which of the following methods can be used to directly obtain common salt from sea water ?

☒ A. filtration
☐ B. dissolution
☐ C. electrolysis
☐ D. crystallisation

3. What is the theoretical mass of hydrogen gas formed when 13.50 g of aluminium reacts with excess dilute hydrochloric acid ?

(Relative atomic masses : H = 1.0, Al = 27.0)

A. 0.67 g
 B. 0.75 g
☒ C. 1.00 g
☐ D. 1.50 g



4. Y is a monobasic acid. The pH of 0.1 M Y(aq) is 2.91. Which of the following statements concerning the 0.1 M Y(aq) is correct ?

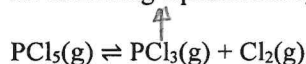
A. It is a concentrated solution of a weak acid. *man*
☒ B. It is a concentrated solution of a strong acid.
 C. It is a dilute solution of a weak acid.
 D. It is a dilute solution of a strong acid.

5. Which of the following is the best process to prepare lead(II) sulphate ?

A. adding lead granules to dilute sulphuric acid
 B. adding lead(II) carbonate powder to dilute sulphuric acid
☒ C. adding lead(II) chloride solid to sodium sulphate solution
 D. adding lead(II) nitrate solution to sodium sulphate solution



34. Refer to the following equilibrium system in a closed container of volume V at temperature T :

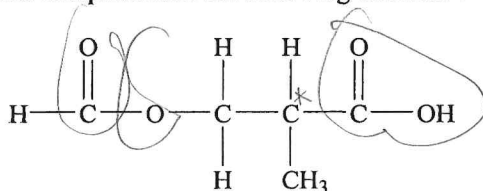


Which of the following changes would increase the number of moles of $\text{PCl}_3(\text{g})$ in the system ?

- (1) adding a catalyst to the system
 (2) removing a small amount of $\text{Cl}_2(\text{g})$ from the system
 (3) increasing the volume of the system at temperature T

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

35. An organic compound has the following structure :



Which of the following statements concerning this compound are correct ?

- (1) It is optically active. ✓
 (2) It is soluble in $\text{NaOH}(\text{aq})$.
 (3) It has an aldehyde functional group.

- 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

Iron exhibits variable oxidation states in its compounds.

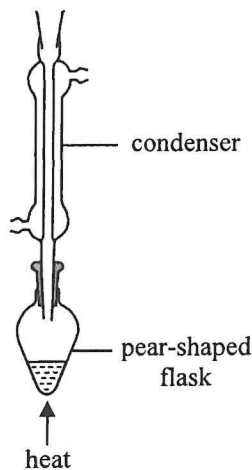
2nd statement

Iron forms coloured compounds.

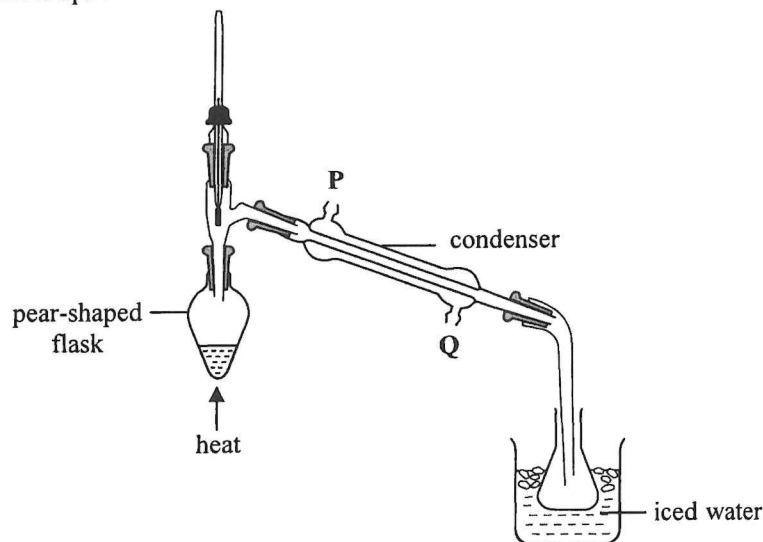
- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
 B. Both statements are true and the 2nd statement is NOT a correct explanation of the 1st statement.
 C. The 1st statement is false but the 2nd statement is true.
 D. Both statements are false.

