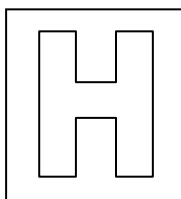


Candidate Name: _____

Class Adm No

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2025 Preliminary Examination Pre-University 3

H2 CHEMISTRY

9729/01

Paper 1 Multiple Choice

17 Sep 2025

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not turn over this question paper until you are told to do so

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and admission number in the spaces provided at the top of this page and on the Multiple Choice Answer Sheet provided.

There are **thirty** questions on this paper. Answer **ALL** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet provided.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

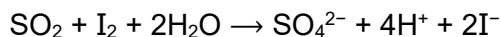
Any rough working should be done in this question paper.

The use of an approved scientific calculator is expected, where appropriate.

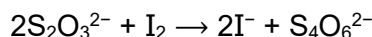
FOR EXAMINER'S USE	
TOTAL (30 marks)	

- 1 Sulfur dioxide is a preservative that can be found in small amount in wines. The sulfur dioxide content in wine can be determined through back titration.

A 25 cm³ sample of wine is reacted with 30.0 cm³ of 0.01 mol dm⁻³ of excess aqueous iodine, oxidising the sulfur dioxide in the wine to sulfate, SO₄²⁻, in the process.



The unreacted iodine requires exactly 24.80 cm³ of 0.02 mol dm⁻³ sodium thiosulfate for complete reaction.



What is the concentration of sulfur dioxide, in mol dm⁻³, in the wine?

- A** 2.08×10^{-3} **B** 2.48×10^{-3} **C** 9.92×10^{-3} **D** 2.77×10^{-2}

- 2 Which of the following contains approximately the same number of the stated particles as there are atoms in 18.0 g of water?

- 1 number of ions in 142.1 g of sodium sulfate, Na₂SO₄
- 2 number of molecules in 6.0 g of hydrogen gas
- 3 number of neutrons in 6.0 g of carbon-12

- A** 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

- 3 Ions of the two most common isotopes of zinc are shown below:



Which of the following statements is correct?

- A** Both these Zn²⁺ ions have the same number of electrons but different number of protons.
B Both these Zn²⁺ ions have the same electronic configuration 1s²2s²2p⁶3s²3p⁶3d⁸4s².
C The ${}_{30}^{64}\text{Zn}^{2+}$ ion has fewer neutrons in its nucleus than the ${}_{30}^{66}\text{Zn}^{2+}$ ion.
D The ${}_{30}^{66}\text{Zn}^{2+}$ ion will be deflected more than the ${}_{30}^{64}\text{Zn}^{2+}$ ion in an electric field of the same strength.

- 4 The successive ionisation energies (IE) of two elements, **W** and **X**, are given below.

IE / kJ mol ⁻¹	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
W	1090	2350	4610	6220	37800	47000	-	-
X	1251	2298	3822	5158	6542	9362	11018	33604

What is the likely formula of the compound that is formed when **W** reacts with **X**?

- A** **WX** **B** **W₂X₃** **C** **WX₄** **D** **W₄X**

- 5 Which of following statements are **incorrect**?

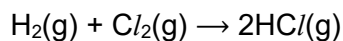
- Any covalent compound that contains both hydrogen and oxygen in its molecule can form intermolecular hydrogen bond.
- Ionic compounds can be distinguished from metals by their electrical conductivity in the liquid states.
- All substances with covalent bonding have poor electrical conductivity.

- A** 1 and 2 **B** 2 and 3 only **C** 1 and 3 only **D** 1, 2 and 3

- 6 Which of the following species contains the smallest bond angle?

