



CHEMISTRY

Paper 1 Multiple Choice

8873/01

19 September 2025

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.

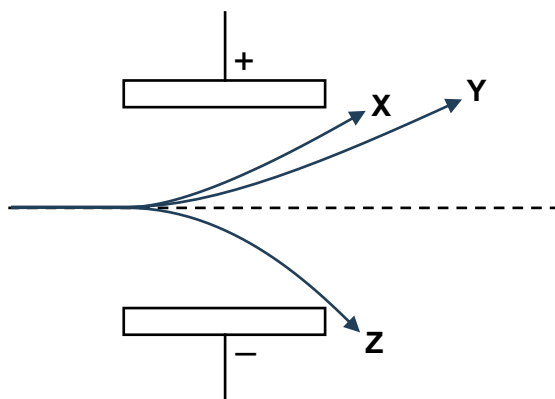
Any rough working should be done in this question paper.

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

- 1 In which pair of atoms, in their ground states, have the same number of unpaired electrons?

A B and Ca **B** F and Na **C** Ne and P **D** Be and Si

- 2 Three particles approach an electric field at the same speed. They are deflected as they pass through the electric field.



What could be the identities of particles **X**, **Y** and **Z**?

	X	Y	Z
A	$^{35}_{17}\text{Cl}^-$	$^{37}_{17}\text{Cl}^-$	$^{23}_{11}\text{Na}^+$
B	$^6_3\text{Li}^+$	$^7_3\text{Li}^+$	$^1_1\text{H}^-$
C	$^{37}_{17}\text{Cl}^-$	$^{35}_{17}\text{Cl}^-$	$^{23}_{11}\text{Na}^+$
D	$^7_3\text{Li}^+$	$^6_3\text{Li}^+$	$^1_1\text{H}^-$

- 3 Which molecule has the largest bond angle?

A BF_3 **B** SiCl_4 **C** H_2S **D** PH_3

- 4 The boiling points of hydrogen chloride, HCl , and chlorine, Cl_2 are shown in the table.

	boiling point / $^{\circ}\text{C}$
HCl	-85
Cl_2	-34

Which pair of statements explain this difference?

- 1 The forces of attraction between Cl_2 molecules are instantaneous dipole-induced dipole attractions.
- 2 The forces of attraction between HCl molecules are permanent dipole-permanent dipole attractions.
- 3 H-Cl bonds are stronger than Cl-Cl bonds.
- 4 The forces of attraction between Cl_2 molecules are stronger because Cl_2 molecules have more electrons.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

- 5 Which of the following molecule will **not** form a hydrogen bond with another of its own molecule?

A CH_3CHO **B** CH_3NH_2 **C** CH_3OH **D** HF

- 6 Gases can be liquefied under certain conditions.

Which statement best describes why a gas liquefies under high pressure?

- A** Increasing the pressure causes the temperature of the gas to decrease to below its boiling point.
- B** Increasing the pressure decreases the kinetic energy of the molecules, creating the ordered liquid state.
- C** Increasing the pressure decreases the size of the molecules, and so the intermolecular forces of attraction become stronger.
- D** Increasing the pressure pushes the molecules closer together, and so the intermolecular forces of attraction become stronger.

- 7 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.

	X^- (aq)	Y^- (aq)	Z^- (aq)
X_2	no reaction	no reaction	no reaction
Y_2	X_2 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 $\longrightarrow$ weakest		
A	X^-	Y^-	Z^-
B	X^-	Z^-	Y^-
C	Y^-	Z^-	X^-
D	Z^-	X^-	Y^-

- 8 Which element forms a chloride in which both covalent bonding and dative bonding are present?

