

Catholic Junior College JC 2 Preliminary Examinations Higher 1

CHEMISTRY

Paper 1 Multiple Choice

8873/01 12 September 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name, HT group and NRIC/FIN number on the Answer Sheet in the spaces provided. Write in soft pencil.

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

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.

For each question there are *four* possible answers, *A*, *B*, *C* and *D*. Choose the **one** you consider to be correct.

1 A sample of bromine contains a mixture of two isotopes, ⁷⁹Br and ⁸¹Br. The relative atomic mass of Br in this sample is 79.92.

	⁷⁹ Br	⁸¹ Br
Α	46.0%	54.0%
В	41.2%	58.8%
С	54.0%	46.0%
D	58.8%	41.2%

What is the percentage abundance of each isotope?

2 Use of Data Booklet is relevant to this question.

How many atoms of silver (proton number 47) are there in a pure silver ring with a mass of 2.88 g?

Α	1.20 x 10 ²¹	С	1.20×10^{22}
В	2.00 x 10 ²¹	D	1.61×10^{22}

3 In an experiment, 100 cm³ of a 0.2 mol dm⁻³ solution of a metallic salt reacts exactly with 50 cm³ of 0.2 mol dm⁻³ aqueous sodium sulfite, Na₂SO₃. The half-equation for the oxidation of the sulfite ion is shown below:

 $SO_{3}^{2-}(aq) + H_{2}O(I) \rightarrow SO_{4}^{2-}(aq) + 2H^{+}(aq) + 2e^{-}$

If the original oxidation number of the metal ion for the metallic salt is +3, what is the new oxidation number of the metal ion?

A +1 B +2	C +4	D	+5
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A and **B** represent two consecutive elements in the periodic table.

 A^{2+} contains *n* protons while the cation of **B** contains (*n*+1) protons and is isoelectronic with **A**.

What is the formula of the chloride formed by **B**?

- **A** BCl **B** BCl_2 **C** BCl_3 **D** BCl_4
- 5 Which of the following is the correct electronic configuration of a copper(II), Cu²⁺ ion in the ground state?
 - $A \qquad 1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$
 - **B** 1s² 2s² 2p⁶ 3s² 3p⁶ 3d¹⁰ 4s¹
 - **C** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$
 - **D** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$
- **6** Which of the following gives the symbols of elements in the order of decreasing first ionisation energy?
 - A Cl, Br, I
 - **B** F, Ne, Na
 - C Al, Mg, Na
 - **D** C*l*, S, P
- 7 Which of the following have giant lattice structures under standard conditions at 298 K?
 - 1 magnesium
 - 2 buckminsterfullerene, C₆₀
 - 3 beryllium chloride
 - 4 sodium fluoride
 - A 1 and 2 only
 - **C** 3 and 4 only

- **B** 1 and 4 only
- **D** 1, 2 and 4 only

- 8 Which of the following species has the smallest bond angle?
- 9 Which one of the following statements about aluminium chloride is **incorrect**?
 - **A** A/Cl_3 has a simple molecular structure.
 - **B** AlCl₃ has a lower melting point than Al₂O₃.
 - **C** The Al_2Cl_6 dimer contains intermolecular hydrogen bonding.
 - **D** The reaction $A/Cl_3 + Cl^- \rightarrow A/Cl_4^-$ involves the formation of a dative bond.
- **10** The table shows the boiling points of some halogenoalkanes.

compound	boiling point/ °C
CH ₃ C <i>l</i>	-24.2
CH₃Br	3.6
CH ₃ I	42.4

Which of the following correctly explains the difference in the boiling points?

