



JURONG PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2023

CHEMISTRY**9729/01****Higher 2****19 September 2023**

Paper 1 Multiple Choice Questions

1 hour

Candidates answer on the Question paper.

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 **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** or **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 Element X has eight more protons than element Y.

Which statement **must** be correct?

- A Atoms of element Y are larger than atoms of element X.
- B Element X has at least one fully filled shell of electrons.
- C Element X and element Y are in the same group.
- D Element X and element Y are in the same period.

- 2 Molecular dimerisation can be described as the process in which two identical molecules combine to give a single product.

Examples of dimers are: Al_2Cl_6 and $(\text{CH}_3\text{CH}_2\text{CO}_2\text{H})_2$.

Which statement about the above dimers is **incorrect**?

- A Two hydrogen bonds hold the $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ molecules together in the dimer.
- B Each aluminium atom is surrounded by four chlorine atoms in the dimer, Al_2Cl_6 .
- C $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ exists as dimers when dissolved in water.
- D Al_2Cl_6 dimers are non-polar molecules.

- 3 Which statement is correct?

- A Cl has a relative isotopic mass of 35.5.
- B Cl_2 has a relative molecular mass of 70.
- C ICl has a relative molecular mass of 162.4.
- D NaCl has a relative molecular mass of 58.5.

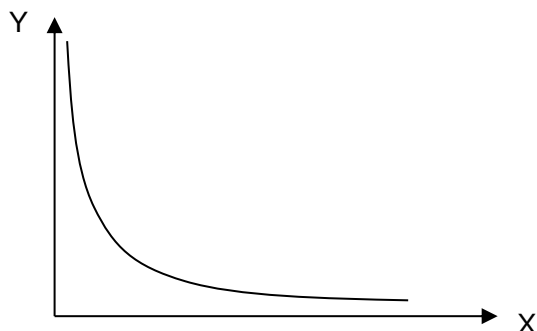
- 4 *Use of the Data Booklet is relevant to this question.*

The most common scuba diving gas tank typically comprises 11.7% of helium gas, 56.2% of nitrogen gas and 32.1% of oxygen gas by volume.

What is the mass of oxygen gas inside the diving gas tank of 0.018 m^3 and 300 bar at 293K?

- A 1.14 kg
- B 2.28 kg
- C 7.10 kg
- D 7100 kg

- 5 The following graph shows the behaviour of an ideal gas with fixed mass.



Which of following will yield the graph above?

	X-axis	Y-axis	condition
A	p in Pa	pV in Pa m ³	constant temperature
B	p in Pa	ρ (density) in g m ⁻³	constant temperature
C	T in K	V in m ³	constant pressure
D	T in K	$\frac{1}{p}$ in Pa ⁻¹	constant volume

- 6 Which description of Dalton's Law is correct?

- A** Equal volumes of gases at the same temperature and pressure contain equal numbers of molecules.
- B** The partial pressure of a gas in a mixture is given by the product of its mole fraction and the total pressure.
- C** The partial pressure of a gas in a mixture is given by the product of its percent by mass and the total pressure.
- D** The total pressure of a mixture of gases is equal to the sum of the partial pressures of these gases.

- 7 When iodine is oxidised by nitric acid, a white crystalline solid iodine-containing oxide can be isolated from the mixture.

0.001 mole of this oxide reacts with 0.010 mole of acidified potassium iodide to give 0.006 mole of iodine, I₂.

What is the oxidation number of iodine in the oxide?

- A** +1 **B** +3 **C** +5 **D** +7

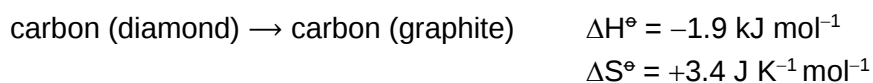
8 Which statements are correct?

- 1 enthalpy change of combustion of H_2 = enthalpy change of formation of H_2O
- 2 enthalpy change of atomisation of H_2 = bond energy of $\text{H}-\text{H}$
- 3 enthalpy change of solution of HCl = $\sum$ enthalpy change of hydration of H^+ and Cl^-

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

9 Use of Data Booklet is relevant to this question

Carbon can exist naturally in two different crystalline forms, diamond and graphite.

