

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY

8873/01

Paper 1 Multiple Choice

22 September 2025

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, CT and NRIC / FIN on the Answer Sheet in the spaces provided.

There are **thirty** questions in 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 separate Answer Sheet.

Read the instructions on the 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 booklet.

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

- 1 X, Y and Z are different sub-atomic particles.

X has a mass of 9.11×10^{-31} kg and Y has a mass of 1.67×10^{-27} kg.

Z is not deflected when passed through an electric field.

What could be the identities of X, Y and Z?

	X	Y	Z
A	electron	neutron	proton
B	electron	proton	neutron
C	proton	electron	neutron
D	proton	neutron	electron

- 2 M and T are cations. M contains n protons and has a charge of 3+. T contains (n–2) protons and has the same number of electrons as M.

What is the formula of the oxide formed by T?

- A** TO
B T₂O
C T₂O₃
D TO₂

- 3 When aqueous copper(II) sulfate is mixed with potassium iodide, a white precipitate of CuI in a brown solution is formed.

What is the electronic configuration of the copper cation in the white precipitate?

- A** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$
B $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$
C $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$
D $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^1$

- 4 The boiling point of methane is $-161.5\text{ }^{\circ}\text{C}$ while that of neon is $-264\text{ }^{\circ}\text{C}$.

Why is the boiling point of methane greater than that of neon?

- A Molecules of methane have a larger surface area to form stronger intermolecular forces than those of neon.
- B A molecule of methane has more electrons than an atom of neon.
- C A molecule of methane has a greater relative molecular mass than an atom of neon.
- D Molecules of methane form hydrogen bonds, but those of neon do not.

- 5 Boron trifluoride is a highly reactive gas at room temperature and hence it is difficult to handle. To store it in liquid form, 2 mol of BF_3 reacts with 1 mol of $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ to form compound N.

Which statement is correct?

- A The boron atom in compound N has an incomplete octet.
- B 2 mol of AlF_3 can also react with 1 mol of $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ to form a similar compound.
- C Two dative bonds are formed from the boron atom in two BF_3 molecules towards the O atom in $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$.
- D The bond angle with respect to boron atom in BF_3 is bigger than the bond angle with respect to boron in compound N.

- 6 Which pairs of ions give an ionic compound with the lowest melting point?

	cation	anion
A	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{P}^+ - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{O} \\ \\ ^-\text{O} - \text{S} - \text{O}^- \\ \\ \text{O} \end{array}$
B	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{CH}_2 - \text{P}^+ - \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$	$\text{CH}_3 - \text{C}_6\text{H}_4 - \begin{array}{c} \text{O} \\ \\ \text{S} - \text{O}^- \\ \\ \text{O} \end{array}$
C	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{P}^+ - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	$\text{CH}_3 - \text{C}_6\text{H}_4 - \begin{array}{c} \text{O} \\ \\ \text{S} - \text{O}^- \\ \\ \text{O} \end{array}$
D	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3\text{CH}_2 - \text{P}^+ - \text{CH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$	$\begin{array}{c} \text{O} \\ \\ ^-\text{O} - \text{S} - \text{O}^- \\ \\ \text{O} \end{array}$

- 7 X is a transition element that forms ions of various oxidation states. One ion, X^{2+} , reduces $\text{Cr}_2\text{O}_7^{2-}$ in acid solution.

If 1 mol of $\text{Cr}_2\text{O}_7^{2-}$ is reduced by 2 mol of X^{2+} , which species is formed in the reaction?

- A** XO_4^{2-} **B** XO_2^+ **C** XO^{2+} **D** X^{3+}

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

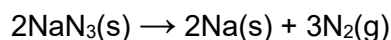
Osmium, $_{76}\text{Os}$, is an exceptionally dense metal, with a density of 23 g cm^{-3} .

How many atoms are present in 1.0 cm^3 of Os?

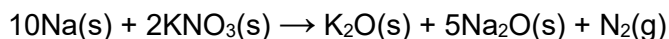
- A** 7.3×10^{22} **B** 1.8×10^{23} **C** 2.0×10^{24} **D** 5.0×10^{24}

- 9 Sodium azide, NaN_3 , and potassium nitrate, KNO_3 , are both present in the airbags of some cars.