- **A** the bond energy of C–X bond decreases from C–Cl to C–I.
- **B** the strength of permanent dipole-permanent dipole attractions increases from C-C*l* to C-I.
- **C** the strength of instantaneous dipole-induced dipole attraction increases from CH₃C*l* to CH₃I.
- **D** the electronegativity difference between the halogen and carbon increases from C-Cl to C-I.
- Use of Data Booklet is relevant to this question.Which solid has the least exothermic lattice energy?
 - A NaF B MgO C CaO D LiCl

- **12** Which equation correctly describes the standard enthalpy change of formation of water at 298K?
 - $\mathbf{A} \qquad 2\mathrm{H}(\mathrm{g}) + \frac{1}{2}\mathrm{O}_2(\mathrm{g}) \rightarrow \mathrm{H}_2\mathrm{O}(\mathrm{g})$
 - **B** $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$
 - **C** $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(I)$
 - **D** $H^+(aq) + OH^-(aq) \rightarrow H_2O(I)$
- **13** The gas-phase reaction of carbon monoxide with hydrogen forming methanol is as follows:

$$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$$

The reaction was investigated by mixing 4.0 mol of $H_2(g)$ with 2.0 mol of CO(g) in a 2.0 dm³ flask and allowing equilibrium to be established. At equilibrium, y mol dm⁻³ of H₂ has reacted with CO(g).

What is the equilibrium concentration of CO(g) in mol dm⁻³?

- **A** 1 y **B** 1 - $\frac{y}{2}$ **C** 4 - $\frac{y}{2}$ **D** 4 - y
- **14** For a reversible reaction, what is the effect of a catalyst on the rate constant, $k_{\rm f}$ for the forward reaction, the rate constant, $k_{\rm r}$, for the reverse reaction, and the equilibrium constant $K_{\rm c}$?

	<i>k</i> f	<i>k</i> r	Kc
Α	increase	increase	increase
В	no effect	no effect	increase
С	increase	decrease	no effect
D	increase	increase	no effect

15 When 10.00 cm³ of a 0.100 mol dm⁻³ NaOH is titrated against 0.100 mol dm⁻³ of aqueous CH₃CO₂H, the following titration curve is obtained.



Which of the following points on the curve shows that it is functioning as a buffer?

- 1 Point W
- 2 Point X
- 3 Point Y
- 4 Point Z
- A 1 only
- C 3 and 4 only

- **B** 1 and 2 only
- D 4 only

16 Carbon-14 is an isotope of carbon. It is unstable and undergoes radioactive decay to form nitrogen-14. This radioactive decay is a first-order reaction with a half life of 5700 years.

What is the molar proportion of carbon-14 to nitrogen-14 after a period of 17100 years?

- **A** 1:1 **B** 1:3 **C** 1:7 **D** 1:15
- **17** Hydrogen peroxide reacts with acidified iodide to form iodine. The following results were obtained.

	Initial con	Initial rate of		
Expt		formation of		
No	$[H_2O_2]$	[I ⁻]	[H+]	iodine /
				mol dm ⁻³ s ⁻¹
1	0.010	0.010	0.10	2 x 10 ⁻⁶
2	0.010	0.010	0.20	2 x 10 ⁻⁶
3	0.020	0.010	0.10	4 x 10 ⁻⁶
4	0.020	0.030	0.10	1.2 x 10 ⁻⁵

Which of the following correctly explains the results?

- **A** The reaction is dependent on the concentration of the acid.
- **B** The reaction is overall first order.
- **C** The rate constant is $2.0 \times 10^{-1} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$.
- **D** The rate equation for the reaction is rate = $k[H_2O_2][I^{-}]$.

18 Some data on two acid-base indicators are shown in the table below:

indicator	Approximate pH working colour ch		change
indicator	range	acid	alkali
bromophenol blue	3.0 – 4.6	yellow	violet
bromothymol blue	6.0 – 7.6	yellow	blue

What conclusion can be drawn about a solution in which bromophenol blue is violet and bromothymol blue is yellow at 25 °C?

- A It is weakly acidic.
- **B** It is strongly acidic.
- **C** It is neutral.
- D It is weakly basic.
- Silicon is an element in the third period, Na to Ar, of the Periodic Table.Which statement is true for silicon?
 - **A** The oxide of silicon reacts with water to give a basic solution.
 - **B** Silicon has the highest melting point of the elements in this period.
 - **C** Silicon is the only element in this period whose chloride react with water to form acidic solution.
 - **D** Silicon is the only element in this period which can exist, at room temperature and pressure, as a simple molecule.

