

EUNOIA JUNIOR COLLEGE JC2 Preliminary Examination 2024 General Certificate of Education Advanced Level Higher 1

## CHEMISTRY

Paper 1 Multiple Choice

# 8873/01

18 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, civics group and registration 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** 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 question paper.

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

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

In the analysis of an oxide of nitrogen,  $N_xO_y$ , 0.10 mol of the oxide were reacted with excess hydrogen under suitable conditions.

$$N_x O_y \xrightarrow{H_2} xNH_3 + yH_2O$$

3.6 g of water were formed in this reaction, while the ammonia produced required 100 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> HCl(aq) for neutralisation.

What is the formula of the oxide of nitrogen analysed?

**A** NO **B** NO<sub>2</sub> **C** N<sub>2</sub>O **D** N<sub>2</sub>O<sub>5</sub>

2 The isotopic composition of an element is shown.



**3** Three chemical reactions involving hydrogen peroxide, H<sub>2</sub>O<sub>2</sub>, are shown.

reaction 1	$\mathrm{H_2O_2} + 2\mathrm{HI} \rightarrow 2\mathrm{H_2O} + \mathrm{I_2}$
reaction 2	$5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 5O_2 + 2MnSO_4 + 8H_2O + K_2SO_4$
reaction 3	$2H_2O_2 \rightarrow 2H_2O + O_2$

Which row identifies the reaction in which the oxygen of hydrogen peroxide undergoes oxidation, reduction and disproportionation?

	oxidation reduction		disproportionation
Α	reaction 1	reaction 2	reaction 3
в	reaction 2	reaction 1	reaction 3
С	reaction 2	reaction 3	reaction 1
D	reaction 3	reaction 1	reaction 2

4 The table below shows the composition of the nucleus in some particles.

particle	number of neutrons	number of nucleons	
P-	21	40	
Q⁺	18	38	
R <sup>2–</sup>	19	39	
S <sup>2+</sup>	20	41	

Which of the following pairs consists of particles that are isoelectronic?

A Q<sup>+</sup> and R<sup>2-</sup> B Q<sup>+</sup> and S<sup>2+</sup> C P<sup>-</sup> and R<sup>2-</sup> D R<sup>2-</sup> and S<sup>2+</sup>

5 When a beam of protons travelling at the same speed passes through an electric field of constant strength, the protons, <sup>1</sup>H<sup>+</sup>, are deflected through an angle of +15<sup>o</sup>.

Under identical conditions, which particle would be deflected through an angle of +5°?

**A** <sup>2</sup>H<sup>+</sup> **B** <sup>3</sup>He<sup>2+</sup> **C** <sup>6</sup>Li<sup>2+</sup> **D** <sup>12</sup>C<sup>3+</sup>

**6** Silica, SiO<sub>2</sub>, is a major constituent of sand.

In the structure of solid SiO<sub>2</sub>,

- each silicon atom is bonded to **x** oxygen atoms,
- each oxygen atom is bonded to y silicon atoms,
- each bond is **z** in nature.

What is the correct combination of **x**, **y** and **z**?

	x	У	z
Α	2	1	covalent
в	2	1	intermolecular
С	4	2	covalent
D	4	2	intermolecular

7 In which pair of molecules do the values of the bond angles differ the greatest?

**A**  $BF_3$  and  $NH_3$  **B**  $BF_3$  and  $SF_6$  **C**  $CH_4$  and  $NH_3$  **D**  $CH_4$  and  $SF_6$ 

8 In group 17 elements, the F—F bond is weaker than the C*l*—C*l* bond. Hence, fluorine has higher reactivity than chlorine.

Which statement best accounts for the weaker F–F bond?

- A greater repulsion between the lone pair of electrons
- **B** smaller nuclear charge of the fluorine atom
- **C** greater effective overlap between orbitals
- D shorter length of the bond

**9** The boiling points of hydrogen bromide, HBr, and hydrogen chloride, HC*l*, are shown in the table.

	HC1	HBr
boiling point / °C	-85	-67

Which statements explain the increase in boiling points from hydrogen chloride to hydrogen bromide?

- 1 Covalent bonds between atoms increase in strength.
- 2 Hydrogen bonds between the molecules increase in strength.
- 3 Induced dipole forces between molecules increase in strength.
- **A** 1 and 2 **B** 2 and 3 **C** 2 only **D** 3 only
- 10 Which of the following statements is incorrect?
  - A Bond energy is the energy required to break 1 mole of covalent bonds between two atoms in the gaseous state.
  - **B** The enthalpy change of neutralisation between any strong acid and strong base is about –57.0 kJ mol<sup>-1</sup>.
  - **C** Third ionisation energy of aluminium is the energy needed to convert 1 mole of Al(g) into 1 mole of  $Al^{3+}(g)$ .
  - **D** Lattice energy always has an exothermic value.
- 11  $Fe_2O_3$  reacts with CO during the process of extraction from the haematite ore.