- A** N₂H₄ **B** BrF₅ **C** XeF₂ **D** SO₂

- 7 The table below shows the standard thermodynamic values for the synthesis of hydrogen chloride:



ΔH^\ominus	-184.6 kJ mol ⁻¹
ΔS^\ominus	+20.0 J K ⁻¹ mol ⁻¹

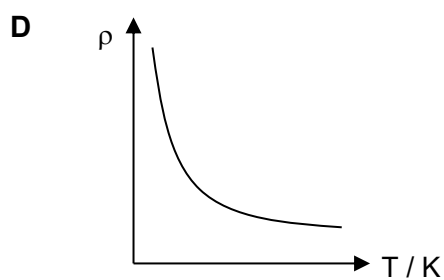
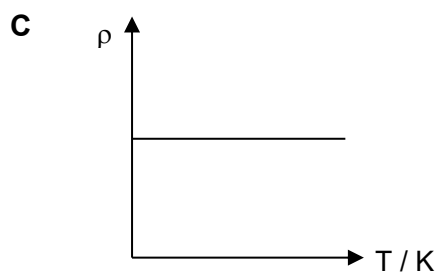
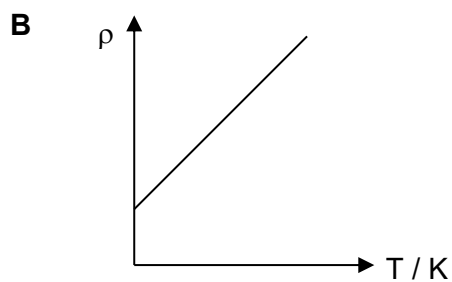
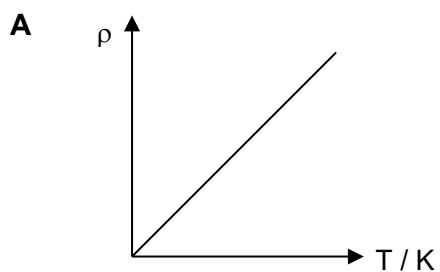
What is the value of ΔG^\ominus of the reaction?

- A** +179 kJ mol⁻¹ **B** -179 kJ mol⁻¹ **C** -185 kJ mol⁻¹ **D** -191 kJ mol⁻¹

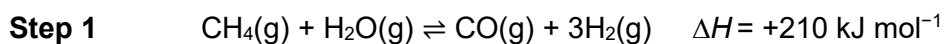
- 8 Which of the following has the same value as the standard enthalpy change of formation of carbon monoxide?

- A $\frac{1}{2}\Delta H_c^\ominus(\text{C}(\text{graphite}))$
B $\Delta H_f^\ominus(\text{CO}_2) - \Delta H_c^\ominus(\text{C}(\text{graphite}))$
C $\Delta H_f^\ominus(\text{CO}_2) - \frac{1}{2}\Delta H_c^\ominus(\text{C}(\text{graphite}))$
D $\Delta H_c^\ominus(\text{C}(\text{graphite})) - \Delta H_c^\ominus(\text{CO})$

- 9 Which of the following graphs shows the correct relationship between the density of a gas (ρ) against temperature (T) for an ideal gas under constant pressure?



- 10** Steam reforming of methane is the main source of production of hydrogen in the industry. There are two steps in the process, both being in equilibrium in closed systems:



Which statement about **Step 1** and **Step 2** is correct?

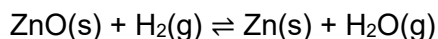
- A** Increasing the pressure increases the equilibrium constant for **Step 2**.
 - B** Increasing the temperature increases the equilibrium constant for **Step 1**.
 - C** Addition of a catalyst increases both the yield and rate of production of hydrogen gas.
 - D** Increasing the temperature decreases the rate constant for the forward reaction in **Step 2**.
- 11** The Contact process is an industrial process to produce sulfuric acid. One of the reactions involved is the reaction of sulfur dioxide with oxygen.



Which of the following pair of changes will increase the amount of SO_3 present at equilibrium?

	temperature	pressure
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

- 12 Zinc oxide reacts with hydrogen according to the following equation.

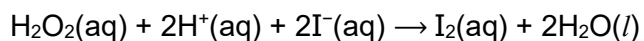


At temperature T and a total pressure of 10 atm, it is found that initial amounts of 1 mole of zinc oxide and hydrogen gas each produce 0.01 mole of zinc and steam at equilibrium.

What is the approximate value of K_p at temperature T?