END OF SECTION A

32. Refer to the following two experimental set-ups :



Set-up A



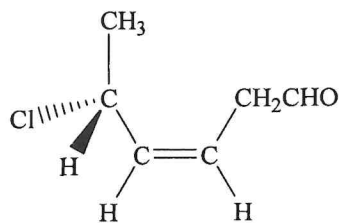
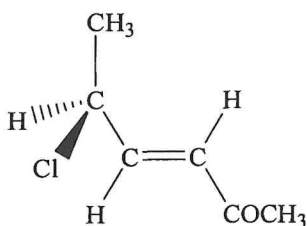
Set-up B

Which of the following statements concerning these two set-ups is / are correct ?

- (1) Anti-bumping granules should be placed in the pear-shaped flasks in both set-ups.
 (2) Water should flow into the condenser at position P and flow out from position Q in set-up B.
 (3) Set-up A is suitable to be used to prepare ethanal from the reaction between ethanol and excess acidified $K_2Cr_2O_7(aq)$ under prolonged heating.

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

33. Refer to the following two compounds :

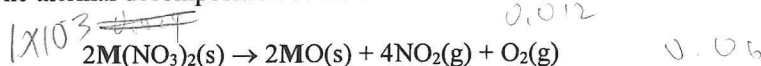


Which of the following statements is / are correct ?

- (1) They are enantiomers.
 (2) They are structural isomers.
 (3) They are *cis-trans* isomers. ✓

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

6. The thermal decomposition of the nitrate of metal **M** is shown below :



When 0.164 g of $\text{M}(\text{NO}_3)_2(\text{s})$ is decomposed, the total number of moles of gases evolved is 2.50×10^{-3} mol. What is metal **M**?

(Relative atomic masses : N = 14.0, O = 16.0)

- | | | |
|----|----|-------|
| A. | Mg | 24.3 |
| B. | Ca | 40.1 |
| C. | Sr | 87.6 |
| D. | Ba | 137.3 |

7. Which of the following air pollutants can be removed by the electrostatic precipitators installed in coal-fired power plants?

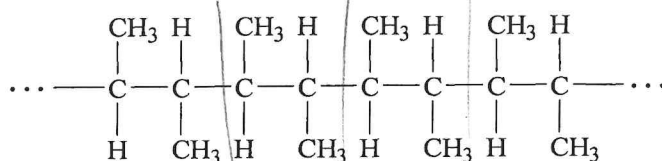
- | | |
|----|------------------------|
| A. | suspended particulates |
| B. | carbon monoxide |
| C. | nitrogen oxides |
| D. | sulphur dioxide |

8. In a hydrogen-oxygen fuel cell, hydrogen is

- | | |
|----|--------------------------|
| A. | oxidised at the anode. |
| B. | oxidised at the cathode. |
| C. | reduced at the anode. ✓ |
| D. | reduced at the cathode. |

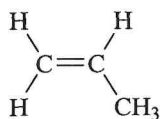


9. A part of the structure of a polymer is shown below :

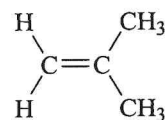


Which of the following is the monomer of this polymer?

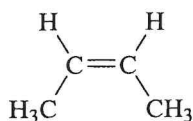
A.



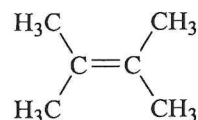
B.



C.



D.





10. 12.80 cm³ of a H₂SO₄(aq) sample is completely neutralised by 25.0 cm³ of 0.10 M KOH(aq). What is the concentration of the H₂SO₄(aq) sample ?

- A. $2.56 \times 10^{-2} \text{ M}$
 B. $9.77 \times 10^{-2} \text{ M}$
 C. $1.95 \times 10^{-1} \text{ M}$
 D. $3.91 \times 10^{-1} \text{ M}$

11. Which of the following statements about intermolecular forces is INCORRECT ?

- A. Hydrogen bonding is an electrostatic attraction.
 B. Van der Waals' forces exist between polar molecules and also between non-polar molecules.
 C. The intermolecular forces in bromine are stronger than those in chlorine.
 D. The intermolecular forces in hydrogen chloride are stronger than those in hydrogen fluoride.