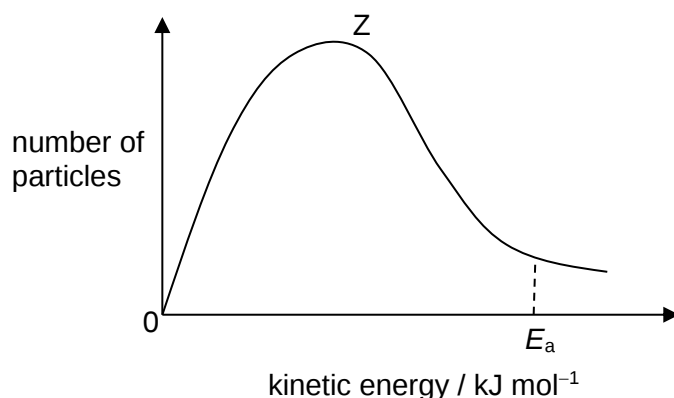


Which statements are correct **and** explain why diamond does **not** change into graphite at room temperature and pressure?

- 1 The forward reaction has an extremely small rate constant.
- 2 ΔG° is -2.9 kJ mol^{-1} for the above transformation.
- 3 The reverse reaction is spontaneous.

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

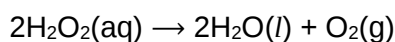
10 The diagram shows the Boltzmann distribution for one mole of a gas. The gas takes part in a reaction with an activation energy, E_a .



Which statement correctly describes the effect of an increase in temperature?

- A Peak Z will be higher and fewer molecules will have energy $> E_a$.
- B Peak Z will be higher and more molecules will have energy $> E_a$.
- C Peak Z will be lower and fewer molecules will have energy $> E_a$.
- D Peak Z will be lower and more molecules will have energy $> E_a$.

- 11 Hydrogen peroxide solution decomposes. The equation for this reaction is shown.

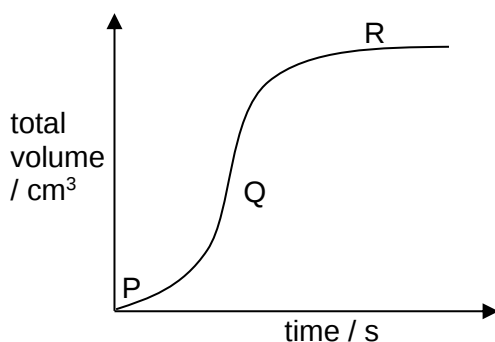


A 100cm^3 sample of hydrogen peroxide solution is warmed. After 80 minutes, 6.00 dm^3 of oxygen gas, measured at room temperature and pressure, is collected. Under these conditions, the reaction has a constant half-life of 40 minutes.

What is the initial concentration of the hydrogen peroxide solution?

- A 0.66 mol dm^{-3}
 B 2.0 mol dm^{-3}
 C 3.3 mol dm^{-3}
 D 6.6 mol dm^{-3}
- 12 A large excess of magnesium ribbon is added to dilute hydrochloric acid and the volume of hydrogen gas produced is measured as the reaction proceeds. The reaction is exothermic.

The results are shown.



Which row explains the changes in the rate of reaction between points P and Q and between points Q and R?

- | | between points P and Q | between points Q and R |
|---|--|-----------------------------------|
| A | the reaction temperature is increasing | the acid concentration is falling |
| B | the reaction temperature is increasing | the magnesium has been used up |
| C | magnesium's surface area is decreasing | the acid concentration is falling |
| D | magnesium's surface area is decreasing | the magnesium has been used up |

- 13 The variation of the ionic product of water, K_w , with temperature is given in the table.

Temperature / °C	$K_w / \text{mol}^2 \text{dm}^{-6}$
0	1.14×10^{-15}
25	1.00×10^{-14}
50	5.50×10^{-14}

What can be deduced from this information?