When the airbag is activated, the sodium azide first decomposes to give sodium and nitrogen.



The sodium then reacts with the potassium nitrate to produce more nitrogen.



The nitrogen produced in these two reactions inflates the airbag.

The amount of gas needed to inflate the airbag is 2.00 mol.

Which amount of sodium azide is needed to make a total of 2.00 mol of nitrogen gas?

- A** 0.625 mol **B** 1.00 mol **C** 1.25 mol **D** 1.33 mol

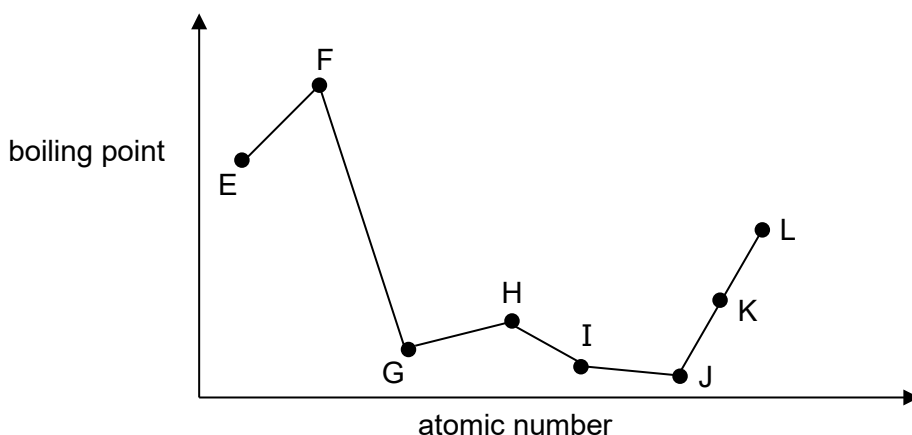
- 10 *Use of the Data Booklet is relevant to this question.*

Due to its radioactive nature, the properties of astatine, At, have to be predicted based on its position in the Periodic Table.

Which statement concerning At or its compounds is correct?

- A** Hydrogen astatide has a higher decomposition temperature than hydrogen bromide.
B Astatine is a light coloured solid at room temperature.
C Silver astatide is soluble in $\text{NH}_3(\text{aq})$.
D Astatine is a weaker oxidising agent than iodine.

- 11 The graph below shows the variation in the boiling point for 8 consecutive elements in the Periodic Table, all with atomic number less than 21.



Which statements are correct?

- 1 The chloride of E reacts with aqueous sodium hydroxide to give a precipitate which is soluble in excess sodium hydroxide.
- 2 The oxide of F is neutral in aqueous solution.
- 3 The oxide of K dissolves readily in water to give a strongly alkaline solution.

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

- 12 The variation in the melting points of the elements in Period 3 can be explained by reference to their structure and bonding.

Which row is correct?

	relative melting point of two elements	explanation
A	$Al > Na$	aluminium is giant covalent, sodium is giant metallic
B	$Cl > S$	chlorine has stronger instantaneous dipole-induced dipole forces due to the additional electron in each chlorine atom
C	$Mg > Cl$	magnesium is giant metallic, chlorine is simple molecular
D	$Si > P$	both are giant covalent but the bonding in silicon is stronger

13 In which reaction is the underlined substance in the equation acting as a Bronsted-Lowry base?

- A** $\text{CaO(s)} + \underline{\text{H}_2\text{O(l)}} \rightarrow \text{Ca(OH)}_2\text{(aq)}$
- B** $\underline{\text{CH}_3\text{CH}_2\text{Cl(g)}} + \text{OH}^-\text{(aq)} \rightarrow \text{CH}_3\text{CH}_2\text{OH(aq)} + \text{Cl}^-\text{(aq)}$
- C** $\text{NaOH(aq)} + \underline{\text{HCl(aq)}} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$
- D** $\underline{\text{NH}_3\text{(g)}} + \text{HCl(g)} \rightarrow \text{NH}_4\text{Cl(s)}$

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

At 60 °C the ionic product of water, K_w , has the value of $9.5 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.