- A** 10^{-4} **B** 10^{-2} **C** 10 **D** 100

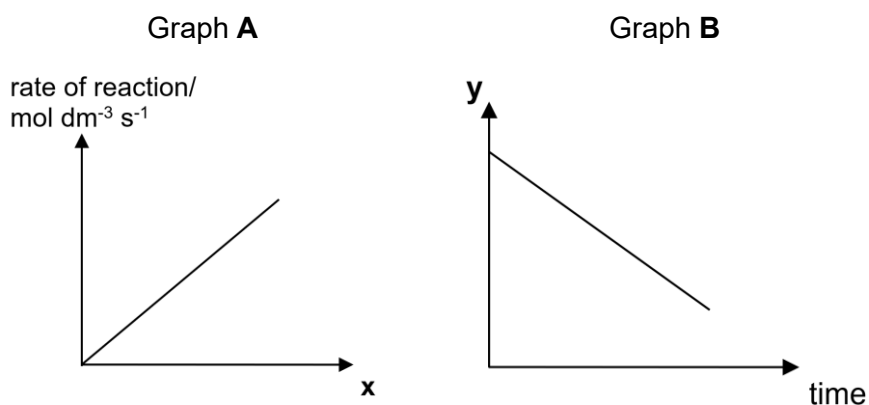
- 13 The reaction between hydrogen peroxide and acidified iodide ions produces iodine. This reaction can be represented by the following equation:



Investigation of the reaction kinetics revealed that the rate equation takes the form:

$$\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$$

The results of two separate series of experiments are displayed in Graph **A** and Graph **B**.



Which of the following shows the correct labeling of the x-axis for Graph **A** and y-axis for Graph **B**?

	x-axis for Graph A	y-axis for Graph B
A	$[\text{H}_2\text{O}_2][\text{I}^-] / \text{mol}^2 \text{ dm}^{-6}$	$[\text{H}^+] / \text{mol dm}^{-3}$
B	$[\text{I}^-][\text{H}^+] / \text{mol}^2 \text{ dm}^{-6}$	$[\text{I}_2] / \text{mol dm}^{-3}$
C	$[\text{H}_2\text{O}_2] / \text{mol dm}^{-3}$	$[\text{I}^-] / \text{mol dm}^{-3}$
D	$[\text{H}^+] / \text{mol dm}^{-3}$	$[\text{H}_2\text{O}_2] / \text{mol dm}^{-3}$

- 14 The reaction between substances **A** and **B** is found to follow the rate law

$$\text{rate} = k[\mathbf{A}]^m[\mathbf{B}]$$

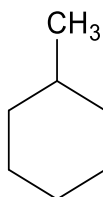
where k is the rate constant and has units of $\text{mol}^{-2} \text{dm}^6 \text{s}^{-1}$.

Two experiments to study the kinetics of this reaction were carried out and the data obtained are tabulated below.

Experiment	Initial [A] / mol dm^{-3}	Initial [B] / mol dm^{-3}	Initial rate / $\text{mol dm}^{-3} \text{s}^{-1}$
1	0.040	0.080	R
2	0.020	y	$\frac{R}{2}$

What is the value of y in experiment 2?

- A** 0.020 **B** 0.040 **C** 0.160 **D** 0.320
- 15 Methylcyclohexane can react with chlorine gas to form monochlorinated products.

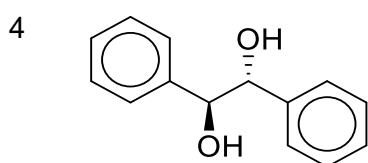
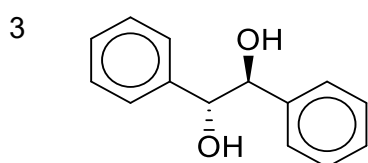
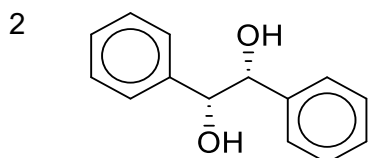
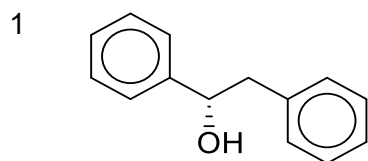


methylcyclohexane

How many different constitutional isomers of monochlorinated products can be formed?