- A $[\text{H}^+]$ is more than $[\text{OH}^-]$ as temperature increases.
 B pH of water at 50 °C is higher than that at 25 °C.
 C As temperature increases, more water ionises.
 D The ionisation of water is an exothermic process.
- 14 Which row correctly describes the species in terms of its behaviour as a Lewis base and as a Brønsted-Lowry acid?

	species	Lewis base	Brønsted-Lowry acid
A	CH_3OH	✓	✓
B	NH_4^+	✗	✗
C	OH^-	✗	✗
D	O^{2-}	✗	✓

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

Natural water in reservoirs often contains very finely divided solid particles of between 1 and 100 nm in diameter which have negative charges on their surface.

One stage in purifying the water consists of adding salt solutions containing high charge density cations which neutralise the negative charges and cause the solid particles to join together and settle out.

Which compound, in aqueous solution, would be the most effective in precipitating finely divided solid particles?

- A MgCl_2 B FeCl_3 C AlCl_3 D SiCl_4

- 16 Element G is in Period 3 of the Periodic Table. The following four statements describe the properties of element G or its compounds.

Three statements are correct descriptions. One of the statements is not correct because it does not fit with the other three.

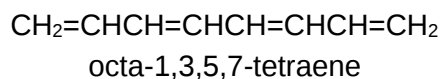
Which statement is **not** correct?

- A Element G is a solid at room temperature which conducts electricity.
- B The chloride GCl_3 reacts with water to give an acidic solution.
- C Element G forms a chloride, GCl_3 , which reacts with more chlorine to give GCl_5 .
- D Adding $NaOH(aq)$ to the solution resulting from the reaction of GCl_3 with water produces a white precipitate which is soluble in an excess of $NaOH(aq)$

- 17 How many σ and π bonds are present in one $HC\equiv C-CO_2CH(CH_3)CN$ molecule?

	σ	π
A	10	3
B	10	5
C	13	3
D	13	5

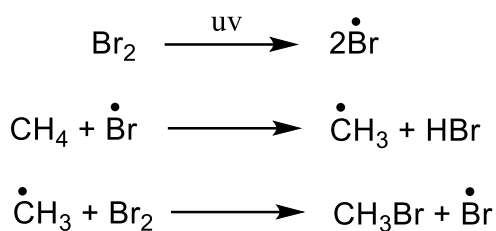
- 18 The unsaturated hydrocarbon octa-1,3,5,7-tetraene can display *cis-trans* isomerism.



How many isomers exist?

- A 3
- B 4
- C 8
- D 16

- 19 The substitution reaction between $\text{CH}_4(\text{g})$ and $\text{Br}_2(\text{g})$ in the presence of ultraviolet light involves the following steps.



Why is this called homogenous catalysis?

- 1 Bromine radicals are in the same physical phase as bromine and methane.
- 2 Bromine and methane are in the same physical phase.
- 3 The initiation step involves the homolytic fission of bromine molecules into two bromine radicals.

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

- 20 Which reaction is a termination step in the chain reaction between chlorine and ethane, in the presence of ultraviolet light?

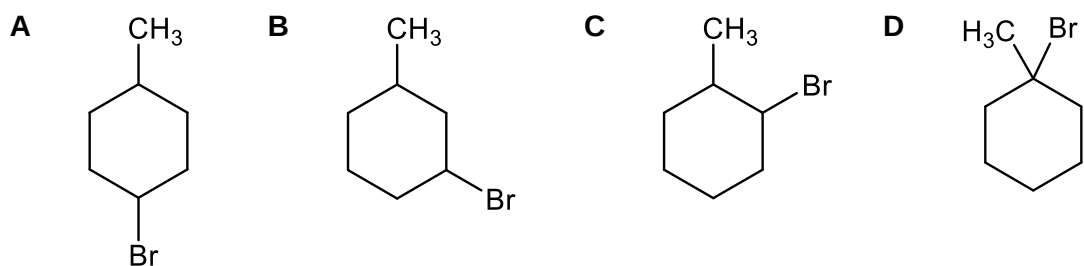
- A** $\cdot\text{CH}_2\text{CH}_3 + \cdot\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_3$
B $\cdot\text{CH}_2\text{CH}_3 + \text{Cl}_2 \rightarrow \text{CH}_3\text{CH}_2\text{Cl} + \cdot\text{Cl}$
C $\cdot\text{CH}_2\text{CH}_3 + \text{H}\cdot \rightarrow \text{CH}_3\text{CH}_3$
D $\cdot\text{CH}_2\text{CH}_3 + \cdot\text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

- 21 Compound U, $\text{C}_7\text{H}_{13}\text{Br}$, reacts with hot alcoholic NaOH to produce two compounds, V and W.