A Mg

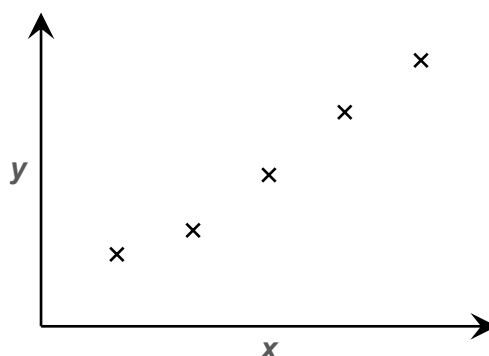
B Al

C Si

D P

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

The sketch below shows the variation of properties of Period 3 elements.



Which option shows the correct label for the axes?

	<i>y</i>	<i>x</i>
1	melting point	nucleon number
2	electronegativity	atomic number
3	atomic radius	highest possible oxidation state

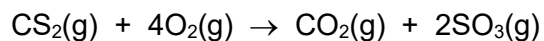
- A** 2 only **B** 2 and 3 **C** 1 and 3 **D** 1, 2 and 3
- 10 Use of the *Data Booklet* is relevant to this question.

A 5 g sample of a diatomic gas, Y_2 , was found to contain 3.76×10^{22} atoms.

What is the relative molecular mass of the gas?

- A** 40 **B** 80 **C** 120 **D** 160

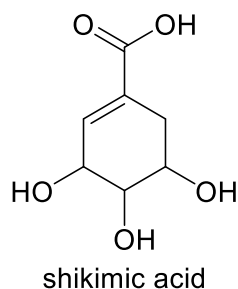
- 11 Carbon disulfide vapour, $\text{CS}_2(\text{g})$, burns in oxygen according to the following equation.



A sample of 10 cm^3 of carbon disulfide was burned in 60 cm^3 of oxygen. The residual gases were passed through sodium hydroxide.

Assuming all measurements were made at the same temperature and pressure in which CS_2 was in the gaseous state, what is the final volume of gases left?

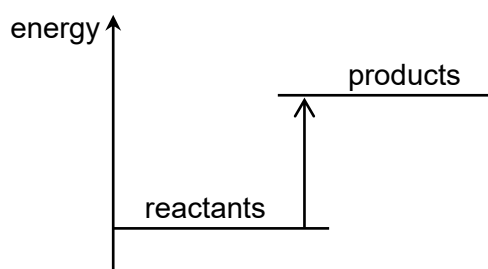
- A** 50 **B** 40 **C** 30 **D** 20
- 12 Shikimic acid is a naturally occurring compound found in the spice plant star anise, also known as Japanese flower shikimi.



What is the percentage composition by mass of carbon in shikimic acid?

- A** 48.3% **B** 48.5% **C** 49.7% **D** 50.0%

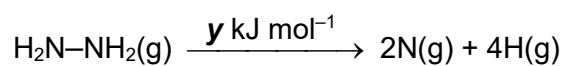
13 Which reaction could represent the energy level diagram shown?



- A $\text{CO}_2(\text{g}) \rightarrow \text{C}(\text{g}) + 2\text{O}(\text{g})$
- B $\text{Ca}^{2+}(\text{g}) + 2\text{Br}^{-}(\text{g}) \rightarrow \text{CaBr}_2(\text{s})$
- C $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
- D $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

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

Hydrazine, N_2H_4 , undergoes the following reaction.

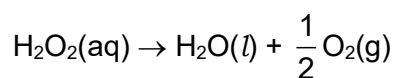


What is the value of y ?

- A 550
- B 1720
- C 1970
- D 2550

Use the following information to answer **Q15** and **Q16**.

Hydrogen peroxide slowly decomposes at room temperature.



A series of experiments were carried out to study the energetics and kinetics of this reaction.

- 15** 50 cm³ of 0.500 mol dm⁻³ aqueous hydrogen peroxide were placed in a polystyrene cup and its temperature was determined to be 23.0 °C. 10 cm³ of 0.500 mol dm⁻³ iron(III) nitrate, Fe(NO₃)₃, solution was added to catalyse the reaction.

The mixture was stirred with a thermometer and a maximum temperature of 32.2 °C was recorded.

