



Catholic Junior College
JC 2 Preliminary Examination
Higher 2

CANDIDATE
NAME

CLASS

2T

CHEMISTRY

9729/01

Paper 1 Multiple Choice

18 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, class and NRIC/FIN number on the Answer Sheet in the spaces provided.

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

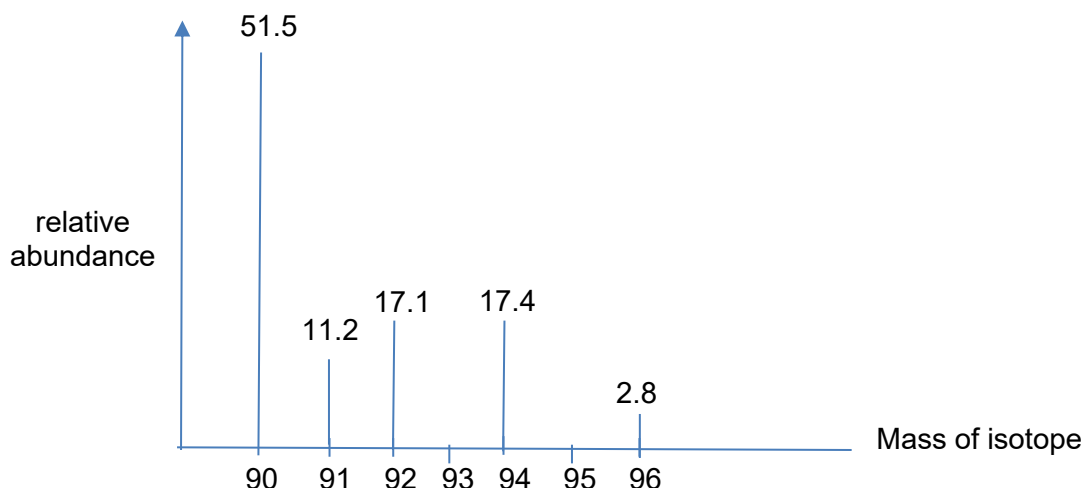
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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 The relative abundances of all the isotopes present in a sample of zirconium are shown.



What is the relative atomic mass of zirconium calculated from these data?

- A** 91.1 **B** 91.3 **C** 91.6 **D** 93.1
- 2 In the interhalogen compound ICl , there is a single polar covalent bond.
Which of the following statement(s) helps to explain the polarity of the I-Cl covalent bond?
- 1 Cl is more electronegative than I .
 - 2 The outer shell electronic configuration of both elements is $s^2 p^6$.
 - 3 The outer shell electrons are more shielded from nuclear charge in I than they are in Cl .
- A** 1, 2 and 3 **B** 1 and 2 **C** 1 and 3 **D** 1 only
- 3 In which pairs of compounds does the first molecule have a smaller bond angle than that in the second molecule?

- | | | |
|---|----------------------|----------------------|
| 1 | NF_3 | CCl_4 |
| 2 | H_2S | H_2O |
| 3 | SF_6 | CS_2 |

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

- 4 The table shows the boiling point of three alcohols.

	boiling point / °C
pentan-1-ol	138
2-methylbutan-2-ol	129
2,2-dimethylpropanol	114

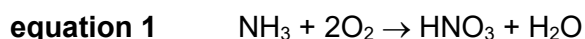
What is responsible for the differences in boiling point?

- A** different relative molecular mass
B different number of carbon-carbon bonds
C weaker hydrogen bonding between branched chain molecules
D more extensive instantaneous dipoles-induced dipoles attractions between straight chain molecules
- 5 Which statements about the behaviour of Group 17 elements from chlorine to iodine are correct?
- A** The elements become stronger oxidising agents.
B The volatility of the elements decreases.
C The thermal stability of the hydrogen halides increases.
D The bond energy of H-X bond increases.
- 6 0.10 mol of an oxide of nitrogen (N_xO_y) is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.
 The water produced in this reaction has a mass of 7.2 g.
 The ammonia produced requires 200 cm³ of 1.0 mol dm⁻³ HCl for complete neutralisation.

