

**RAFFLES INSTITUTION
2025 YEAR 6 PRELIMINARY EXAMINATION**

Higher 1



CHEMISTRY

8873 / 01

Paper 1 Multiple Choice

26 September 2025

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not open this question booklet until you are told to do so.

Write in **soft pencil**.

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

Write your name, class and index number in the spaces provided on the Answer Sheet.

There are **thirty** questions in this section. 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 the question booklet.

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

1 Which statement about $^{32}\text{S}^{2-}$ and ^{34}S is correct?

- A Both have the same number of protons.
- B Both have the same number of electrons.
- C Both have the same number of neutrons.
- D Both have the same mass number.

2 Which statement about orbitals and electrons in an argon atom is correct?

- 1 The shell with principal quantum number 3 has no unpaired electrons.
- 2 The valence electronic configuration of an isolated atom is $3s^2 3p^6 3d^{10}$.
- 3 The 2p orbitals have different energies but same shape.

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

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

Substances exhibit magnetic behaviour based on the presence or absence of unpaired electrons.

Paramagnetic species contain one or more unpaired electrons, making them slightly attracted to an external magnetic field.

Diamagnetic species have all their electrons paired, causing them to be weakly repelled by a magnetic field.

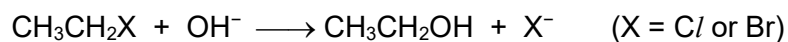
Which of the following species is diamagnetic?

- A Ti^{2+} B Zn^{2+} C Cu^{2+} D Fe^{2+}

4 Which species contains only covalent and dative bonds within itself?

- A Al_2O_3 B SO_3 C NH_4Cl D H_3O^+

- 5 The reactivity of halogen derivatives can be observed in the following reaction.



Which statement explains why the reaction takes place more rapidly for bromoethane than for chloroethane?

- 1 Permanent dipole-permanent dipole forces between chloroethane molecules are stronger than those between bromoethane molecules.
- 2 C–Cl bond is more polar than C–Br bond.
- 3 C–Cl bond is stronger than C–Br bond.

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

- 6 Liquefying gases is a common practice to reduce their volume, allowing for easy transportation and efficient storage.

Which statement correctly explains why O₂ is easier to liquefy than N₂?

- A** O₂ has a lower boiling point than N₂.
- B** O₂ has a longer bond length than N₂.
- C** O₂ has a double bond but N₂ has a triple bond.
- D** O₂ has stronger instantaneous dipole-induced dipole forces than N₂.

- 7 Substance S

- is a solid at room temperature
- does not conduct electricity in solid and molten state
- is insoluble in water.

What could be the structure of S?

- A** ionic
- B** metallic
- C** giant molecular
- D** simple molecular

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

Chlorine gas is a severe irritant to the eyes. The maximum safe level of tolerance of chlorine gas in air is 0.005 mg dm^{-3} .

How many molecules of chlorine gas are present in 1 dm^3 of air at this toleration level?

- A** $\frac{0.005}{6 \times 10^{23}} \times 71$
- B** $\frac{0.005}{71} \times 6 \times 10^{23} \times 2$
- C** $\frac{0.005}{1000} \times \frac{1}{71} \times 6 \times 10^{23}$
- D** $\frac{0.005}{1000} \times 71 \times 6 \times 10^{23}$

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

The complete combustion of 0.0050 mol of hydrocarbon Q requires 0.720 dm^3 of oxygen measured at r.t.p.

0.36 g of water is produced.

What is the molecular formula of Q?

- A** C_2H_4 **B** C_3H_4 **C** C_4H_8 **D** C_6H_8

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

When 1.0 g of magnesium is added to 100 cm^3 of 1.0 mol dm^{-3} dilute hydrochloric acid in a insulated container, the temperature of the solution rose from 20.0°C to 35.0°C .

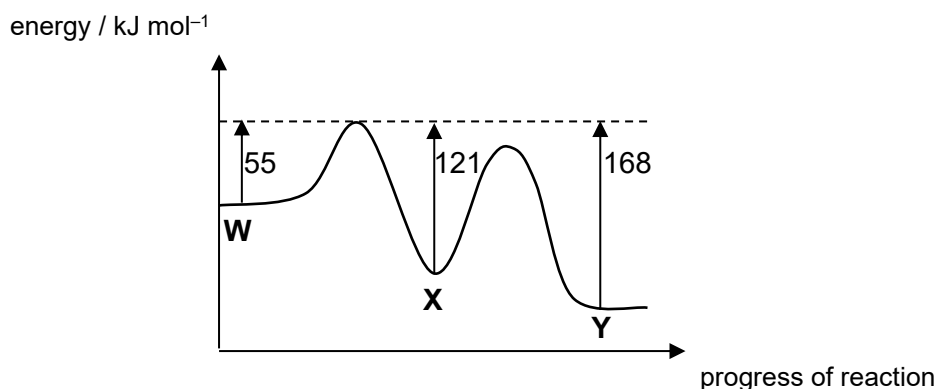
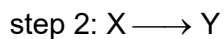
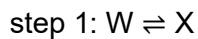
Assume that the specific heat capacity of the solution is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$ and the density of the solution is 1.00 g cm^{-3} .