- **20** Which of the following properties of the Group 17 elements increases with increasing atomic number?
 - A First ionisation energy
 - **B** Electronegativity of the element
 - **C** Oxidising power of the elements
 - **D** Atomic radius
- **21** Y and Z are 2 elements from Period 3 (Na to C*l*) of the Periodic Table.

Element **Y** has the highest electrical conductivity in the period, and it has an oxide that does not dissolve in water.

Element **Z** has a chloride that reacts vigorously with water to form a colourless solution with white fumes of HCl.

What are the identities of Y and Z?

	Y	Z
Α	aluminium	phosphorus
В	silicon	aluminium
С	magnesium	sulfur
D	phosphorus	silicon

- \cap ,CH₂CH₃ Ο HN NH₂ Oseltamivir 1 Alkene 2 Amide 3 Amine Alcohol 4 2 and 3 only Α 2 and 4 only В С 1, 3 and 4 only D 1, 2 and 3 only
- 22 Which functional group(s) is present in Oseltamivir?

23 Compound A below is used as a flavour enhancer in processed orange juice.



Compound A

What is the IUPAC name of compound A?

- A ethyl butanoate
- B propyl ethanoate
- C ethyl propanoate
- D butyl ethanoate



24 What types of reaction occur in steps 1 and 2?

25 A student considered the following synthetic route to produce compound D.



Which steps show an incorrect type of reaction and/or reagent used?

	step	type of reaction	reagent
1	I	substitution	excess concentrated sulfuric acid
2	Ш	oxidation	$K_2Cr_2O_7$ in dilute H_2SO_4
3	Ш	condensation	dicyclohexylcarbodiimide (DCC)
4	IV	elimination	ethanolic NaOH

Α	1 and 3 only	В	2 and 3 only
С	3 and 4 only	D	1 and 4 only

26 Which one of the following statements is true about the compound chosen below?



- **A** It reacts with H₂ gas to form a product with four alcohol groups.
- **B** Effervescence is observed upon reacting the compound with sodium carbonate.
- **C** The alcohol groups undergo elimination when reacted with hot dilute H₂SO₄.
- **D** It can be oxidised under suitable conditions to form a compound with 4 ketone groups.
- 27 The repeat unit of a polymer is shown below.



What deductions about this polymer can be drawn from its structure?

- 1 It is a polyester.
- 2 It could be readily made from HOCH₂CH₂CH₂CO₂H.
- 3 There are intermolecular hydrogen bonds formed between two polymer chains.
- A 1 only
- C 2 and 3 only

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

28 Poly(diallyl phthalate) is a polymer which is commonly used for electronics and electrical parts.

The structure of its monomer, diallyl phthalate is shown below.



Diallyl phthalate

Which of the following statement is true of its polymer?

- A It is a thermoplastic polymer.
- **B** It is formed via condensation polymerisation.
- **C** It can form cross–links through its ester bonds.
- **D** It can be hydrolysed when heated using dilute H_2SO_4 .
- 29 Dishwasher pouches are small convenient packets that contain the detergent needed to be used in dishwashers. Such pouches are sturdy enough to be easily transported and safely handled by hand yet dissolve easily when it is time to wash dishes. What could be the polymer that is used for the pouches?
 - A bakelite
 - **B** poly(vinyl alcohol)
 - **C** poly(vinyl chloride)
 - **D** poly(ethylene terephthalate)
- 30 Which of the following statements are **incorrect**?
 - 1 Graphene has low tensile strength.
 - 2 Geckos can stick to walls as they form strong covalent bonds to the walls.
 - **3** Catalytic converters have a honeycomb structure to maximise the surface area available for catalysis to take place.
 - A 1 and 2 only B 1 and 3 only
 - **C** 1, 2 and 3 **D** 1 only