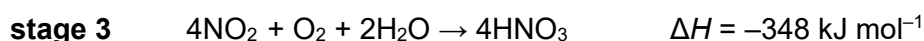
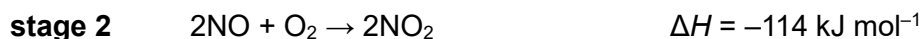
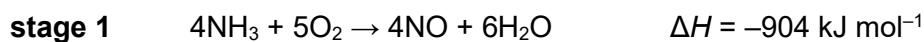
What is the formula of this oxide of nitrogen?

- A** N₂O **B** NO **C** NO₂ **D** N₂O₄
- 7 Sodium thiosulfate is used in the textile industry to remove an excess of chlorine from bleaching processes by reducing it to chloride ions.
- One mole of thiosulfate ions, S₂O₃²⁻, is able to remove 4 moles of chlorine, Cl₂, in this process. In this process, S₂O₃²⁻ is oxidised. What is the resultant sulfur-containing product in this reaction?
- A** HSO₄⁻ **B** S₄O₆²⁻ **C** SO₂ **D** S

- 8 Nitric acid is made industrially by the oxidation of ammonia. The overall equation for the process is shown.



The process happens in three stages. The equations and enthalpy changes for these stages are given.



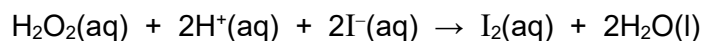
What is the enthalpy change of the process shown in equation 1?

- A** $-1480 \text{ kJ mol}^{-1}$
B -370 kJ mol^{-1}
C $-341.5 \text{ kJ mol}^{-1}$
D $+82 \text{ kJ mol}^{-1}$
- 9 A radioactive element has 2 isotopes, **G** and **H**, with half-lives of 3 days and 6 days respectively. An experiment starts with 4 times as many atoms of **G** as of **H**.

Given that radioactive decay is a first-order reaction, how long will it be before the number of atoms of **G** left equals the number of atoms of **H** left?

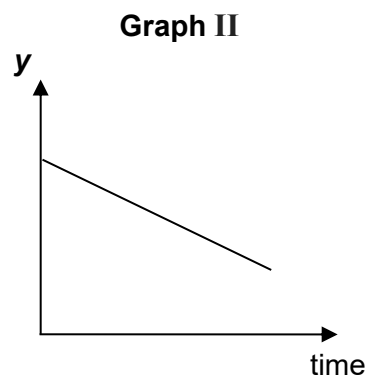
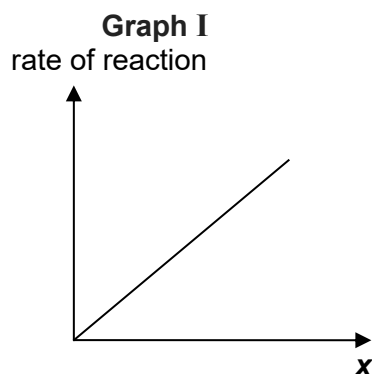
- A** 12 days **B** 15 days **C** 24 days **D** 48 days

- 10 The kinetics of the reaction between hydrogen peroxide and acidified iodide ions were investigated.



The rate equation was found to be $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$

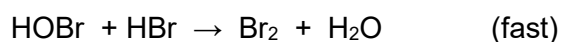
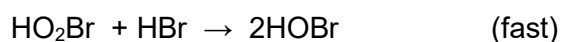
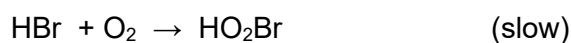
Which of the following shows the correct labelling of the **x**-axis for **Graph I** and **y**-axis for **Graph II**?



x-axis for **Graph I**

y-axis for **Graph II**

- | | | |
|----------|--------------------------------------|--------------------------------------|
| A | $[\text{I}^-]$ | $[\text{H}_2\text{O}_2][\text{I}^-]$ |
| B | $[\text{H}^+]$ | $[\text{I}_2]$ |
| C | $[\text{H}_2\text{O}_2][\text{I}^-]$ | $[\text{H}^+]$ |
| D | $[\text{H}_2\text{O}_2][\text{H}^+]$ | $[\text{I}^-]$ |
- 11 The reaction between HBr and O_2 is thought to occur via a multi-step mechanism:

