

Name: _____

Class: _____



JURONG PIONEER JUNIOR COLLEGE

JC2 Preliminary Examination 2024

CHEMISTRY

Higher 1

Paper 1

8873/01

2024

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 exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **30** questions in this section. 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.

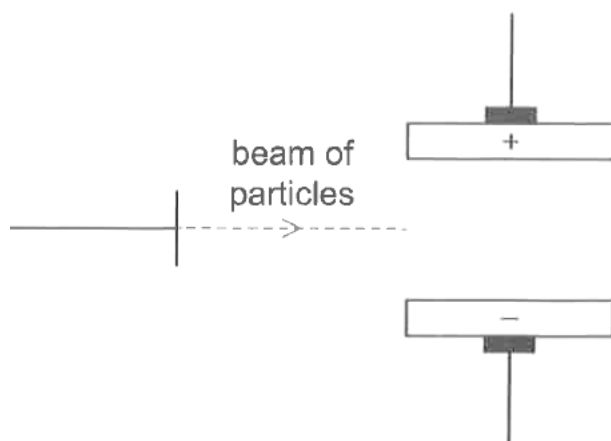
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

This document consists of **9** printed pages and **3** blank pages.

- 1 In two separate experiments a beam of protons and a beam of electrons, travelling at the same velocity, pass through an electric field as shown.



Which statements are correct?

- 1 The electrons are deflected to a larger extent than the protons.
- 2 The electron beam is deflected in the opposite direction to the proton beam.
- 3 The proton beam travels in a straight path towards the negatively charged plate.

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

- 2 The 7th, 8th, 9th and 10th ionisation energies of four consecutive elements in the Periodic Table, P, Q, R and S are shown.

element	7th ionisation energy / kJ mol^{-1}	8th ionisation energy / kJ mol^{-1}	9th ionisation energy / kJ mol^{-1}	10th ionisation energy / kJ mol^{-1}
P	9941	18580	21610	25180
Q	10530	12140	22480	25860
R	9520	12810	14530	26740
S	10300	11690	15280	17110

Which element has the highest first ionisation energy?

A P **B** Q **C** R **D** S

- 3 A gaseous mixture containing 10 cm^3 of C_3H_8 and 90 cm^3 of oxygen was sparked and C_3H_8 undergoes complete reaction. The resultant mixture was passed through excess NaOH(aq) . What is the final volume of gas remaining after cooling back to room temperature?

A 20 cm^3 **B** 40 cm^3 **C** 60 cm^3 **D** 80 cm^3

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

HFC-134a is a molecule that was developed during the 1980s to replace CFCs that were causing great damage to the ozone layer.

The percentage composition by mass of HFC-134a is: C, 23.5%; H, 2.0%; F, 74.5%.

Which structural formula could be that of HFC-134a?

- A CH_2FCF_3 B CHF_2CF_3 C CHF_3 D CH_2F_2

- 5 A 25.0 cm^3 sample of 0.20 mol dm^{-3} TlNO_3 required 25.0 cm^3 of 0.10 mol dm^{-3} acidified KMnO_4 to oxidise it to Tl^{3+} in solution.

What is the oxidation state of the manganese in the reduced form?

- A +2 B +3 C +4 D +5

- 6 Silicon carbide, SiC , has the same structure as silicon(IV) oxide, SiO_2 . Hence, SiC is used as a major industrial abrasive, and a refractory material which is resistant to decomposition by heat. Which type of structure explains these properties?

- A A simple molecular structure with covalent bonds between silicon and carbon atoms.
 B A layered structure with covalent bonds between silicon and carbon atoms and weak instantaneous dipole-induced dipole attraction between the layers.
 C A giant covalent structure with strong covalent bonds between silicon and carbon atoms forming a 3-dimensional network.
 D A giant ionic lattice with strong ionic bonds holding the oppositely charged ions together.

- 7 Consider the following four compounds.

- 1 $(\text{CH}_3)_3\text{CH}$
 2 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
 3 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 4 $\text{CH}_3\text{CH}_2\text{Cl}$

What is the order of **decreasing** boiling point of these compounds?