Which statements concerning water at 60 °C are correct?

- 1 $[\text{OH}^-] = 4.75 \times 10^{-7} \text{ mol dm}^{-3}$
- 2 heating water from 25 °C to 60 °C causes water to ionise more
- 3 the pH is 6.51

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

15 Acid Q is a strong acid. A $0.050 \text{ mol dm}^{-3}$ solution of Q has a pH of 1.00.

Which acid is Q?

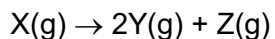
- A** HCl **B** HNO_3 **C** H_3PO_4 **D** H_2SO_4

- 16** The rate of a reaction is measured in $\text{mol dm}^{-3} \text{s}^{-1}$.

Which row is correct?

	overall order of reaction	units of rate constant
A	zero	$\text{mol}^{-1} \text{dm}^{-3} \text{s}^{-1}$
B	first	$\text{mol dm}^3 \text{s}^{-1}$
C	second	$\text{mol}^2 \text{dm}^{-6} \text{s}^{-1}$
D	third	$\text{mol}^{-2} \text{dm}^6 \text{s}^{-1}$

- 17** The gaseous decomposition reaction of X is observed to be first order.



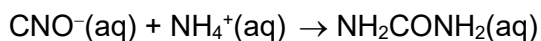
In an experiment, 0.10 mol of pure X(g) was put into an evacuated flask. It was found that there was 0.025 mol of X left after 30 minutes.

Which statements are correct?

- 1 There was 0.0625 mol of X left after 15 minutes.
- 2 There was 0.05 mol of Z in the flask after 30 minutes.
- 3 It took 15 minutes for the amount of Y to rise from 0 mol to 0.10 mol.

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

- 18** Urea can be formed from cyanate ions and ammonium ions as shown.



Keeping the temperature constant, different initial concentrations of $\text{CNO}^-(\text{aq})$ and $\text{NH}_4^+(\text{aq})$ are mixed and the relative initial rates of reaction determined.

experiment	initial $[\text{CNO}^-]$ / mol dm^{-3}	initial $[\text{NH}_4^+]$ / mol dm^{-3}	relative rate
1	0.5	2.5	5.80
2	0.5	0.5	1.16
3	2.0	2.5	23.20
4	1.0	1.0	?

What is the relative rate of experiment 4?

- A** 4.64 **B** 6.96 **C** 9.28 **D** 11.60

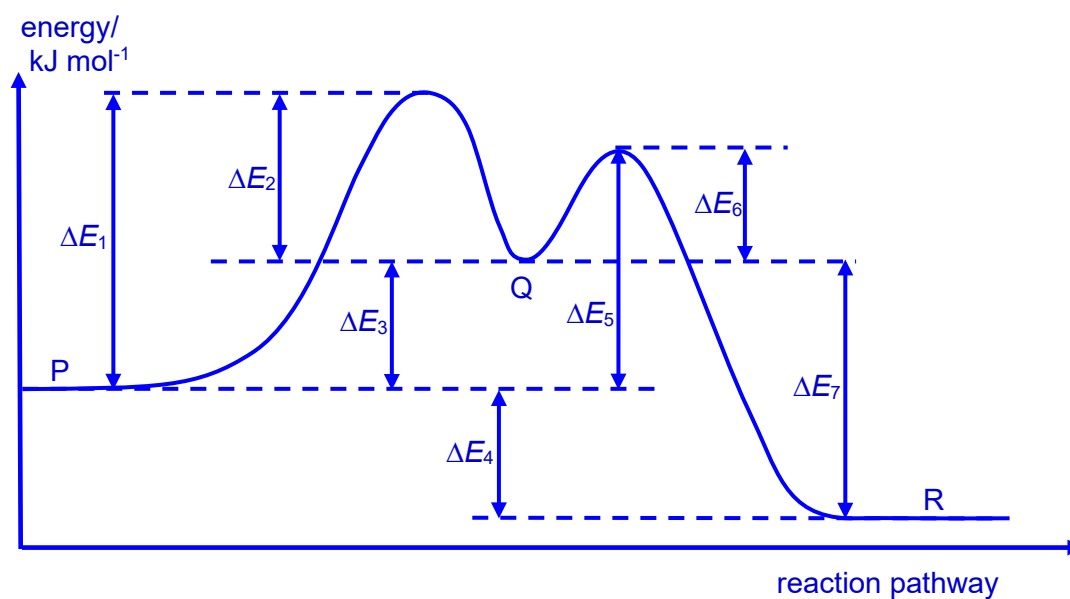
- 19 This question refers to 'reaction X' in which compound P is converted into compound R.