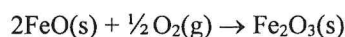
12. In which of the following chemical species does V (vanadium) have the lowest oxidation number ?
 (Given: The oxidation number of oxygen in each of the following species is -2.)

- A. V_2O_3
 B. VO_2
 C. VO_2^+
 D. VO_4^{3-}

13. Which of the following is NOT a redox-reaction ?

- A. $\text{BaCO}_3(\text{s}) \rightarrow \text{BaO}(\text{s}) + \text{CO}_2(\text{g})$
 B. $4\text{KClO}_3(\text{s}) \rightarrow 3\text{KClO}_4(\text{s}) + \text{KCl}(\text{s})$
 C. $\text{Cl}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HCl}(\text{aq}) + \text{HOCl}(\text{aq})$
 D. $\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$

14. Refer to the following reaction and the given information under certain conditions :



Enthalpy change of formation of FeO(s) = -270 kJ mol⁻¹

Enthalpy change of formation of Fe₂O₃(s) = -820 kJ mol⁻¹

Which of the following expressions gives the enthalpy change for the above reaction under these conditions ?

- A. $[(-820 \times \frac{1}{2}) - (-270)] \text{ kJ mol}^{-1}$
 B. $[-270 - (-820 \times \frac{1}{2})] \text{ kJ mol}^{-1}$
 C. $[-820 - (-270 \times 2)] \text{ kJ mol}^{-1}$
 D. $[(-270 \times 2) - (-820)] \text{ kJ mol}^{-1}$

28. Refer to the following conversion :



Which of the following combinations of steps is correct ?

- | | Step 2 |
|--|---|
| A. concentrated $\text{H}_2\text{SO}_4(\text{l})$, heat ✓ | $\text{PCl}_3(\text{l})$ |
| B. $\text{Al}_2\text{O}_3(\text{s})$, heat | $\text{HCl}(\text{g})$ |
| C. $\text{NaOH}(\text{aq})$ ✓ | concentrated $\text{HCl}(\text{aq})$ |
| D. $\text{NaOH}(\text{aq})$ ✓ | Cl_2 (dissolved in an organic solvent) ✓ |

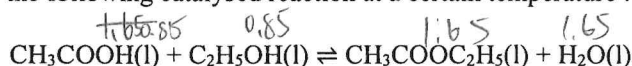
29. An acyclic hydrocarbon **R** contains $\text{C}=\text{C}$ bond as the only functional group. 0.4 mol of **R** completely reacts with 19.2 dm^3 of hydrogen gas at room conditions. How many $\text{C}=\text{C}$ bond(s) may **R** have ?

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

- A. 1
B. 2
C. 3
D. 4

0.8 mol

30. Refer to the following catalysed reaction at a certain temperature :



A mixture of 2.50 mol of $\text{CH}_3\text{COOH}(\text{l})$ and 2.50 mol of $\text{C}_2\text{H}_5\text{OH}(\text{l})$ was placed in a closed container and kept at this temperature. When equilibrium was attained, 0.85 mol of $\text{CH}_3\text{COOH}(\text{l})$ remained in the reaction mixture. What is the numerical value of the equilibrium constant K_c for the above reaction at this temperature ?

- A. 0.27
B. 2.28
C. 3.77
D. K_c cannot be determined because the total volume of the mixture is not known.

31. Which of the following statements concerning the elements in the Periodic Table is correct ? ✓

- ~~A.~~ The electrical conductivities of metals in the third period decrease from left to right.
~~B.~~ The melting points of the Group I elements increase down the group.
~~C.~~ The atomic sizes of noble gases decrease down the group.
~~D.~~ The boiling points of halogens increase down the group.