- A $1 \rightarrow 2 \rightarrow 4 \rightarrow 3$
 B $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$
 C $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$
 D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

- 8 Which of the following statement explains why the boiling point of water (100 °C) is higher than that of ammonia (−33 °C)?
- A There are, on average, more hydrogen bonds between water molecules than there are between ammonia molecules.
- B The M_r of water is greater than that in ammonia, so instantaneous dipole-induced dipole forces of attraction between water molecules is stronger.
- C Ammonia has intramolecular hydrogen bonds, which water does not have.
- D The O–H bond in water is stronger than the N–H bond in ammonia.
- 9 Phosphorus reacts with chlorine to form **both** PCl_3 and PCl_5 . However, nitrogen reacts with chlorine, to form **only** NCl_3 . Which statement is the best explanation for this?
- A Nitrogen cannot attain an oxidation state of +5.
- B The N–Cl bond is weaker than the P–Cl bond.
- C The valence orbitals of P are higher in energy than that of N.
- D N does not have vacant low-lying d orbitals to expand octet.
- 10 Which statements are correct for the sequence of compounds below considered from left to right?
- NaF MgO AlN SiC
- 1 The electronegativity difference between the elements in each compound increases.
- 2 The compounds are isoelectronic.
- 3 The bonding becomes increasingly covalent.
- A 3 only
- B 2 and 3 only
- C 1 and 2 only
- D 1, 2 and 3

- 11 The table shows the thermal decomposition of three hydrogen halides.

	HCl	HBr	HI
decomposition temperature / °C	1500	1200	500

Why is there a decrease in the decomposition temperature of the hydrogen halides from hydrogen chloride to hydrogen iodide?

- 1 Induced dipole forces between molecules decrease in strength.
- 2 Hydrogen bonds between molecules decrease in strength.
- 3 Covalent bonds between the atoms decrease in strength.

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

- 12 Element X reacts with oxygen to form a high melting point solid which is insoluble in water. When X reacts with chlorine, a low melting point liquid is formed which is soluble in water, giving a solution with a pH of 1.

What is X?

- | | |
|--------------------|---------------------|
| A magnesium | B aluminium |
| C silicon | D phosphorus |

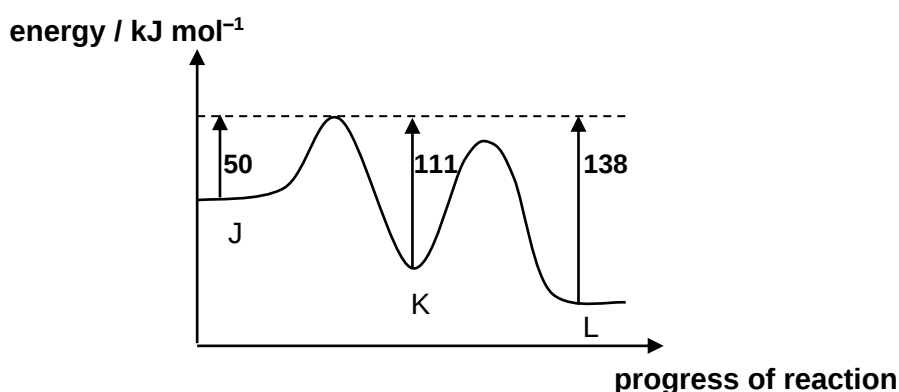
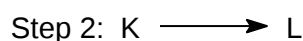
- 13 Which difference best explains the variation in melting points across Period 3?

- A** the difference in structure and bonding
B the difference in nuclear charge
C the difference in number of unpaired electrons
D the difference in bond energies

- 14 Which equation correctly represents the lattice energy of sodium oxide?