This reaction can be broken into two steps as shown.



The energy profile of reaction X is shown.



Which rows about the magnitudes of activation energy and enthalpy change of reaction are correct?

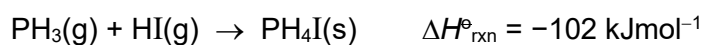
		magnitude of activation energy	magnitude of enthalpy change of reaction
1	reaction X	ΔE_1	ΔE_4
2	step 1	ΔE_1	ΔE_3
3	step 2	ΔE_6	ΔE_7

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

20 Which equation represents the standard enthalpy change of formation of magnesium oxide?

- A** $\text{Mg(s)} + \frac{1}{2}\text{O}_2\text{(g)} \rightarrow \text{MgO(s)}$
B $\text{Mg(g)} + \text{O(g)} \rightarrow \text{MgO(s)}$
C $\text{Mg}^+\text{(g)} + \text{O}^-\text{(g)} \rightarrow \text{MgO(s)}$
D $\text{Mg}^{2+}\text{(g)} + \text{O}^{2-}\text{(g)} \rightarrow \text{MgO(s)}$

21 Phosphine reacts with hydrogen iodide to form phosphonium iodide.



Given that ΔH°_f for $\text{PH}_3\text{(g)} = +5.4 \text{ kJ mol}^{-1}$ and ΔH°_f for $\text{HI(g)} = +26.5 \text{ kJ mol}^{-1}$, what is the enthalpy change of formation of phosphonium iodide?

- A** $-56.5 \text{ kJ mol}^{-1}$ **B** $-70.1 \text{ kJ mol}^{-1}$ **C** $-80.9 \text{ kJ mol}^{-1}$ **D** $-133.9 \text{ kJ mol}^{-1}$

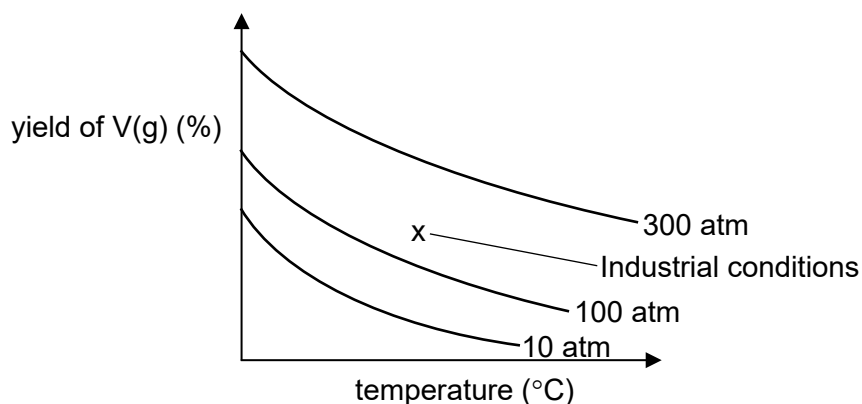
22 Consider the equilibrium $3\text{P}_2\text{(g)} + 2\text{OP(g)} \rightleftharpoons 2\text{OP}_4\text{(g)}$.

When 4 mol of OP_4 was put into a 2 dm^3 container and heated, the equilibrium mixture contained 0.8 mol of OP.

What is the numerical value of the equilibrium constant, K_c ?