What is the enthalpy change of the reaction?

- A** -77 kJ mol⁻¹ **B** -92 kJ mol⁻¹ **C** -96 kJ mol⁻¹ **D** -323 kJ mol⁻¹

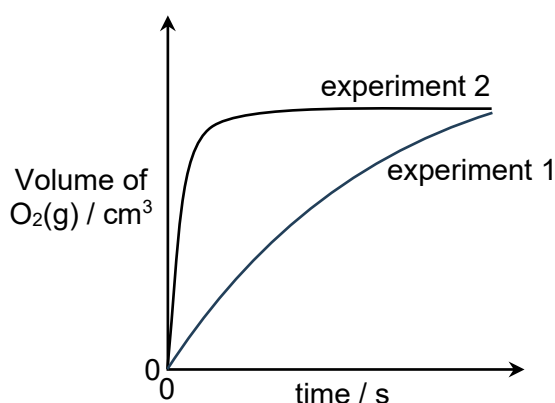
- 16 Two further experiments were performed to study the effects of adding lead(IV) oxide on the decomposition of hydrogen peroxide at constant temperature.

Experiment 1 : 20 cm³ of H₂O₂

Experiment 2 : 20 cm³ of H₂O₂ and 1.0 g of lead(IV) oxide

At the end of experiment 2, the mixture was filtered and 1.0 g of lead(IV) oxide was recovered.

The results of the experiments are as shown.



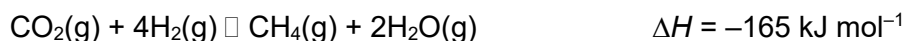
Which row is correct?

	value of rate constant	activation energy
A	equal in experiment 1 and 2	higher in experiment 1
B	equal in experiment 1 and 2	higher in experiment 2
C	higher in experiment 2	higher in experiment 1
D	higher in experiment 2	higher in experiment 2

- 17 If the reaction $\text{Q} + \text{R} \rightarrow \text{S} + \text{T}$ is described as zero order with respect to **Q**, which of the following statements correctly describes **Q**?

- A** **Q** is a limiting reagent.
- B** The rate of reaction is independent of **[Q]**.
- C** The concentration of **Q** does not change during the reaction.
- D** All of molecules **Q** do not possess energy sufficient to overcome the activation energy of the reaction.

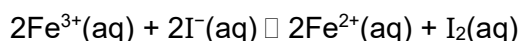
- 18** Methane, CH₄, is manufactured industrially by the catalytic reaction shown below.



The operating conditions are: 350 °C; a pressure between 25 and 35 bar; a nickel catalyst.

Which factor influences the choice of these conditions?

- A** The catalyst increases the equilibrium yield of methane.
 - B** At higher pressures, the equilibrium yield of methane increases.
 - C** At higher temperatures, the rate of formation of methane decreases.
 - D** At higher temperatures, the equilibrium yield of methane increases.
- 19** The equilibrium between Fe³⁺ and I⁻ may be represented by



In a particular mixture, the equilibrium amount of Fe³⁺ is 0.3 mol.

What will be the new equilibrium amount of Fe³⁺ if 0.5 moles of pure iron(II) sulfate is added to the mixture?

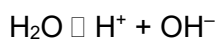
- A** less than 0.3 mol
 - B** 0.3 mol
 - C** between 0.3 mol and 0.8 mol
 - D** 0.8 mol
- 20** Which of the following statements regarding chemical equilibria is correct?
- 1 A change in pressure has no effect on the value of K_c .
 - 2 A change in temperature will always result in a change in value of K_c .
 - 3 For a reversible reaction at equilibrium, the rates of the forward and backward reactions are both zero.

