



# TAMPINES MERIDIAN JUNIOR COLLEGE

## JC2 PRELIMINARY EXAMINATION

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**H1 CHEMISTRY**

**8873/01**

Paper 1 Multiple Choice

**25 September 2025**

**1 hour**

Additional materials: Multiple Choice Answer Sheet  
Data Booklet

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### READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

There are **thirty** questions in this section. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

**Read very carefully the instructions on the use of Answer Sheet.**

You are advised to fill in the Answer Sheet as you go along; no additional time will be given for the transfer of answers once the examination has ended.

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.

#### **Use of Answer Sheet**

Ensure you have written your name, class, date and subject on the Answer Sheet.

Shade the last four digits of your centre/index number on the Multiple Choice Answer Sheet. (e.g. if your centre/index number is 3054**1234**, shade 1234).

Use a **2B** pencil to shade your answers on the Answer Sheet; erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.

- 1 The relative atomic mass of antimony, which consist of the isotopes  $^{121}\text{Sb}$  and  $^{123}\text{Sb}$ , is 121.8. Calculate the percentage of  $^{123}\text{Sb}$  in the isotopic mixture.

**A** 40%                      **B** 45%                      **C** 50%                      **D** 60%

- 2 Atoms of elements from hydrogen to zinc have specific electronic arrangements.

Which statement is correct?

- A** The shell with principal quantum number 3 can hold a maximum of 8 electrons.  
**B** The electrons always occupy the highest energy orbitals available.  
**C** The order of filling the orbitals is 1s, 2s, 2p, 3s, 3p, 3d, 4s.  
**D** In some atoms, electrons occupy the fourth shell even though the third shell is not full.

- 3 Elements **E** and **F** have the following successive ionisation energies in  $\text{kJ mol}^{-1}$ .

|          | 1 <sup>st</sup> | 2 <sup>nd</sup> | 3 <sup>rd</sup> | 4 <sup>th</sup> | 5 <sup>th</sup> | 6 <sup>th</sup> | 7 <sup>th</sup> |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>E</b> | 580             | 1800            | 2700            | 11600           | 14800           | 18400           | 23300           |
| <b>F</b> | 1310            | 3400            | 5300            | 7500            | 11000           | 13300           | 20300           |

What could be the formula of the compound formed by these two elements?

**A**  $\text{EF}_3$                       **B**  $\text{E}_2\text{F}_3$                       **C**  $\text{E}_3\text{F}_2$                       **D**  $\text{E}_4\text{F}_3$

- 4 Which combination correctly represents the shape around the central atom in each of the species?

|          | $\text{SH}_2$ | $\text{BF}_3$      | $\text{NCI}_3$     |
|----------|---------------|--------------------|--------------------|
| <b>A</b> | linear        | trigonal pyramidal | trigonal planar    |
| <b>B</b> | linear        | trigonal planar    | trigonal pyramidal |
| <b>C</b> | bent          | trigonal pyramidal | trigonal planar    |
| <b>D</b> | bent          | trigonal planar    | trigonal pyramidal |

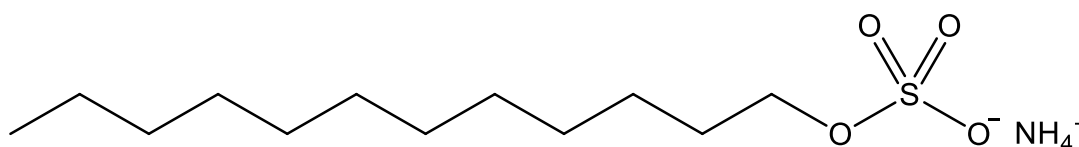
- 5 Gases can be liquefied under certain conditions.

Which statements about liquefaction of a non-polar gas are correct?

- 1 Some gases can be liquefied at room temperature by applying pressure.
- 2 The strength of the intermolecular forces is negligible at high pressure.
- 3 The strength of the intermolecular forces becomes more significant at low temperature.

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

- 6 Ammonium lauryl sulfate (ALS) is an anionic surfactant found primarily in shampoos and body-wash as a foaming agent. ALS is soluble in both water and oil. The structure of ALS is as follows.



Which statement is incorrect about ALS?

- A** It is soluble in oil, due to the presence of compatible intermolecular instantaneous dipole-induced dipole interactions with oil molecules.
- B** It is soluble in water, due to the presence of ion-dipole interactions with water molecules.
- C** It has a high melting and boiling point due to the hydrogen bonding between the particles.
- D** The pi bond in S=O is due to the side-on overlap of the orbitals.