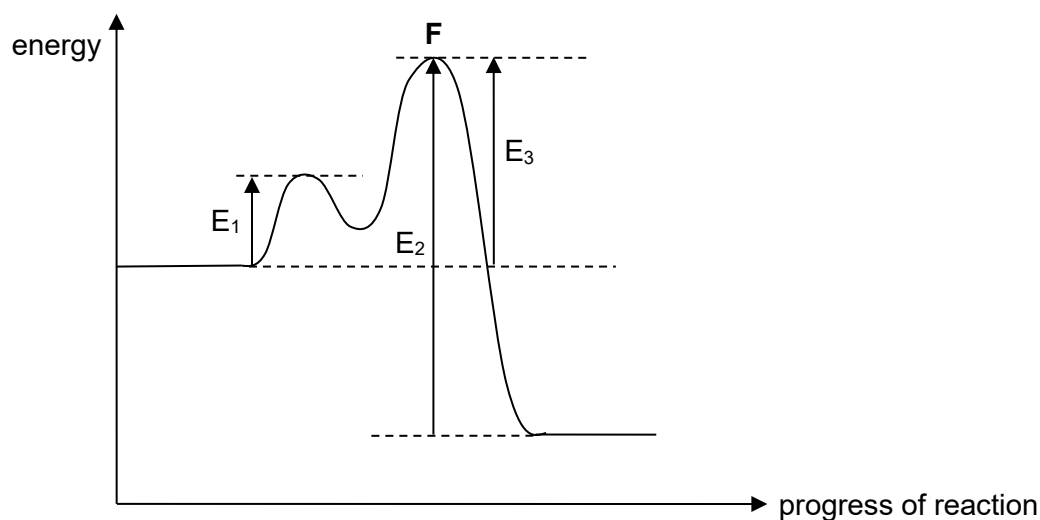


The overall reaction is $4\text{HBr} + \text{O}_2 \rightarrow 2\text{Br}_2 + 2\text{H}_2\text{O}$.

Which statement is correct?

- A** The overall order of reaction is 3.
- B** HO_2Br is the only intermediate in the reaction.
- C** HOBr acts as a catalyst in the reaction.
- D** Units of the rate constant is $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$.

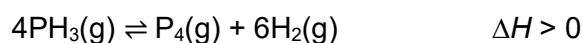
- 12 Which of the following statements is true about the following energy profile for a catalysed reaction shown below?



- 1 The reaction is catalysed by a heterogeneous catalyst.
- 2 The enthalpy change of the reaction is $E_3 - E_2$.
- 3 **F** is the intermediate formed.
- 4 The second step of the reaction is the rate determining step.

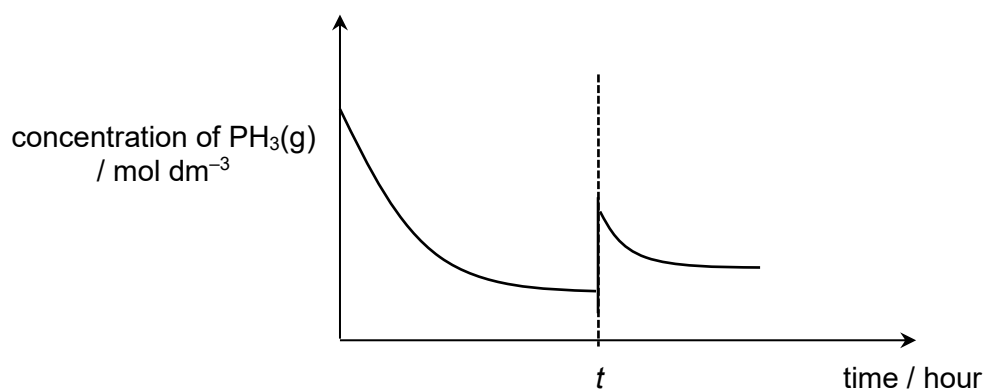
A 2 and 3 **B** 2 and 4 **C** 1 only **D** 4 only

- 13 Phosphine, PH_3 , decomposes to give phosphorus and hydrogen gas.



The graph below shows the change in concentration of PH_3 over time until the reaction mixture reaches equilibrium at a constant temperature of 400 K.

Which of the following is a possible change made at t hour?



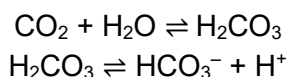
- A** reduction of volume of the vessel
- B** addition of PH_3
- C** removal of P_4
- D** addition of a catalyst

- 14 Which statement about the chemical properties of the oxides in the third period of the Periodic Table is true?
- A Na_2O and MgO can be mixed in water to give an approximately neutral solution.
- B Al_2O_3 is soluble in both KOH and HCl .
- C SO_3 is insoluble in water.
- D SiO_2 forms a solution of pH 2 when dissolved in water at room temperature.