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

21 What is the definition of a Brønsted-Lowry acid?

- A a substance that donates hydrogen ions
- B a substance that accepts a lone pair of electrons
- C a substance that produces hydrogen ions in aqueous solution
- D a substance that readily reacts with a base to form a salt and water only

22 Water dissociates into H^+ and OH^- as shown.



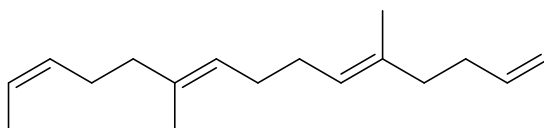
The pH of water decreases at higher temperatures.

Which statements are correct?

- 1 Water becomes acidic at higher temperatures.
- 2 The dissociation of water is endothermic.
- 3 The pOH decreases at higher temperatures.

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

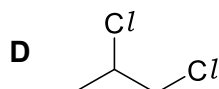
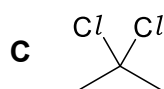
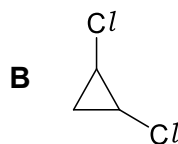
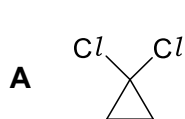
23 How many *cis-trans* isomers does the following compound have?



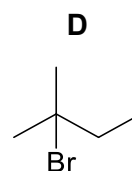
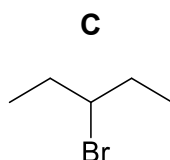
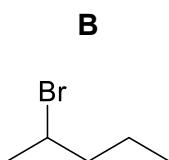
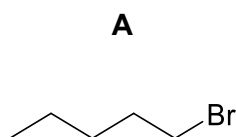
- A 10 B 16 C 40 D 64

24 C_3H_6 can exist as cyclopropane or propene.

Which compound could **not** be formed by the reaction of chlorine with either hydrocarbon under suitable conditions?



25 Which bromoalkane gives the greatest number of different alkenes, including *cis-trans* isomers, on elimination?



26 Compound **X** has the molecular formula $C_4H_{10}O_2$.

X has an unbranched carbon chain and contains two OH groups.

On reaction with an excess of hot, acidified, aqueous manganate(VII) ions, **X** is converted into a compound of molecular formula $C_4H_6O_4$.

To which two carbon atoms in the chain of **X** are the two OH groups attached?

A 1st and 2nd

B 1st and 3rd

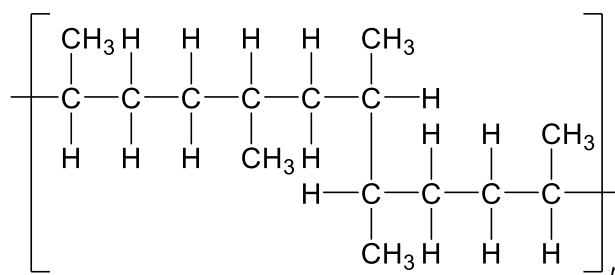
C 1st and 4th

D 2nd and 3rd

27 Which ester produces butan-2-ol and ethanoic acid upon hydrolysis?

- A** $\text{CH}_3\text{CO}_2\text{CH}(\text{CH}_3)_2$
B $\text{CH}_3\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
C $\text{CH}_3\text{CH}(\text{CH}_3)\text{CO}_2\text{CH}_2\text{CH}_3$
D $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$

28 Which monomer will react to give the polymer shown below?



- 1 $\text{CH}_2=\text{CH}-\text{CH}_3$
 2 $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$
 3

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

29 Some properties of polymers **W**, **X**, **Y** and **Z**, are shown.

polymer	properties of the polymer
W	low tensile strength and can be recycled
X	low melting point and easy to mould
Y	high tensile strength and rigid
Z	decompose when heated and cannot be recycled

Which polymers are thermosets?

- A** W and X **B** W and Z **C** X and Y **D** Y and Z

30 Which of the following applications does not involve surface area of nanoparticles?

- A** Decomposition of hydrogen peroxide is faster when catalysed by manganese dioxide nanoparticles
B Removal of harmful gases in a catalytic converter
C Electrical conductivity of graphene
D Ability of gecko to climb walls

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