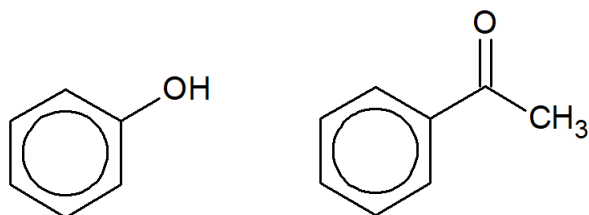
- A** 4 **B** 5 **C** 6 **D** 7

16 Which molecules rotate plane polarised light?



- A** 1 and 2 only **B** 3 and 4 only **C** 1, 3 and 4 only **D** 1, 2, 3 and 4

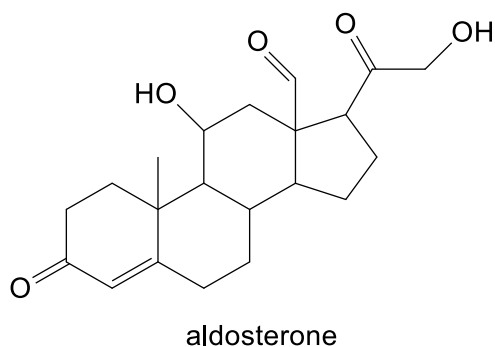
17 Which of the following reagents can be used to distinguish between the two compounds below?



- 1 alkaline $\text{I}_2(\text{aq})$
 2 neutral $\text{FeCl}_3(\text{aq})$
 3 $\text{Na}_2\text{CO}_3(\text{aq})$
 4 2,4-dinitrophenylhydrazine

- A** 1 and 3 only **B** 2 and 4 only **C** 1, 2 and 4 only **D** 1, 2, 3 and 4

- 18 Aldosterone is a hormone essential for sodium conservation in the kidney and colon.



How many chiral carbons are there in the product of the reaction between aldosterone and LiAlH_4 in dry ether?

- A** 7 **B** 8 **C** 9 **D** 10

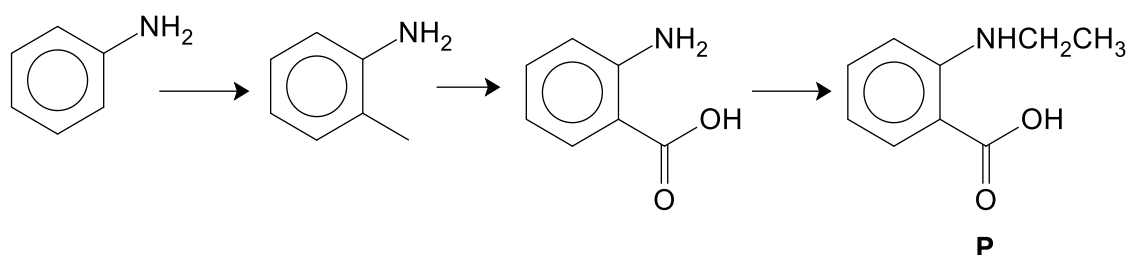
- 19 The molecular formula of compound **X** is $\text{C}_5\text{H}_{12}\text{O}$. **X** has the following properties:

- reacts with alkaline aqueous iodine
- can be dehydrated to form two alkenes only.

What could be the identity of **X**?

- A** $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$
B $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CH}_3$
C $(\text{CH}_3)_2\text{CHCH}(\text{OH})\text{CH}_3$
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$

- 20 The reaction scheme below shows the synthesis of compound **P** from phenylamine.



Which of the following types of reaction is **not** involved in the reaction scheme shown?