- 7 Consecutive elements **L**, **M** and **N** are in Period 3 of the Periodic Table. Element **M** has the lowest melting point and the highest first ionisation energy of these three elements.

What are the identities of **L**, **M** and **N**?

- A** sodium, magnesium, aluminium
- B** magnesium, aluminium, silicon
- C** aluminium, silicon, phosphorus
- D** silicon, phosphorus, sulfur

[Turn over



8 Which statement about Period 3 elements is true across the period?

- A The pH of the oxides in water decreases.
- B The solubility of the oxides in water increases.
- C The melting points of the elements decreases.
- D The electrical conductivity of the elements decreases.

9 How do the following properties for Group 1 elements change down the group?

|   | reducing power | ionic radius | ionisation energy |
|---|----------------|--------------|-------------------|
| A | increases      | increases    | decreases         |
| B | increases      | decreases    | increases         |
| C | decreases      | decreases    | increases         |
| D | decreases      | increases    | decreases         |

10 Which statements are correct for all three halogens, chlorine, bromine and iodine?

- 1 The volatility decreases down the group.
- 2 The electronegativity increases down the group.
- 3 Their reactivity as oxidising agents decreases down the group.
- 4 They form hydrides that are strong acids in aqueous solutions.

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

11 Oxygen-17,  $^{17}\text{O}$ , isotope is commonly used in Nuclear Magnetic Resonance Spectroscopy to study the chemical environment of oxygen atoms in molecules.

How many neutrons are present in 0.17 g of  $^{17}\text{O}$ ?  
[ $L$  = Avogadro constant]

A 0.01L    B 0.08L    C 0.09L    D 0.17L



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

Titanite is a mineral known to be a relatively soft gemstone. A particular sample of titanite has the following composition by mass:

Ca: 20.5%    Ti: 24.4%    Si: 14.3%    O: 40.8%

The empirical formula of titanite is  $\text{Ca}_w\text{Ti}_x\text{Si}_y\text{O}_z$ .

What is the value of  $z$ ?

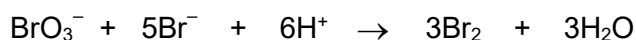
- A**    2                      **B**    3                      **C**    5                      **D**    7

- 13  $25.0 \text{ cm}^3$  of an aqueous solution of  $0.200 \text{ mol dm}^{-3} \text{ T}^{2+}$  required  $20.00 \text{ cm}^3$  of  $0.100 \text{ mol dm}^{-3}$  of acidified  $\text{KMnO}_4(\text{aq})$  for a complete reaction.

What is the final oxidation state of T?

- A**    0                      **B**    +3                      **C**    +4                      **D**    +5

- 14 Under acidic conditions, bromate(V) ions and bromide ions react as shown.



The reaction is found to be first order with respect to both  $\text{BrO}_3^-$  and  $\text{Br}^-$  and second order with respect to  $\text{H}^+$ .

The initial concentration of  $\text{BrO}_3^-$  and  $\text{Br}^-$  is increased by a factor of 4 while concentration of  $\text{H}^+$  decreased by half.

By which factor will the initial rate increase?

- A**    2                      **B**    4                      **C**    8                      **D**    16

- 15 Caffeine is a drug that increases the activity of the brain and nervous system. Its elimination from the body follows a first-order kinetics with a half-life of 5.0 h.

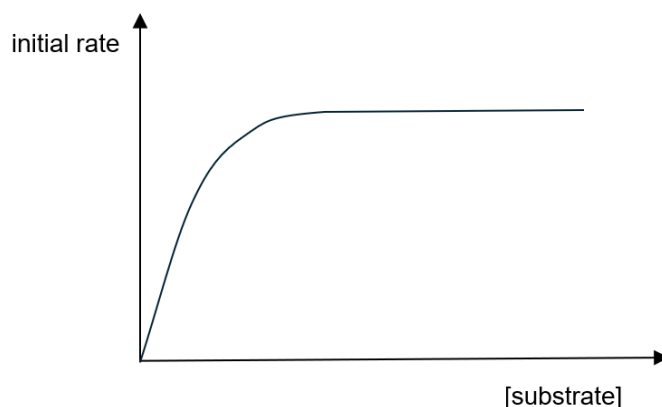
How long will it take for someone who took 52 mg of caffeine, to have 6.5 mg of caffeine left in his system?