- A** $2\text{Na(s)} + \frac{1}{2}\text{O}_2\text{(g)} \rightarrow \text{Na}_2\text{O(s)}$
B $2\text{Na}^+\text{(g)} + \text{O}^{2-}\text{(g)} \rightarrow \text{Na}_2\text{O(s)}$
C $\text{Na(g)} + \frac{1}{4}\text{O}_2\text{(g)} \rightarrow \frac{1}{2}\text{Na}_2\text{O(s)}$
D $\text{Na}^+\text{(g)} + \frac{1}{2}\text{O}^{2-}\text{(g)} \rightarrow \frac{1}{2}\text{Na}_2\text{O(s)}$

- 15 The reaction pathway diagram for a two-step reaction is shown below.



Which statement is correct?

- A** Step 2 is more exothermic than step 1.
B The enthalpy change for both the forward and backward reactions in step 1 is the same.
C The activation energy for the backward reaction in step 1 is 61 kJ mol^{-1} .
D The enthalpy change of reaction for the conversion of J to L is the sum of the enthalpy changes in step 1 and step 2.

16 For a reversible reaction, what is the effect of a catalyst on the

- rate constant for the forward reaction, k_1 ,
- rate constant for the reverse reaction, k_{-1} , and
- the equilibrium constant, K_c ?

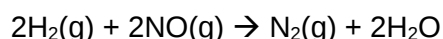
	k_1	k_{-1}	K_c
A	increases	decreases	no effect
B	increases	increases	increases
C	increases	increases	no effect
D	no effect	no effect	increases

17 Radioactive decay is a first order reaction.

The rate of decay of a radioactive isotope decreases from 200 counts per minutes to 25 counts per minutes after 24 hours. What is its half-life?

- A** 3 hours **B** 4 hours **C** 6 hours **D** 8 hours

18 Hydrogen and nitrogen monoxide can react to form nitrogen and steam.



The rate of this reaction is first order with respect to hydrogen and second order with respect to nitrogen monoxide.

Which of the following conclusions can be drawn from this information?

- A** The unit of rate constant is $\text{mol}^3 \text{dm}^{-9}$.
- B** Halving the concentration of hydrogen will not change the rate of reaction.
- C** The value of rate constant depends on the concentrations of hydrogen and nitrogen monoxide.
- D** Doubling the concentration of nitrogen monoxide increases the rate of evolution of nitrogen gas by 4 times.

19 Exhaust fumes from car engines contain the gases carbon dioxide, nitrogen oxides and unburnt hydrocarbons.

Use of a catalytic converter in the car exhaust changes the gases emitted.

Which statements are correct about the reactions occurring in the catalytic converter?

- 1 Carbon dioxide is removed by reduction.
- 2 Oxides of nitrogen are removed by reduction.
- 3 Unburnt hydrocarbons are removed by oxidation.

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

- 20 2.00 mol dm⁻³ of ethanol and 2.40 mol dm⁻³ of ethanoic acid are mixed, and the reaction mixture is allowed to reach equilibrium at constant temperature.

The equilibrium mixture is found to contain 1.45 mol dm⁻³ of ethyl ethanoate.



What is the correct expression for the equilibrium constant K_c ?

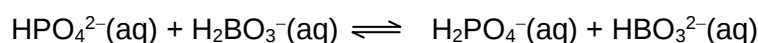
A $\frac{(1.45)^2}{0.55 \times 0.95}$

B $\frac{1.45}{0.55 \times 0.95}$

C $\frac{2 \times 1.45}{2.00 \times 2.40}$

D $\frac{2 \times 1.45}{1.45 \times 1.45}$

- 21 The equilibrium constant for the following reaction is less than 1.



Which one of the following gives the correct relative strengths of the acids and bases in the reaction?

	Acids				Bases		
A	H_2PO_4^-	>	H_2BO_3^-		HBO_3^{2-}	>	HPO_4^{2-}
B	H_2BO_3^-	>	H_2PO_4^-		HBO_3^{2-}	>	HPO_4^{2-}
C	H_2PO_4^-	>	H_2BO_3^-		HPO_4^{2-}	>	HBO_3^{2-}
D	H_2BO_3^-	>	H_2PO_4^-		HPO_4^{2-}	>	HBO_3^{2-}

- 22 10 cm³ of a 0.01 mol dm⁻³ solution of strong acid, HNO₃ is diluted with 90 cm³ of water. What is the pH of the resulting solution?

