

VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY

8873/01

Paper 1 Multiple Choice

19 September 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 and CT group on the Answer Sheet.

There are **thirty** questions. 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.

A Data Booklet is provided.

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 **10** printed pages and **2** blank pages.

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

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

Which particle has a half-filled set of p orbitals?

- A** C^- **B** N^{2-} **C** F^+ **D** Ne

- 2 The table shows the sixth ionisation energies of four consecutive elements in the Periodic Table.

element	W	X	Y	Z
sixth ionisation energy / kJ mol^{-1}	19800	21300	8500	9360

What is the formula of the fluoride of W?

- A** WF_3 **B** WF_4 **C** WF_5 **D** WF_6

- 3 Boron trifluoride, BF_3 , is very difficult to handle due to its high reactivity at room temperature. 1 mole of BF_3 can react with 1 mole of dimethyl ether, CH_3OCH_3 to form compound Q.

Which statements are correct?

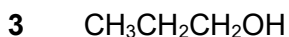
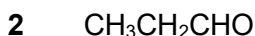
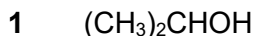
- 1 Lone pair electrons on oxygen in CH_3OCH_3 is donated to the vacant orbital of boron in BF_3 .
- 2 The bond angle about boron changes from 120° in BF_3 to 107° in compound Q.
- 3 The molecular shape about oxygen changes from bent in CH_3OCH_3 to trigonal pyramidal in compound Q.

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

- 4 In which of the following pairs does the second molecule have a greater net dipole moment than that of the first molecule?

- A** NH_3 , CCl_4
B CO, HF
C H_2O , H_2S
D CO_2 , BF_3

5 Consider the following three compounds.



What is the order of decreasing boiling points of the compounds?

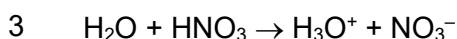
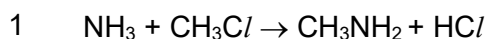
A 1, 3, 2

B 2, 1, 3

C 3, 2, 1

D 3, 1, 2

6 In which reactions is the first reactant acting as a Bronsted-Lowry base?



A 1, 2 and 3

B 1 and 3 only

C 2 and 3 only

D 2 only

7 The ionic product of water, K_w , is found to increase when the temperature of water is raised.

Which statement describes what happens when the temperature of water is raised?

A pH of water decreases and $[\text{H}^+] = [\text{OH}^-]$

B pH of water decreases and $[\text{H}^+]$ is greater than $[\text{OH}^-]$

C pH of water increases and $[\text{H}^+]$ is less than $[\text{OH}^-]$

D pH of water increases and $[\text{H}^+] = [\text{OH}^-]$

8 10.0 cm^3 of $0.010 \text{ mol dm}^{-3}$ solution of nitric acid is diluted with deionised water to form 100 cm^3 of solution.

What is the pH of the resulting solution?

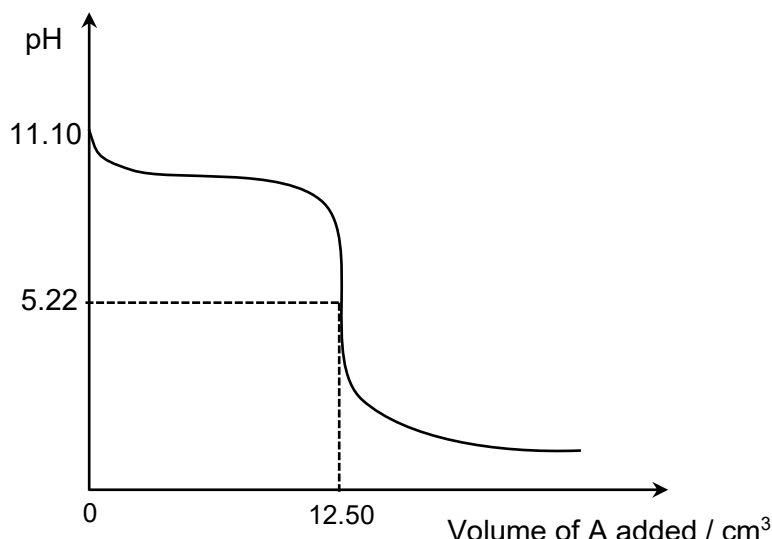
A 1

B 2

C 3

D 4

- 9 The following titration curve shows the changes in pH of 25.0 cm³ of 0.125 mol dm⁻³ monoprotic base (solution B) when an excess monobasic acid (solution A) is added to it gradually.



Which statement about this titration is correct?