**C** -10.3 kJ mol<sup>-1</sup> **D** +6.2 kJ mol<sup>-1</sup>

**12** The equations show some reactions which occur in the upper atmosphere.

$$O_3 \rightarrow O + O_2$$
  
NO +  $O_3 \rightarrow NO_2 + O_2$   
NO<sub>2</sub> + O  $\rightarrow$  NO + O<sub>2</sub>

Which statements are correct?

- 1 Oxygen free radicals are formed by the action of ultraviolet light.
- 2 NO acts as a catalyst.
- 3 NO acts as an oxidising agent.
- A 1 and 3 B 1 and 2 C 2 and 3 D 3 only
- **13** The Maxwell-Boltzmann distribution of molecular energies is useful for explaining why increasing temperature affects the rate of a chemical reaction.

Which of the following statements describes how the shape of the Maxwell-Boltzmann distribution curve changes as temperature increases?

- A The peak decreases in height and moves to the left.
- **B** The peak increases in height and moves to the left.
- **C** The peak decreases in height and moves to the right.
- **D** The peak increases in height and moves to the right
- **14** A catalyst is added to a system in equilibrium.

What is the effect on the rates of the forward and reverse reactions?

- A There is no effect on the rate in either direction.
- **B** Both rates increase by the same factor.
- **C** The rate in the forward direction increases by a greater factor than the reverse direction.
- **D** The rate in the reverse direction increases by a greater factor than the forward direction.

$$2H_2S(g) + SO_2(g) \square 3S(s) + 2H_2O(g)$$
  $\Delta H$  is negative

Which statements are correct?

- 1 Increases in temperature increases rate and decreases yield.
- 2 Increases the concentration of H<sub>2</sub>S decreases rate and decreases yield.
- 3 Decreases in pressure decreases rate and decreases yield.

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

**16** Four equilibrium reactions are set up.

The concentration of each gas in the equilibrium mixtures is 0.1 mol dm<sup>-3</sup>.

Which equilibrium has a numerical  $K_c$  value of 0.01?

- **A**  $CH_4(g) + 2H_2O(g) \square CO_2(g) + 4H_2(g)$
- **B**  $N_2(g) + 3H_2(g) \square 2NH_3(g)$
- **C**  $H_2(g) + I_2(g) \square 2HI(g)$
- **D**  $2NO_2(g) \square N_2O_4(g)$

17 Which reaction involves both Arrhenius acid and Arrhenius base behaviour?

- **A**  $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$
- $\textbf{B} \quad HNO_3 + NH_3 \rightarrow NH_4NO_3$
- $\textbf{C} \quad HC\mathit{l} + H_2O \rightarrow H_3O^+ + C\mathit{l}^-$
- **D** HNO<sub>3</sub> + KOH  $\rightarrow$  KNO<sub>3</sub> + H<sub>2</sub>O
- **18** 20 cm<sup>3</sup> of 0.1 mol dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub> was added to 80 cm<sup>3</sup> of 0.1 mol dm<sup>-3</sup> of NaOH. What is the pH of the final solution at 25 °C?
  - **A** 12.8 **B** 12.6 **C** 11.8 **D** 11.6

**19** The normal pH range of blood is 7.35–7.45. During exercise, lactic acid is produced.

Which reaction occurs during exercise to maintain the pH of blood?

- $\mathbf{A} \quad \mathsf{H}_2\mathsf{CO}_3 + \mathsf{OH}^- \to \mathsf{HCO}_3^- + \mathsf{H}_2\mathsf{O}$
- **B**  $HCO_3^- + OH^- \rightarrow CO_3^{2-} + H_2O$
- $\textbf{C} \quad HCO_3^- \textbf{+} H_3O^+ \rightarrow H_2CO_3 \textbf{+} H_2O$
- $\textbf{D} \quad \textbf{CO}_3^{2-} \textbf{+} \textbf{H}_3\textbf{O}^{\scriptscriptstyle +} \rightarrow \textbf{HCO}_3^{\scriptscriptstyle -} \textbf{+} \textbf{H}_2\textbf{O}$
- 20 Which property when plotted for Na to Si gives the shape of the following graph?