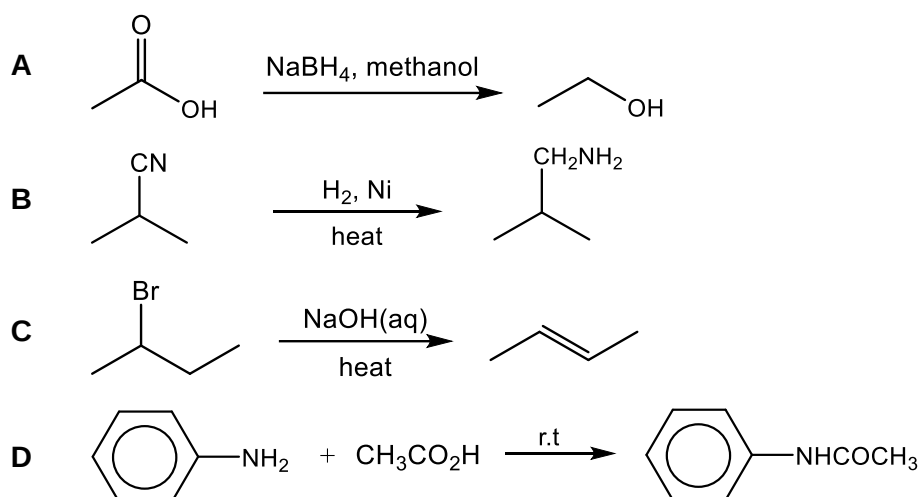
On reaction with Br_2 , V gives a product, $\text{C}_7\text{H}_{12}\text{Br}_2$, which exists as a mixture of four enantiomers

On reaction with Br_2 , W gives a product, $\text{C}_7\text{H}_{12}\text{Br}_2$, which is achiral.

What could U be?



22 Which of the following transformation will occur under the given conditions?



23 Two isomeric alcohols, L and M, have molecular formula C_4H_9OH .

L is oxidised to carbonyl compound Q which gives a silver mirror with Tollen's solution.

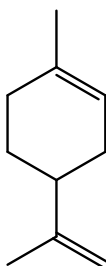
M is oxidised to carbonyl compound R which does **not** give a silver mirror with Tollen's solution.

Which of L and M gives a yellow precipitate with alkaline $I_2(aq)$?

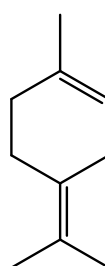
- A Insufficient data is given to answer this question
- B L only
- C M only
- D Neither L nor M

- 24 A diketo acid is a compound with two ketone groups and one carboxylic acid group.

limonene



terpinolene



Which statement about the reactions of limonene and terpinolene are correct?

- 1 When reacted with an excess of hydrogen and a nickel catalyst, limonene and terpinolene produce the same compound.
 - 2 An excess of hot acidified KMnO_4 reacts with limonene and with terpinolene to form different diketo acids.
 - 3 Both limonene and terpinolene can be formed from the same dichloroalkane under suitable conditions.
- A** 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

- 25 Chiral chloroalkanes can undergo nucleophilic substitution with NaOH(aq) to form alcohols.

The reaction mechanism is either $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$.

Which statements are correct?

- 1 Inversion of configuration occurs in the $\text{S}_{\text{N}}2$ mechanism.
- 2 Product mixture from the $\text{S}_{\text{N}}1$ mechanism results in no optical activity.
- 3 The hydrolysis of tertiary chloroalkane takes place by the $\text{S}_{\text{N}}1$ mechanism because the substituent alkyl groups stabilise the carbocation intermediate.