A 1 B 2 C 3 D 4

- 23 The 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 1 and 3 only D 2 and 3 only

- 24 Which pairs of organic compounds contain the same number of **hydrogen** atoms in each of their molecules?
- 1 butanone and 2-methylpropanal
 - 2 ethylpropanoate and butane-1,2-diol
 - 3 2-aminopropane and 2-bromo-2-methylpropane

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

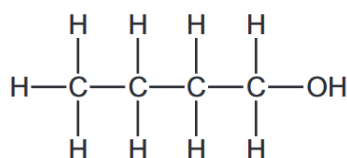
- 25 In the substitution of 2-methylbutane with bromine, a mixture of mono-brominated compounds were obtained.

What is the statistical ratio of the two mono-brominated compounds with the highest yields?

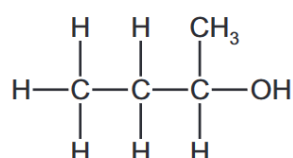
A 1 : 2 **B** 1 : 3 **C** 1 : 4 **D** 1 : 6

- 26 Which of the following isomers of $C_4H_{10}O$ gives, on complete dehydration, the greatest number of different alkenes?

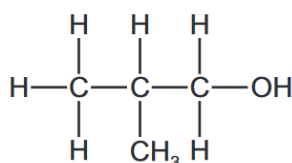
A



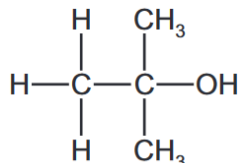
B



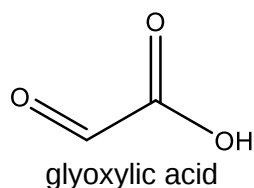
C



D

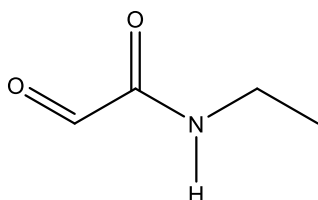


- 27 Glyoxylic acid is widely used in hair straightening products.

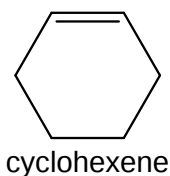


Which statement about this compound is **incorrect**?

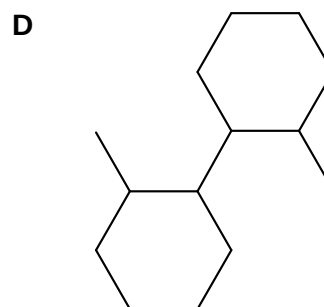
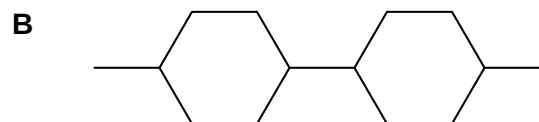
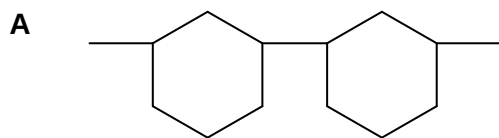
- It can turn hot acidified potassium dichromate(VI) from orange to green.
- It can undergo acid base reaction with aqueous sodium hydroxide.
- It can undergo reduction with sodium boron hydride, NaBH_4 to form $\text{HOCH}_2\text{CH}_2\text{OH}$.
- It can undergo condensation with ethylamine, in the presence of DCC to form



- 28 Cyclohexene can form an addition polymer.



Which of the following shows a section of the polymer?



- 29 Part of the structure of a polyamide is shown below:



Which of the following statements is **not** true?

- A** It is a thermoplastic.
- B** The polymer chains are held together by hydrogen bonds.
- C** The polymer can be used to make containers to contain acids.
- D** The N–C–O angle in the polymer is 120° .

- 30 In which contexts is surface area important?

- 1 high tensile strength of graphene
- 2 the ability of a gecko to climb a wall
- 3 prevention of atmospheric pollution using catalytic convertors.

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

BLANK PAGE

BLANK PAGE

BLANK PAGE