- A electrophilic substitution
 - B nucleophilic addition
 - C nucleophilic substitution
 - D oxidation
- 21 What is produced when $\text{CH}_3\text{NHCH}_2\text{CONH}_2$ is added to an excess of $\text{H}_2\text{SO}_4(\text{aq})$ and heated?
- A $\text{CH}_3\text{NH}_2^+\text{CH}_2\text{CONH}_2$
 - B $\text{CH}_3\text{NH}_2^+\text{CH}_2\text{CO}_2\text{H}$
 - C $\text{CH}_3\text{NHCH}_2\text{CONH}_3^+$
 - D $\text{CH}_3\text{NH}_2^+\text{CH}_2\text{COO}^-$
- 22 Which of the following statements about the theories of acids and bases is true?
- A All Arrhenius acids can behave as Lewis acids.
 - B All Brønsted-Lowry bases can behave as Arrhenius bases.
 - C All Lewis acids can behave as Arrhenius acids.
 - D All Lewis bases can behave as Arrhenius bases.

- 23** Paracetamol ($pK_a = 9.5$) is a widely used over-the-counter pain reliever and fever reducer. Its solubility in water is 12.78 g dm^{-3} at 25°C .

What is its pH of a saturated solution of paracetamol at 25°C ?

[M_r of paracetamol = 151.0]

- A** 4.20 **B** 5.29 **C** 6.79 **D** 8.71

- 24** Soap scum is a white residue that forms when soap reacts with minerals such as Ca^{2+} in hard water. Soap scum forms when the concentration of Ca^{2+} ions in water is greater than $10^{-5} \text{ mol dm}^{-3}$.

What is the minimum mass of sodium carbonate that should be added to 1 dm^3 of water to prevent soap scum from being formed?

[$K_{sp} \text{ CaCO}_3 = 5.0 \times 10^{-9} \text{ mol}^2 \text{ dm}^{-6}$]

- A** 0.037 g **B** 0.042 g **C** 0.050 g **D** 0.053 g

- 25** Which compound dissolves in water to give a solution with the lowest pH?

- A** SO_3 **B** P_4O_{10} **C** MgCl_2 **D** Al_2O_3

- 26** Which property generally increases down for elements in Group 2?

- A** charge density of the M^{2+} ion
B electronegativity
C first ionisation energy
D thermal stability of the carbonate

27 *Use of the Data Booklet is relevant to this question.*

Electric cars use zinc-air battery with one electrode made up of zinc and the other is a carbon electrode. During discharge, zinc dissolves as ions. At the carbon electrode, hydroxide ions are formed. Zinc ions then react with the hydroxide ions, forming solid zinc hydroxide.

Which statements about this cell are correct?

- 1 The e.m.f of the cell is +1.16V.
- 2 The overall cell reaction is $2\text{Zn} + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Zn}(\text{OH})_2$.
- 3 Overall pH of the solution does not change at the end of the reaction.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

28 Electrolysis of a dilute hydrochloric acid solution was carried out by passing a current of 0.1 A through it.

How long will it take to liberate 0.01 mol of H_2 gas at the cathode?

- A** $9.65 \times 10^3 \text{ s}$
B $1.93 \times 10^4 \text{ s}$
C $2.90 \times 10^4 \text{ s}$
D $3.86 \times 10^4 \text{ s}$

29 Which of the following species cannot act as a ligand in the formation of complexes?

- A** CH_3NH_2 **B** Cl^- **C** NH_4^+ **D** OH^-

30 When drops of $\text{NH}_3(\text{aq})$ are added to $\text{Cu}(\text{NO}_3)_2(\text{aq})$, a pale blue precipitate is formed. This precipitate dissolves when an excess of $\text{NH}_3(\text{aq})$ is added, giving a dark blue solution.

Which of the following process does **not** occur?

- A** ligand exchange
B acid-base reaction
C reduction of Cu^{2+} ions
D formation of a complex ion

1	2	3	4	5
A	D	C	C	D
6	7	8	9	10
B	D	D	D	B
11	12	13	14	15
C	B	A	C	B
16	17	18	19	20
A	C	C	C	B
21	22	23	24	25
B	A	B	D	A
26	27	28	29	30
D	B	B	C	C