- 15 Which one of the following statements about the behaviour of the Group 2 elements from magnesium to barium is correct?

- A They become weaker reducing agents.
- B The electronegativity increases.
- C The thermal stability of the metal carbonate increases.
- D The enthalpy change of hydration of the ions become more exothermic.

- 16 The concentration of carbon dioxide in the blood is regulated by the following equilibria.



During exercise, the production of lactic acid decreases the pH of blood. Which statements about these equilibria are correct when this happens?

- 1 The positions of both equilibria shift left.
- 2 $[\text{H}^+]$ decreases.
- 3 HCO_3^- acts as a Bronsted-Lowry acid.

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

- 17 Equal volumes of aqueous KI and $0.200 \text{ mol dm}^{-3}$ of $\text{Pb}(\text{NO}_3)_2$ are mixed together to precipitate PbI_2 . Given that the K_{sp} value of PbI_2 is $8.70 \times 10^{-9} \text{ mol}^3 \text{ dm}^{-9}$, which one of the following could have been the initial concentration of KI ?

- A $8.70 \times 10^{-8} \text{ mol dm}^{-3}$
- B $2.95 \times 10^{-4} \text{ mol dm}^{-3}$
- C $5.50 \times 10^{-4} \text{ mol dm}^{-3}$
- D $1.50 \times 10^{-2} \text{ mol dm}^{-3}$

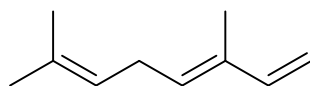
18 Which of the following reactions is ammonia acting as a Brønsted–Lowry base?

- A $\text{NH}_3 + \text{HF} \rightleftharpoons \text{NH}_4^+ + \text{F}^-$
 B $\text{NH}_3 + \text{CH}_3\text{Br} \rightarrow \text{CH}_3\text{NH}_2 + \text{HBr}$
 C $4\text{NH}_3 + [\text{Cu}(\text{H}_2\text{O})_6]^{2+} \rightleftharpoons [\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+} + 4\text{H}_2\text{O}$
 D $\text{NH}_3 + \text{BCl}_3 \rightarrow \text{NH}_3 \cdot \text{BCl}_3$

19 Which statement about benzene and cyclohexene is correct?

- A Both are planar molecules.
 B Both possess delocalised π electrons.
 C Both decolourise aqueous bromine in the presence of finely divided iron.
 D Both undergo complete combustion give the same products.

20 Ocimenes are a group of isomeric hydrocarbons with a sweet herbal scent and are commonly used in perfumes. The structure of one of its isomers is shown below.



β -ocimene

Which statements are correct?

- 1 β -ocimene has a total of four stereoisomers.
- 2 β -ocimene reacts with HBr to produce a major product containing two chiral centres.
- 3 β -ocimene undergoes both electrophilic addition and free radical substitution in the presence of excess bromine in the dark.
- 4 β -ocimene reacts with cold dilute alkaline potassium manganate(VII) to produce a major product with six $-\text{OH}$ groups.

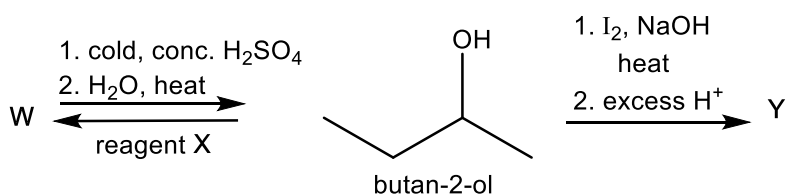
- A 1 and 3 B 2 and 4 C 1, 2 and 3 D 1, 2, 3 and 4

21 Methylbenzene reacts with bromine chloride, BrCl , in different ways, depending on the conditions used.

A reaction is carried out using an excess of methylbenzene in the absence of sunlight and in the presence of an iron-containing catalyst. What is the main reaction taking place?

- A substitution of one bromine atom into the $-\text{CH}_3$ side-chain
 B substitution of one chlorine atom into the $-\text{CH}_3$ side-chain
 C substitution of one bromine atom into the benzene ring
 D substitution of one chlorine atom into the benzene ring

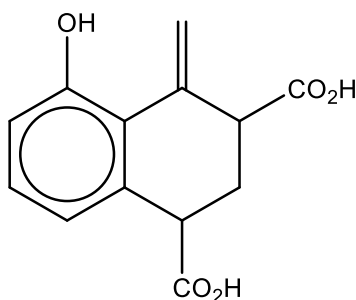
- 22 The diagram shows reactions involving butan-2-ol.