What is the enthalpy change per mole of H_2 produced?

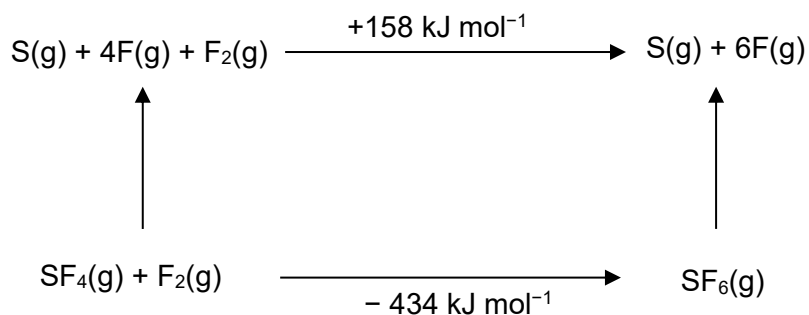
- A** $-1.53 \text{ kJ mol}^{-1}$
- B** $-62.7 \text{ kJ mol}^{-1}$
- C** -152 kJ mol^{-1}
- D** -154 kJ mol^{-1}

- 11 The reaction pathway diagram for a two-step reaction is shown below.



Which statement about the reaction is correct?

- A The activation energy for the forward reaction of step 1 is higher than that of step 2.
- B Step 2 is more exothermic than step 1.
- C The activation energy for the backward reaction of step 1 is $+66 \text{ kJ mol}^{-1}$.
- D The enthalpy change of reaction for the conversion of W to Y is -113 kJ mol^{-1} .
- 12 An energy cycle is shown.



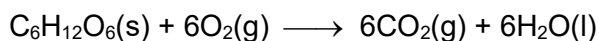
What is the average value for the S-F bond energy?

- A 148 kJ mol^{-1}
- B 276 kJ mol^{-1}
- C 296 kJ mol^{-1}
- D 592 kJ mol^{-1}

- 13 The standard enthalpies of formation for the following compounds are given in the table below.

compound	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
$\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$	-1273
$\text{CO}_2(\text{g})$	-394
$\text{H}_2\text{O}(\text{l})$	-286

Calculate the enthalpy change for the combustion of 1 mole of glucose in the given equation.



- A -593 kJ mol^{-1}
 B -1953 kJ mol^{-1}
 C -2807 kJ mol^{-1}
 D -5353 kJ mol^{-1}
- 14 Melphalan is a drug used in chemotherapy. When dissolved in blood, the rate of elimination of Melphalan from the body follows a first-order kinetics.
- It takes 4 hours for the concentration of Melphalan in a patient's blood to decrease from $100 \mu\text{g cm}^{-3}$ to $25 \mu\text{g cm}^{-3}$.
- How long does it take for the concentration of Melphalan in the blood of the same patient to decrease from $200 \mu\text{g cm}^{-3}$ to $25 \mu\text{g cm}^{-3}$?
- A 8 hours
 B 6 hours
 C 4 hours
 D 2 hours
- 15 Which statement does **not** explain why the introduction of a catalyst leads to an increase in the rate of a reaction?
- A The rate constant increases.
 B The catalyst provides an alternative pathway.
 C The reactant molecules move more quickly.
 D The proportion of collisions that is successful between the reactant molecules is higher.

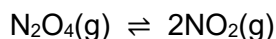
16 Which statements about the conditions used in Haber process are correct?

- 1 An iron catalyst is used to increase the equilibrium yield of ammonia.
- 2 A pressure of 200 atmospheres is used because a high pressure will favour the side of the equilibrium with the greater number of molecules.
- 3 A temperature of 400 °C to 500 °C is used to increase the rate of reaction.
- 4 A temperature of 400 °C to 500 °C is used because a high temperature will increase the equilibrium yield of ammonia.

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

17 Initially, 4.0 mol of nitrogen dioxide, NO_2 , is placed in a flask of volume 1.0 dm^{-3} at $T^\circ\text{C}$.

The flask is sealed and the contents left to reach equilibrium.



At equilibrium, 1.0 mol of dinitrogen tetroxide, N_2O_4 , is present.

What is the value of the equilibrium constant, K_c , at $T^\circ\text{C}$?

A 0.25 **B** 2.00 **C** 4.00 **D** 9.00

18 Which pair of statements is correct for any reversible reaction that is at dynamic equilibrium?

	rate of reaction	concentration of species
A	the forward and reverse reactions have equal rates	the concentration of the reactants and products are constant
B	the forward and reverse reactions have equal rates	the concentration of the reactants and products are equal
C	the forward and reverse reactions stop	the concentration of the reactants and products are constant
D	the forward and reverse reactions stop	the concentration of the reactants and products are equal

- 19 A 25.0 cm³ of 0.100 mol dm⁻³ aqueous solution of an acid HX has a pH of 4.0.