PART II

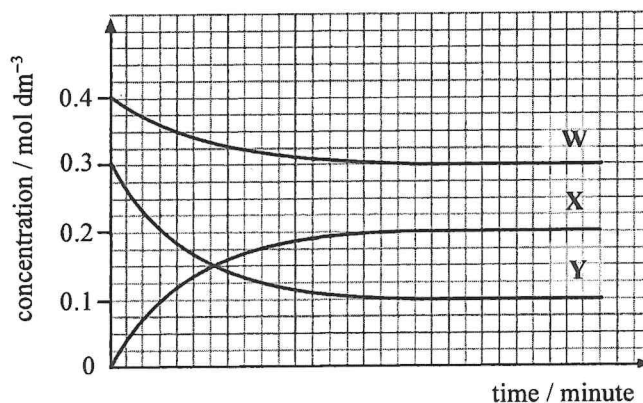
25. An experiment was performed to study the rate of the following reaction :



In a closed container of fixed volume at a certain temperature, the concentration of $\text{X}_2(\text{g})$ decreased from 0.10 mol dm^{-3} to 0.04 mol dm^{-3} in the first 4 minutes.

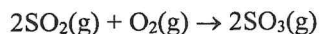
What is the average rate of formation of $\text{X}(\text{g})$ in the first 4 minutes ?

- A. $0.010 \text{ mol dm}^{-3} \text{ min}^{-1}$
 B. $0.015 \text{ mol dm}^{-3} \text{ min}^{-1}$
 C. $0.020 \text{ mol dm}^{-3} \text{ min}^{-1}$
 D. $0.030 \text{ mol dm}^{-3} \text{ min}^{-1}$
26. The graph below shows the changes in the concentrations of the chemical species (W, X and Y) of a reaction with time :



Which of the following equations can best represent the reaction involved ?

- A. $2\text{W} + \text{Y} \rightleftharpoons 2\text{X}$
 B. $2\text{X} \rightleftharpoons 2\text{W} + \text{Y}$
 C. $\text{W} + 2\text{Y} \rightleftharpoons 2\text{X}$
 D. $2\text{X} \rightleftharpoons 3\text{W} + \text{Y}$
27. Consider the rate and the collisions between particles of the following reaction :



Which of the following combinations is correct when the concentration of $\text{SO}_2(\text{g})$ is increased at a constant temperature ?

- | | Rate of reaction | Collisions between particles |
|----|-------------------|-------------------------------|
| A. | increases | have more energy on average ✓ |
| B. | increases | have higher frequency |
| C. | remains unchanged | have more energy on average ✓ |
| D. | remains unchanged | have higher frequency |

15. Which of the following statements concerning the combustion of ethanol is correct?

- A. The combustion of ethanol is endothermic. ~~X~~
 B. The total enthalpy of products is less than that of reactants.
 C. Ethanol burns immediately when it is exposed to air at room conditions.
 D. The total energy involved in the bond-breaking processes is more than that in the bond-formation processes. ~~X~~

16. Consider these atoms: ${}_{32}^{74}\text{Ge}$, ${}_{33}^{75}\text{As}$ and ${}_{34}^{76}\text{Se}$.

Which of the following statements is / are correct?

- (1) They have different numbers of protons. ✓
 (2) They have different numbers of neutrons.
 (3) They have different numbers of outermost shell electrons.

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

17. The monosubstitution of $\text{CH}_4(\text{g})$ with $\text{Cl}_2(\text{g})$ under diffuse sunlight involves three steps: initiation, propagation and termination. Which of the following steps can lead to a termination of the reaction?

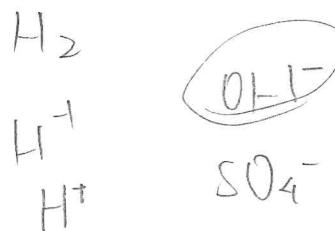
- (1) $\text{Cl}_2 \rightarrow \text{Cl}\cdot + \text{Cl}\cdot$
 (2) $\text{CH}_3\cdot + \text{Cl}\cdot \rightarrow \text{CH}_3\text{Cl}$ ✓
 (3) $\text{CH}_4 + \text{Cl}\cdot \rightarrow \text{CH}_3\cdot + \text{HCl}$

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

18. In electrolytic cell X, dilute $\text{H}_2\text{SO}_4(\text{aq})$ is used as the electrolyte and platinum is used as the electrodes. At the beginning of electrolysis, which of the following electrolytic cells can give the same product at the cathode as at the cathode in electrolytic cell X?