Which row correctly identifies the unknown compounds and reagents?

	W	reagent X	Y
A	2-chlorobut-2-ene	PCl_5	butanoic acid
B	but-2-ene	ethanolic KOH	propanoic acid
C	2-chlorobutane	PCl_5	butanoic acid
D	but-2-ene	conc. H_2SO_4	propanoic acid

- 23 Compound **A** dissolves in heavy water, D_2O , to form compound **B**. Compound **B** contains a number of hydrogen atoms which can be replaced by deuterium, D.
[D, deuterium = ^2_1H]



Compound **A**

What is the maximum number of deuterium atoms present in one molecule of compound **B**?

- A 1 B 2 C 3 D 4

- 24 Methanal, HCHO is the simplest aldehyde.
Which statements about methanal is correct?

- 1 All four atoms in methanal lie in the same plane.
- 2 The carbon atom in methanal has an oxidation number of 0.
- 3 Complete combustion of 1 mol of methanal requires 1 mol of oxygen gas.

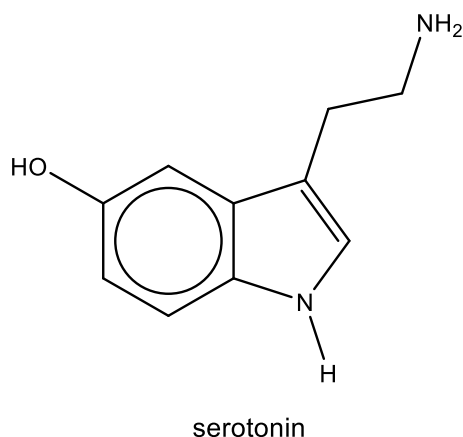
- A 1, 2 and 3 B 1 and 2 C 2 and 3 D 1 only

- 25 A liquid **P** is sparingly soluble in water. It dissolves readily in cold hydrochloric acid. Evaporation of this solution yields a crystalline solid.

Which could be **P**?

- A** $\text{C}_6\text{H}_5\text{COCH}_3$ **B** $\text{C}_6\text{H}_5\text{CONH}_2$ **C** $\text{C}_6\text{H}_5\text{NH}_2$ **D** $\text{C}_6\text{H}_5\text{OH}$

- 26 Serotonin is a neurotransmitter molecule.



Which one of the following reagents will not react with serotonin?

- A** CH_3COCl
B HCl
C NaOH
D PCl_5

- 27 A voltaic cell is set up using the Mg^{2+}/Mg and $\text{Fe}^{3+}/\text{Fe}^{2+}$ half-cells.



Under standard conditions, the cell e.m.f. would be 3.15 V. However, the voltmeter recorded a reading of 3.05 V.

What is the best explanation for this lower e.m.f.?

- 1 a higher concentration of Fe^{3+} was used
- 2 a higher concentration of Mg^{2+} was used
- 3 a smaller magnesium electrode was used

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

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

The table below shows the properties of four metals K, Ca, Cr and Ga. Which set of properties belong to Cr?

	melting point / °C	density / g cm ⁻³
A	1860	7.19
B	30	5.91
C	63	0.86
D	842	1.55

- 29 Which statement best explains why the $[\text{TiCl}_6]^{2-}$ complex ion is expected to be colourless?

- A** The 3d subshell of the transition metal ion is empty.
- B** Electrons from the lower energy level absorb energy outside the visible spectrum.
- C** There is a large energy gap between the non-degenerate orbitals.
- D** There is no d-orbital splitting in the transition metal ion.

- 30 The cathode of an electrolytic cell is a square piece of copper with dimensions 0.1 m x 0.1 m. The electrolyte is copper(II) sulfate.

Assume that each copper atom occupies a cube of length 3.0×10^{-12} m, the piece of copper has no thickness and that there is a uniform coverage.

How long will it take a current of 4.0 A to cover both sides of the piece of copper with new copper to a total of depth of 1000 atoms?

- A** 178 s **B** 24.7 h **C** 49.4 h **D** 98.9 h

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