Which statement is correct?

- A HX is a weak acid.
- B The value of K_a is 1×10^{-4} .
- C The concentration of hydrogen ions is 0.100 mol dm⁻³.
- D A buffer is formed when 25.0 cm³ of 0.100 mol dm⁻³ NaOH(aq) is added to the solution.

- 20 What is the definition of an Arrhenius acid?

- A a substance that accepts hydroxide 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 salt and water only

- 21 Which statements about the Group 17 hydrides, HX, are correct?

- 1 The bonding pair of electrons gets closer to the halogen nucleus going down the group.
- 2 Thermal stability decreases down the group.
- 3 The bond length of H-X increases down the group.

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

- 22** Two chlorides were examined separately and found to have the following properties.

One is a white powder which forms a colourless, slightly acidic solution on dissolving in water. The other is a colourless liquid which, on mixing with water, fumes and leaves an acidic solution with a pH of less than 3.

Which pair of compounds has properties that correspond to the above?

- A** MgCl_2 and Al_2Cl_6
- B** MgCl_2 and PCl_5
- C** NaCl and PCl_5
- D** PCl_5 and SiCl_4

- 23** Some information about some of the elements of Period 5 of the Periodic Table is shown.

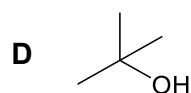
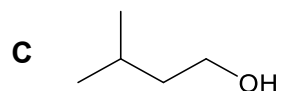
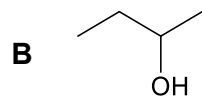
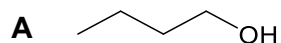
element	Rb	Sr	In	Sn	Sb	Te	I	Xe
electrical conductivity	high	high	high	high	high	semi-conductor	zero	zero
boiling point / K	961	1650	2300	2540	1650	1260	457	165

Which statement about these elements is correct?

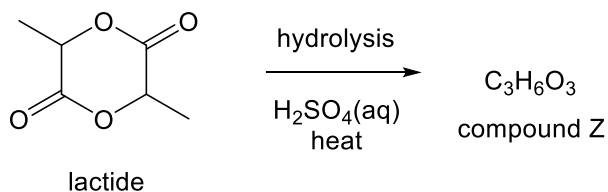
- A** Only Xe exists as simple molecules.
- B** Te exists as a giant metallic structure.
- C** There are more elements with metallic structures in Period 5 than in Period 3.
- D** Those elements in Period 5 which have a boiling point under 1000 K exist as simple molecules.

- 24 On elimination of water followed by reaction with bromine in the dark, compound P produced a mixture of two dibromo compounds that are structural isomers.

What could compound P be?



- 25 The diester lactide undergoes hydrolysis to produce compound Z.

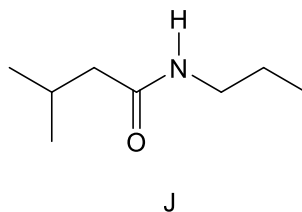


Which statements about Z are correct?

- 1 Z is 2-hydroxypropanoic acid.
- 2 Z undergoes reduction with NaBH_4 .
- 3 Z decolourises Br_2 in CCl_4 .
- 4 Z decolourises acidified $\text{KMnO}_4(\text{aq})$.

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

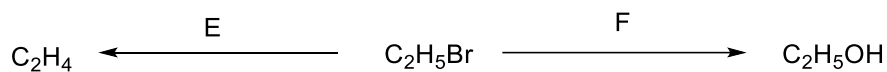
- 26 J can be made by reacting compounds K and L in the presence of dicyclohexylcarbodiimide, DCC.



What are the identities of K and L?

	K	L
A		
B		
C		
D		

- 27 The diagram shows the products of two reactions of bromoethane, C_2H_5Br .



What types of reaction are E and F?

	E	F
A	elimination	substitution
B	reduction	oxidation
C	oxidation	substitution
D	elimination	hydration

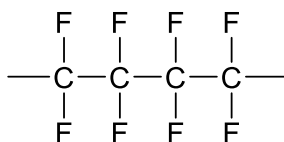
- 28** Information about the structure of a polymer may allow us to predict something about its physical properties.

Which predictions are likely to be accurate?

	information about structure	prediction about property of polymer
1	decrease in branching about the chain	increase in density
2	increase in hydrogen bonding between chains	increase in strength
3	increase cross-linking between chains	increase in flexibility

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

A short section of the chain in the addition polymer Teflon™ is shown.



The relative molecular mass of a typical molecule of Teflon™ is approximately 200 000.

How many monomers are joined together to make this typical polymer molecule?

- A** 1000 **B** 1400 **C** 2000 **D** 4000
- 30** Which statement about the property of graphene is correct?
- A** Graphene is soft because the carbon atoms are held together by weak instantaneous dipole-induced dipole interactions.
- B** Graphene conducts electricity because the carbon atoms are ionised and are free to move.
- C** Graphene is strong because the carbon atoms form a network of covalent bonds.
- D** Graphene is brittle because it has a layered structure that is one atom thick.