- A**    6.5 h                      **B**    15.0 h                      **C**    20.0 h                      **D**    40.0 h

[Turn over



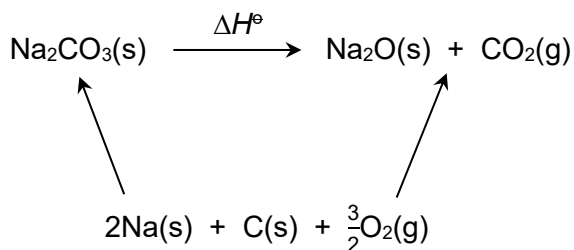
- 16 The Michaelis-Menten graph shows how the initial rate of reaction varies for an enzyme catalysed reaction as the concentration of the substrate changes.



Which statement explains the shape of the graph?

- A** The enzyme is acting as a limiting reagent and is being used up in the reaction.
- B** Substrate molecules inhibit the enzyme at high concentrations which resulted in a constant rate.
- C** At high substrate concentration, the order of reaction with respect to substrate is 1.
- D** The reaction will reach a constant rate when all active sites of the enzyme are occupied.
- 17 Which equation defines standard enthalpy change of formation correctly?
- A**  $\text{Na(s)} + \text{Cl(g)} \rightarrow \text{NaCl(s)}$
- B**  $2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(g)}$
- C**  $\text{Mg}^{2+}\text{(g)} + \text{O}^{2-}\text{(g)} \rightarrow \text{MgO(s)}$
- D**  $\text{H}_2\text{(g)} + \text{S(s)} + 2\text{O}_2\text{(g)} \rightarrow \text{H}_2\text{SO}_4\text{(l)}$

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



Given that:

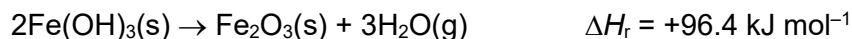
$$\Delta H_f^\ominus(\text{Na}_2\text{CO}_3) = -x \text{ kJ mol}^{-1}$$

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

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

What is the unknown enthalpy change,  $\Delta H^\ominus$ , in  $\text{kJ mol}^{-1}$ ?

- A  $x - y - z$   
 B  $-x + y - z$   
 C  $-x - y - z$   
 D  $x - 2y - z$
- 19 The decomposition of iron(III) hydroxide,  $\text{Fe}(\text{OH})_3$ , produces water and iron(III) oxide,  $\text{Fe}_2\text{O}_3$ , as shown in the equation below.



Given that the values of the enthalpy change of formation of  $\text{Fe}_2\text{O}_3(\text{s})$  and  $\text{H}_2\text{O}(\text{g})$  are  $-824 \text{ kJ mol}^{-1}$  and  $-242 \text{ kJ mol}^{-1}$  respectively, what is the enthalpy change of the formation of  $\text{Fe}(\text{OH})_3(\text{s})$ ?

- A  $-727 \text{ kJ mol}^{-1}$   
 B  $-823 \text{ kJ mol}^{-1}$   
 C  $-1454 \text{ kJ mol}^{-1}$   
 D  $-1646 \text{ kJ mol}^{-1}$

[Turn over



- 20 In a 2.0 dm<sup>3</sup> vessel, 1.6 mol of nitrosyl chloride gas, NOCl, was heated at 320°C. At equilibrium, 40% of the NOCl gas dissociated according to the equation below.



What is the numerical value of the equilibrium constant,  $K_c$ ?

- A 0.071  
B 0.107  
C 0.137  
D 0.142
- 21 The Haber Process is an industrial method used to synthesise ammonia from nitrogen and hydrogen gases.



Which statements about Haber Process are correct?

- 1 Iron catalyst is added to increase the yield of ammonia.
  - 2 An adequately high pressure of 250 atm is used to increase the yield of ammonia while keeping cost of reaction low.
  - 3 A moderate temperature of 450 °C is used to increase yield of ammonia while ensuring high rate of reaction.
- A 1 and 2 only  
B 1 and 3 only  
C 2 and 3 only  
D 1, 2 and 3
- 22 Which equation shows the first reactant acting as a Brønsted–Lowry acid?
- A  $\text{NH}_3 + \text{NaH} \rightarrow \text{NaNH}_2 + \text{H}_2$   
B  $\text{O}^{2-} + \text{H}_2\text{O} \rightarrow 2\text{OH}^-$   
C  $\text{HPO}_4^{2-} + \text{H}_3\text{O}^+ \rightarrow \text{H}_2\text{PO}_4^- + \text{H}_2\text{O}$   
D  $\text{HNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{NO}_3^+ + \text{HSO}_4^-$



- 23 Water dissociates into ions according to the following equilibrium.