- A** 74.1 **B** 9.26 **C** 0.108 **D** 0.0135

- 23** In an industrial process, a single gaseous product V is produced. The percentage yield of V varies according to the pressure and temperature as shown in the graphs. A suitable catalyst is also used in the industrial process.



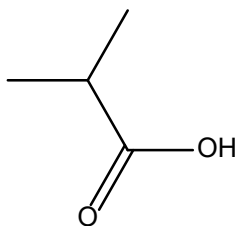
Which statement is incorrect?

- A** The backward reaction is endothermic.
- B** The forward reaction involves a greater number of moles of gaseous reactants than the gaseous product V.
- C** The catalyst is added to increase the yield of V.
- D** The choice of industrial conditions used was decided by taking into consideration the rate of the reaction as well as the cost of building the plant.
- 24** An alkane X with a molecular formula C_4H_{10} reacts with chlorine gas in the presence of ultraviolet light to form only two monochlorinated product Y and Z in a molar ratio of 9:1.

What are the structures of X and Z?

	X	Z
A	$CH_3CH_2CH_2CH_3$	$CH_3CH_2CH_2CH_2Cl$
B	$CH_3CH_2CH_2CH_3$	$CH_3CH_2CHClCH_3$
C	$CH_3CH(CH_3)CH_3$	$CH_3CCl(CH_3)CH_3$
D	$CH_3CH(CH_3)CH_3$	$CH_3CH(CH_3)CH_2Cl$

- 25** The carboxylic acid shown below can be produced by oxidation of an alcohol.



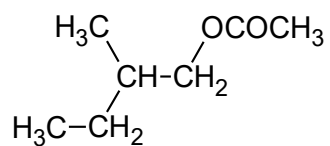
Which alcohol can be oxidised to produce this carboxylic acid?

- A** 2-methylpropan-2-ol
 - B** 2-methylpropan-1-ol
 - C** 2-methylbutan-1-ol
 - D** propan-2-ol
- 26** 2-chlorobutane reacts with sodium hydroxide, under different conditions, to form four different organic products.

Which product is not formed?

- A** but-1-ene
- B** trans-but-2-ene
- C** butan-1-ol
- D** butan-2-ol

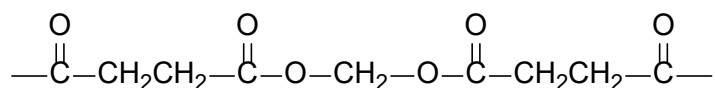
- 27 The following ester is responsible for the smell of banana.



Which pair of reactants can produce the ester?

- A** $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$
- B** $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$
- C** $\text{CH}_3\text{OH} + \text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}_2\text{H}$
- D** $\text{CH}_3\text{CO}_2\text{Na} + \text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$

- 28 Part of the structure of a polymer is shown below.



Which monomers could be used to make the polymer?

- 1 $\text{HO}_2\text{C}-\text{CH}_2\text{CH}_2-\text{CO}_2\text{H}$
- 2 $\text{HO}-\text{CH}_2-\text{OH}$
- 3 $\text{HO}_2\text{C}-\text{CH}_2\text{CH}_2-\text{OH}$
- 4 $\text{HO}_2\text{C}-\text{CH}_2-\text{CO}_2\text{H}$

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

- 29** Which statement about the properties of low-density polyethylene (LDPE) is incorrect?
- A** LDPE is soft and flexible.
 - B** LDPE is chemically inert and has excellent chemical resistance.
 - C** LDPE has high rigidity and is suitable for load bearing application.
 - D** LDPE is used for making films in general packaging and carrier bags.
- 30** Which statement explains why geckos could stick to the surface of the wall?
- A** The millions of tiny setae on its feet can be attached on the rough surface of the wall.
 - B** The millions of tiny setae splits off into thousands of even smaller spatula which provide a large surface area to volume ratio with the wall.
 - C** The millions of tiny setae on its feet can form relatively strong permanent dipole – permanent dipole interactions with the surface of the wall.
 - D** The millions of tiny setae on the wall provides extensive interaction with its feet.