- A Solution B contains a strong base.
 - B Solution A contains a weak acid.
 - C The concentration of solution A used in the titration is 0.500 mol dm⁻³.
 - D Bromocresol green (pH range 3.8 – 5.4) is a suitable indicator to detect the endpoint of this titration.
- 10 Which statement is **incorrect** about the following equilibrium that is present in blood?
- $$\text{H}_2\text{CO}_3(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{HCO}_3^-(\text{aq})$$
- A pH of blood will remain relatively constant when there is a large amount of H⁺ added.
 - B A decrease of [H⁺] in blood will cause more hydrogencarbonate ions to be formed.
 - C A solution containing a large reservoir of H₂CO₃ and HCO₃⁻ is a buffer.
 - D It is present in blood to control its pH.
- 11 Which of the following is correct about sodium to sulfur in the Period 3 of the Periodic Table?
- A The oxides formed by these elements become more ionic across the period.
 - B Phosphorus is the only element in this period which forms more than one oxide.
 - C The chlorides formed by these elements become more covalent across the period.
 - D The chloride formed by sodium can dissolve in water to give a solution that will turn blue litmus red.

- 12 Which statements about the Group 1 elements, sodium, potassium, rubidium and caesium are correct?

- 1 Rubidium reacts with water more easily than sodium.
- 2 Potassium loses electrons less easily than caesium.
- 3 Caesium is a more powerful oxidising agent than rubidium.

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

- 13 Singaporium, ^{117}Sg , is a hypothetical element in Group 17 of the Periodic Table below iodine.

What is likely to be **incorrect** for Singaporium?

- A** Singaporium is a solid at room temperature and pressure.
B The bond energy of Sg-Sg is less endothermic than that of I-I .
C Sg_2 is unable to oxidise iodide to iodine.
D HSg is unable to decompose to H_2 and Sg_2 when heated with a red-hot steel.

- 14 An organic molecule has

- three elements;
- the composition by mass, C, 54.5%; H, 9.1%

What could this molecule be?

- 1 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- 2 $\text{CH}_2(\text{CHO})\text{CH}_2\text{CH}_2\text{OH}$
- 3 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{SH}$

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

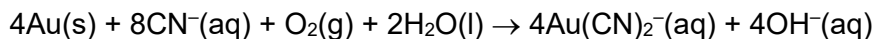
- 15 In acidic solution, dichromate(VI) ions oxidise hydrogen peroxide, H_2O_2 . In alkaline solution, hydrogen peroxide oxidises chromium(III) ions.

Which conditions of oxidation produce oxygen gas?

- A** both acid and alkaline oxidations
B neither acid nor alkaline oxidation
C only the acid oxidation
D only the alkaline oxidation

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

KCN is used to extract gold, Au, from its ore. Gold dissolves in an aqueous cyanide solution in the presence of air to form $\text{Au}(\text{CN})_2^-$, which is stable in aqueous solution.



What is the minimum volume of air, measured at room temperature and pressure, needed to extract 10 kg of gold from its ore?

[You may assume the oxygen content in air to be 20%.]

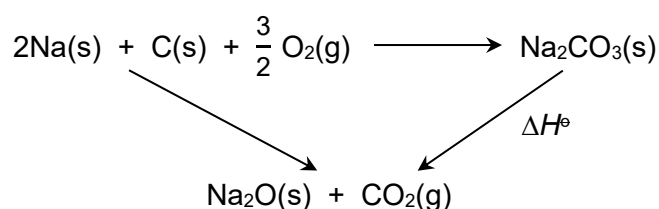
- A** 305 dm³ **B** 610 dm³ **C** 1520 dm³ **D** 3050 dm³

17 Which reactions represent the enthalpy change of formation of a substance?

- 1 $\text{Li}^+(\text{g}) + \text{Cl}^-(\text{g}) \rightarrow \text{LiCl}(\text{s})$
- 2 $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
- 3 $\text{Na}(\text{s}) + \frac{1}{2}\text{Cl}_2(\text{g}) \rightarrow \text{NaCl}(\text{s})$

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

18 The diagram illustrates the energy changes of a set of reactions occurring at standard conditions.



Given that:

$$\Delta H_f^\ominus(\text{sodium carbonate}) = -x \text{ kJ mol}^{-1}$$

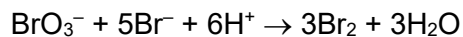
$$\Delta H_c^\ominus(\text{sodium}) = -y \text{ kJ mol}^{-1}$$

$$\Delta H_c^\ominus(\text{carbon}) = -z \text{ kJ mol}^{-1}$$

What is the unknown enthalpy change, $\Delta H^\ominus$, in kJ mol⁻¹?

- A** $x - y - z$ **B** $-x + y - z$ **C** $-x - y - z$ **D** $x - 2y - z$

- 19 In acid solution, BrO_3^- ions will slowly oxidise Br^- ions into Br_2 .



The variation of the initial rate of reaction with the concentrations of the reactants was investigated in four experiments.