Which statements are correct as temperature is increased to  $50^\circ\text{C}$ ?

- 1 The dissociation constant of water,  $K_w$ , increases
- 2  $[\text{H}^+] = [\text{OH}^-]$
- 3 pH of water remains at 7

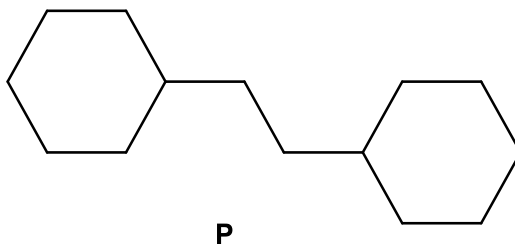
**A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1 only

- 24 The molecule  $\text{H}_2\text{C}=\text{CHC}\equiv\text{N}$  is planar.

State the number of  $\sigma$  and  $\pi$  bonds present in the molecule.

|          | $\sigma$ | $\pi$ |
|----------|----------|-------|
| <b>A</b> | 4        | 2     |
| <b>B</b> | 4        | 5     |
| <b>C</b> | 6        | 3     |
| <b>D</b> | 6        | 5     |

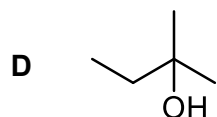
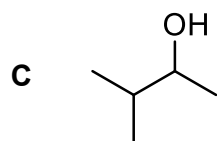
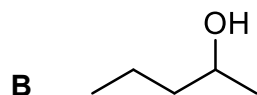
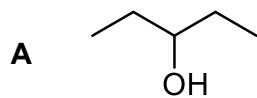
- 25 How many mono-brominated isomers, could be produced when compound **P** reacts with bromine in the presence of sunlight?



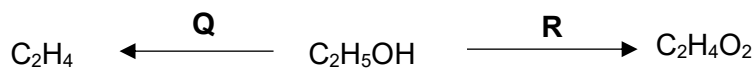
**A** 5                      **B** 6                      **C** 7                      **D** 8

[Turn over

26 Which alcohol gives the greatest number of different alkenes on elimination?



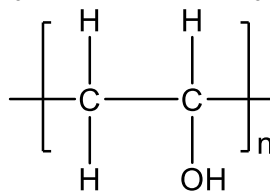
27 The diagram shows the products of two reactions of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ .



Which reagents and conditions are used in reactions **Q** and **R**?

|          | <b>Q</b>                                           | <b>R</b>                      |
|----------|----------------------------------------------------|-------------------------------|
| <b>A</b> | alcoholic KOH, heat                                | $\text{LiAlH}_4$ in dry ether |
| <b>B</b> | excess concentrated $\text{H}_2\text{SO}_4$ , heat | $\text{LiAlH}_4$ in dry ether |
| <b>C</b> | alcoholic KOH, heat                                | acidic $\text{KMnO}_4$ , heat |
| <b>D</b> | excess concentrated $\text{H}_2\text{SO}_4$ , heat | acidic $\text{KMnO}_4$ , heat |

- 28 The structure below is that of a polymer based on vinyl alcohol.



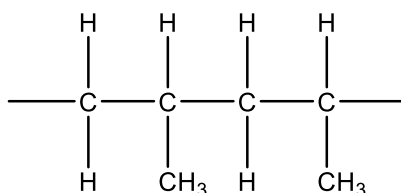
Which statements correctly describe the above polymer?

- 1 It is water-resistant.
- 2 The polymer can react with hot aqueous base.
- 3 The polymer is formed via addition polymerisation.
- 4 The monomer cannot exhibit cis trans isomerism.

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

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

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



The relative molecular mass of a sample of the polypropylene is approximately 150 000.

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

- A** 1790                      **B** 1830                      **C** 3570                      **D** 3750

[Turn over



**30** Which statement about nanomaterials is correct?

- A** Nanomaterials could lead to environment hazard if not disposed properly.
- B** Nanomaterials are good catalysts due to their high surface area to mass ratio.
- C** Nanomaterials are classified as particles with all dimensions between 1–100 nm on the nanoscale.
- D** Nanomaterials could be used in cosmetic products because it has no potential harmful effects on human health.