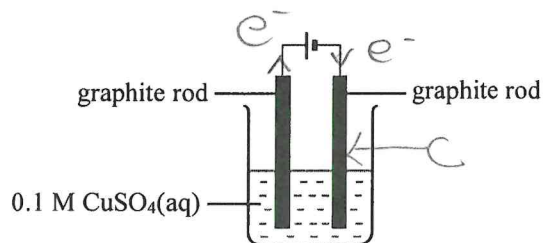
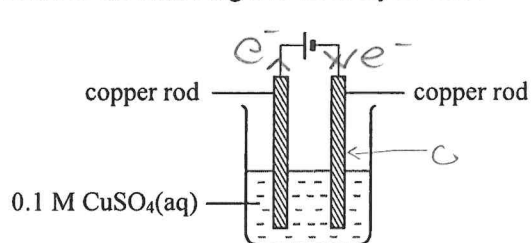
Electrolytic cell	Electrolyte	Anode	Cathode
(1)	dilute $\text{AgNO}_3(\text{aq})$	graphite	graphite
(2)	dilute $\text{CH}_3\text{COOH}(\text{aq})$	graphite	graphite
(3)	dilute $\text{NaOH}(\text{aq})$ ✓	platinum	platinum

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





19. Refer to the following two electrolytic cells :



Which of the following statements is / are correct ?

- (1) During electrolysis, a reddish brown solid is deposited at the cathode in both electrolytic cells.
 (2) During electrolysis, gas bubbles are given out at the anode in both electrolytic cells.
 (3) During electrolysis, the pH of the solution decreases in both electrolytic cells.

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

20. Which of the following processes can be used to distinguish between $\text{K}_2\text{CO}_3(\text{aq})$ and $\text{CaCl}_2(\text{aq})$?

- (1) performing a flame test ✓
 (2) adding dilute hydrochloric acid ✓
 (3) adding acidified silver nitrate solution

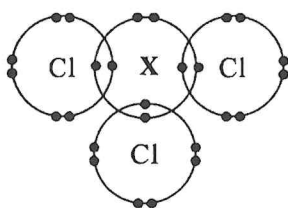
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)

21. Which of the following statements can show that metal Y is more reactive than gold?

- (1) Y can react with dilute hydrochloric acid whilst gold cannot. ✓
 (2) Y can displace copper from copper(II) nitrate solution whilst gold cannot. ✓
 (3) Gold can be extracted from its ore by physical method whilst Y cannot. ✓

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

22. Element X is one of the first twenty elements in the Periodic Table. X can form two chlorides, XCl_3 and XCl_5 . The electron diagram (only electrons in the outermost shells are shown) of XCl_3 is shown below :

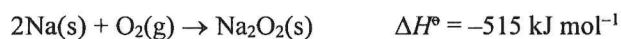


Which of the following statements about X are correct ?

- (1) X belongs to Group V of the Periodic Table. ✓
 (2) X is in the third period of the Periodic Table.
 (3) The X atom in XCl_5 has an octet electronic arrangement.

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

23. Refer to the following thermochemical equation :



Which of the following statements are correct ?

- (1) The standard enthalpy change of formation of $\text{Na}_2\text{O}_2\text{(s)}$ is -515 kJ mol^{-1} . ✓
 (2) The standard enthalpy change of combustion of Na(s) is -515 kJ mol^{-1} .
 (3) When 2 mol of Na(s) reacts with 1 mol of $\text{O}_2\text{(g)}$ to form 1 mol of $\text{Na}_2\text{O}_2\text{(s)}$ under standard conditions, 515 kJ of heat is released.

- 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

~~Copper can react with dilute nitric acid but not with dilute ethanoic acid.~~

2nd statement

Nitric acid is a strong acid while ethanoic acid is a weak acid.

- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
 B. Both statements are true and 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.