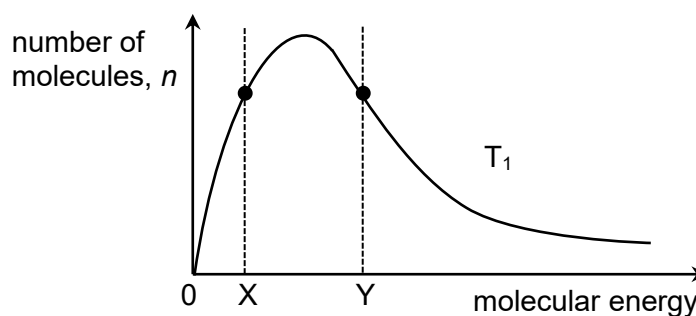
experiment number	Initial concentrations of reactants / mol dm^{-3}			initial rate / $\text{mol dm}^{-3} \text{ s}^{-1}$
	$[\text{BrO}_3^-]$	$[\text{Br}^-]$	$[\text{H}^+]$	
1	0.10	0.10	0.30	7.20×10^{-3}
2	0.10	0.20	0.15	3.60×10^{-3}
3	0.10	0.20	0.30	1.44×10^{-2}
4	0.20	0.20	0.30	2.88×10^{-2}

What can be deduced from the information provided?

- 1 The reaction is second order with respect to H^+ .
- 2 The overall order of reaction is four.
- 3 The rate constant is $8.00 \text{ mol}^{-3} \text{ dm}^9 \text{ s}^{-1}$.

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

- 20 The Boltzmann distribution for a gas at a constant temperature of T_1 is shown.

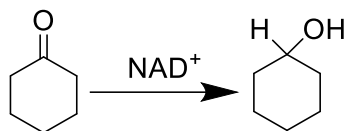


If the temperature of the gas is reduced to T_2 , the graph changes shape.

Which row best describes how the value of n changes at the molecular energies, X and Y, respectively?

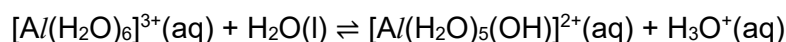
	X	Y
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

- 21 Enzymes can be used in the reduction of organic compounds. One such enzyme is NAD⁺ as illustrated in the reduction of cyclohexanone to cyclohexanol as shown below.



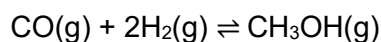
Which statement explains why NAD⁺ cannot be used to reduce cyclopentanone?

- A The enzyme is specific to the reduction of cyclohexanone and is not able to reduce cyclopentanone.
 - B There was insufficient enzyme to reduce cyclopentanone.
 - C Cyclopentanone is resistant to reduction.
 - D Heat is required to reduce cyclopentanone.
- 22 The following equilibrium is established when aluminium chloride dissolves in water.



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

- A The solution will turn damp blue litmus red.
 - B The concentrations of $[\text{Al}(\text{H}_2\text{O})_6]^{3+}(\text{aq})$ and $[\text{Al}(\text{H}_2\text{O})_5(\text{OH})]^{2+}(\text{aq})$ are equal at equilibrium.
 - C The rates of forward and reverse reactions are equal at equilibrium.
 - D More $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ions would be formed when hydrochloric acid is added to it.
- 23 1.00 mol of carbon monoxide and 1.50 mol of hydrogen was introduced into a 2 dm³ sealed vessel at a constant temperature. At equilibrium, 20% of hydrogen has reacted.



What is the K_c value at this temperature?

- A 0.147
 - B 0.123
 - C 0.490
 - D 0.588
- 24 Which of the follow properties **cannot** be explained by high surface area?
- A High tensile strength of graphene
 - B Ability of a gecko to climb a wall
 - C High efficiency of catalytic convertor in automobiles
 - D Use of silver nanoparticles in water filtration system

- 25 Which statement best explains why graphene has good electrical conductivity?
- A Carbon atoms become ionised and are free to move.
 B Carbon atoms combine with electrons and are free to move.
 C σ bonding electrons move through the layer.
 D π bonding electrons move through the layer.
- 26 How many different tertiary alcohols does the molecular formula $C_6H_{14}O$ have?
- A 1 B 2 C 3 D 4
- 27 Which statements about the reaction of 2-chloropropane with hot ethanolic potassium hydroxide are correct?
- 1 The products exist as two isomers.
 2 The product does not contain an oxygen atom.
 3 The product reacts with bromine in CCl_4 .
- A 1, 2 and 3 B 1 and 2 only C 2 and 3 only D 1 and 3 only
- 28 Which row correctly shows the product formed when hex-3-enal is treated with the given reducing agent?
- | | |
|----------------|------------------------------|
| | $CH_3CH_2CH=CHCH_2CHO$ |
| | hex-3-enal |
| reducing agent | product |
| A $H_2 + Pt$ | $CH_3CH_2CH_2CH_2CH_2CH_2OH$ |
| B $H_2 + Pt$ | $CH_3CH_2CH_2CH_2CH_2CHO$ |
| C $NaBH_4$ | $CH_3CH_2CH_2CH_2CH_2CH_2OH$ |
| D $NaBH_4$ | $CH_3CH_2CH_2CH_2CH_2CHO$ |
- 29 Which of the following statement regarding the properties of high density poly(ethene), HDPE and low density poly(ethene), LDPE is **incorrect**?
- A HDPE has less branching than LDPE.
 B HDPE is more suitable to be used to make plastic bags than LDPE.
 C HDPE has a higher melting point than LDPE.
 D HDPE is a harder material than LDPE.

- 30 Polymers used to make contact lenses must be able to absorb water so that they can fit comfortably in the eyes.

Which polymer is **not** suitable to be used to make contact lenses?