- A atomic radius
- B electrical conductivity
- **C** first ionisation energy
- D melting point
- **21** A diagonal relationship is said to exist between certain pairs of diagonally adjacent elements in the second and third period of the Periodic Table. Each of these pairs are said to exhibit similar properties.

An example of a diagonal relationship is between beryllium and aluminum.

Which statements about BeO and BeCl<sub>2</sub> are correct?

- 1 BeO and BeCl<sub>2</sub> both undergo hydrolysis in water.
- 2 BeO and BeC $l_2$  both react with HCl.
- 3 BeO is ionic but  $BeCl_2$  is covalent.
- A 1 and 2 only B 1 and 3 only C 2 and 3 only D 3 only

**22** The table shows the results of experiments in which the halogens  $X_2$ ,  $Y_2$  and  $Z_2$  were added to separate aqueous solutions containing  $X^-$ ,  $Y^-$  and  $Z^-$  ions.

	<i>X</i> ⁻ (aq)	Y⁻ (aq)	<i>Z</i> ⁻(aq)
X <sub>2</sub>	no reaction	no reaction	no reaction
Y <sub>2</sub>	X <sub>2</sub> formed	no reaction	$Z_2$ formed
$Z_2$	$X_2$ formed	no reaction	no reaction

Which set contains the ions  $X^-$ ,  $Y^-$  and  $Z^-$  in order of their decreasing strength as a reducing agent?

	strongest		weakest
Α	X	Ý	Z
В	X	Z	Ύ
С	Ύ	Z	X
D	Z	<i>X</i> -	Υ

23 Which type of formula will show butanone and butanal as different compounds?

	empirical	molecular	structural	skeletal	
Α	×	×	×	$\checkmark$	Key:
в	×	×	$\checkmark$	$\checkmark$	$\checkmark$ = shows difference
С	×	$\checkmark$	$\checkmark$	$\checkmark$	× = shows no difference
D	✓	$\checkmark$	✓	×	

**24** Alkanes used to be known as paraffin, meaning 'lack of affinity' or unreactive.

Which statement best explains the 'lack of affinity' in alkanes?

- A The atoms are arranged tetrahedrally around each carbon atom.
- **B** There are only weak instantaneous dipole-induced dipoles between alkane molecules.
- **C** There are no significant dipole moments in C–C and C–H bonds.
- **D** The alkane molecules are not soluble in water.

25 Which compound is not the product of a single reaction of propan-1-ol?

- A carbon dioxide
- B propene
- C propanone
- **D** propanoic acid
- 26 Butan-2-ol can be made by reducing X with H<sub>2</sub>/Ni.

Butan-2-ol can be dehydrated to form Y and Z which are constitutional isomers of each other.

Which row is correct?

	X is	cis-trans isomerism is shown by
Α	A an aldehyde both Y and Z	
В	an aldehyde	only one of Y and Z
С	a ketone	both Y and Z
D	a ketone	only one of Y and Z

- **27** Which pair of reagents will react under appropriate conditions to produce the ester methyl propanoate?
  - **A**  $HCO_2H + CH_3CH_2CH_2OH$
  - **B** CH<sub>3</sub>CO<sub>2</sub>H + CH<sub>3</sub>OH
  - $C \quad C_2H_5CO_2H + CH_3OH$
  - **D**  $C_2H_5CO_2H + C_2H_5OH$
- **28** A section of a polymer is shown below.



Which monomer could form this polymer?

- A CH<sub>3</sub>CH(OH)CN
- **B** HOCH<sub>2</sub>CH<sub>2</sub>CN
- $\mathbf{C}$  H<sub>2</sub>C=CHCN
- D NCCH=CHCN



Which statement correctly explains why plastics made from this polyester only soften at high temperature?

- A Hydrogen bonds and instantaneous dipole-induced interactions exist between polyester chains.
- **B** Permanent dipole-permanent dipole and instantaneous dipole-induced interactions exist between polyester chains.
- **C** The carbon-carbon bonds in the chain are strong.
- **D** The carbon-oxygen bonds in the chain are strong.
- **30** The following table gives the approximate dimensions of certain substances.

	substance	dimensions
1	red blood cell	diameter up to 8.7 $\mu m,$ thickness up to 2.2 $\mu m$
2	quantum dot	diameter up to 50 nm
3	dust particle	diameter 2.5 μm
4	coronavirus	diameter up to 0.5 µm

(1 µm = 1000 nm)

Which substance(s) would be considered as nanoparticles?

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