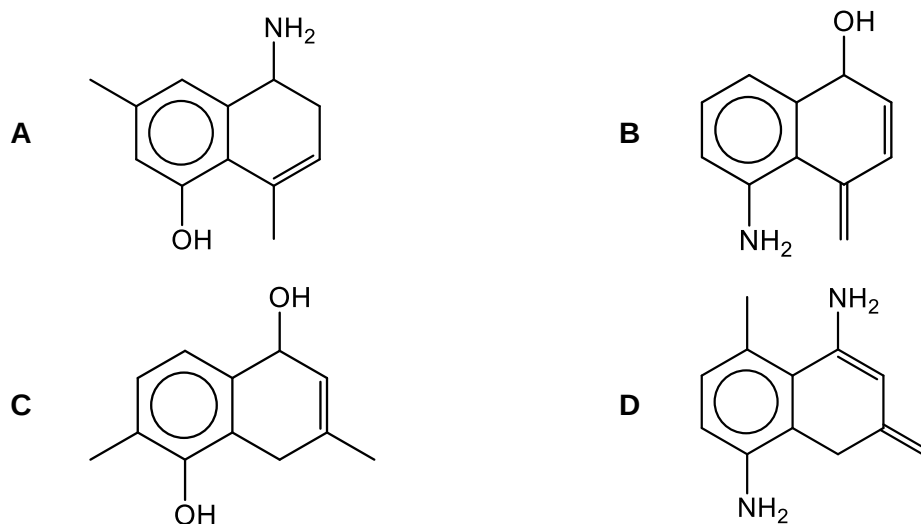
- A** 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

26 What is produced when $\text{CH}_3\text{NHCH}_2\text{CONH}_2$ is added to an excess of hot $\text{HNO}_3(\text{aq})$?

- 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 $\text{CH}_3\text{NH}_2^+\text{CH}_2\text{COO}^-$

27 When mixed with aqueous Br_2 , 1 mole of T reacts with 4 moles of $\text{Br}_2(\text{aq})$.

What could T be?



28 When ethyl ethanoate, $\text{CH}_3\text{C}^{16}\text{O}_2\text{C}_2\text{H}_5$, undergoes acid hydrolysis in a solution containing H_2^{18}O , atoms of ^{18}O isotope appears in the product as $\text{CH}_3\text{CO}^{18}\text{OH}$ and **not** as $\text{C}_2\text{H}_5^{18}\text{OH}$.

What is the correct deduction from this observation?

- A A $^{16}\text{O}-\text{C}$ bond is stronger than a $^{18}\text{O}-\text{C}$ bond.
 B The $\text{O}-\text{C}$ bond in the $\text{O}-\text{C}_2\text{H}_5$ group of the ester is broken
 C The $\text{C}-\text{O}$ single bond in the $-\text{COO}$ group of the ester is broken.
 D The H_2^{18}O attracts a δ^+ carbon atom in the C_2H_5 group.

29 Consider the following standard electrode potentials of 4 different half-cells.

$E^\ominus(\text{P}^+/\text{P}) = -0.30 \text{ V}$	$E^\ominus(\text{Q}^{2+}/\text{Q}) = -0.80 \text{ V}$	$E^\ominus(\text{R}/\text{R}^-) = +0.30 \text{ V}$	$E^\ominus(\text{S}^+/\text{S}) = +1.80 \text{ V}$
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Which of the following statements are correct under standard conditions?

- 1 A cell consisting of P^+/P half-cell and S^+/S half-cell has an e.m.f of +2.10 V.
- 2 P could be oxidised by Q^{2+} .
- 3 Q^{2+} could be oxidised by R.
- 4 S^+ is the strongest reducing agent among all the species listed.

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

30 Use of the Data Booklet is relevant to this question.

Olympic gold medals are made from pure silver with a total of 6 g of gold electroplated over the surface of the medals.

Commercially, the most common electrolyte used in electroplating of gold is potassium gold cyanide, $\text{KAu}(\text{CN})_2$.

How long does it take to complete the electroplating of one Olympic gold medal if the current used is 2.0 A?

A 735 s B 24.5 min C 49.0 min D 1.02 h

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