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# Chemistry

## Standard level

### Paper 1A

16 May 2025

Zone A afternoon | Zone B afternoon | Zone C afternoon

1 hour 30 minutes [Paper 1A and Paper 1B]

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#### Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for paper 1A is **[30 marks]**.
- The maximum mark for paper 1A and paper 1B is **[55 marks]**.

**Section A**

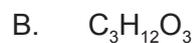
1. A test tube contains a mixture of liquid hydrocarbons. What is the type of mixture and the best method of separation?

	Type of mixture	Method of separation
A.	homogeneous	distillation
B.	homogeneous	filtration
C.	heterogeneous	distillation
D.	heterogeneous	filtration

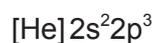
2. Which property is the same for water containing tritium ( $^3\text{H}$ ) and water containing hydrogen ( $^1\text{H}$ )?
- A. Density
  - B. Dipole moment of a molecule
  - C. Boiling point
  - D. Relative molecular mass
3. The emission spectrum of hydrogen provides evidence for which feature of atomic structure?
- A. Nucleus
  - B. Energy levels
  - C. Isotopes
  - D. Protons
4. What is the maximum number of electrons that can occupy the  $n = 3$  main energy level?
- A. 3
  - B. 8
  - C. 18
  - D. 28

5. What is the empirical formula of a compound with the following composition by mass?

C = 37.5%    H = 12.5%    O = 50.0%



6. What is the charge of the monatomic ion usually formed by the element with the following electron configuration?



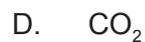
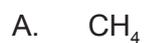
A. 3-

B. 2+

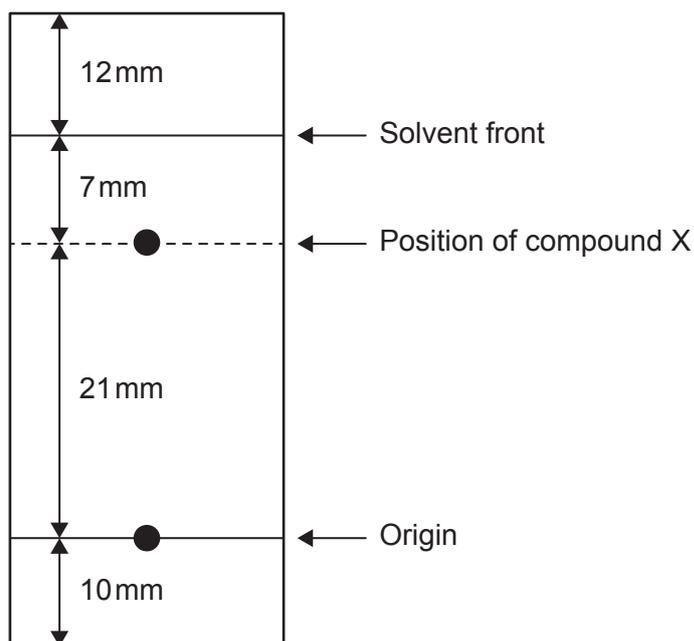
C. 3+

D. 5+

7. Which molecule is polar?

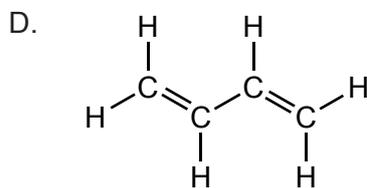
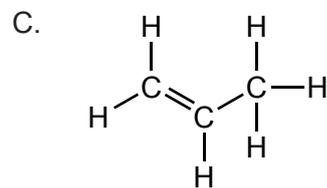
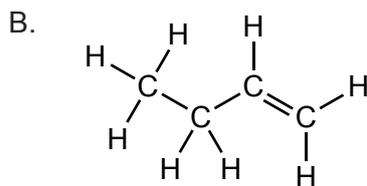
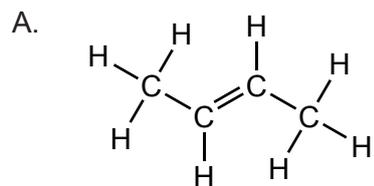
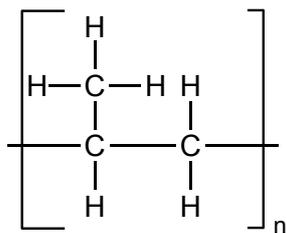


8. What is the retardation factor,  $R_F$ , of compound X according to this paper chromatogram?

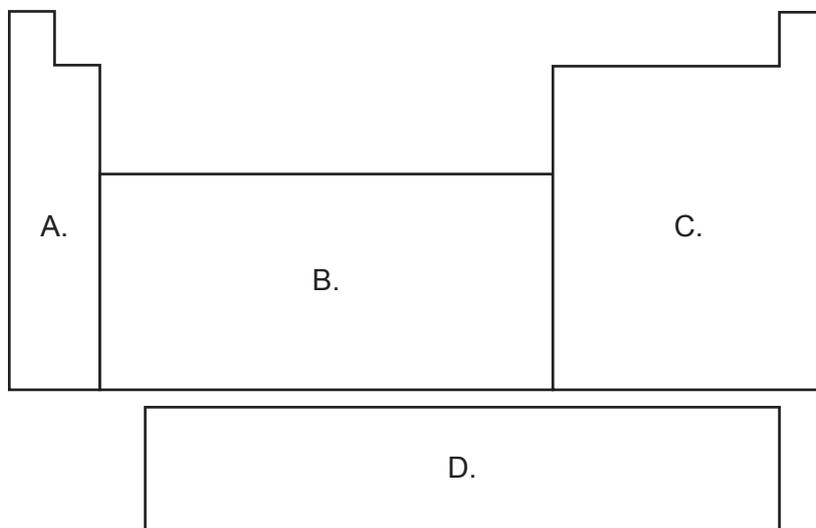


- A. 0.55
  - B. 0.75
  - C. 0.82
  - D. 1.33
9. Which metal has the strongest bonding?
- A. Mg
  - B. Ca
  - C. Sr
  - D. Ba

10. Which monomer produces this addition polymer?



11. Which label shows the d-block elements of the periodic table?



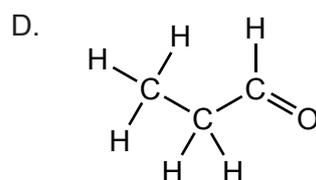
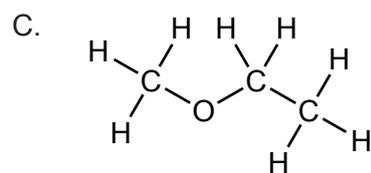
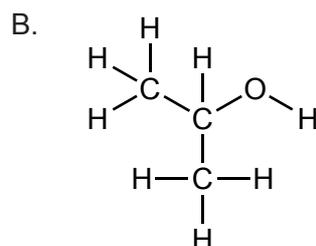
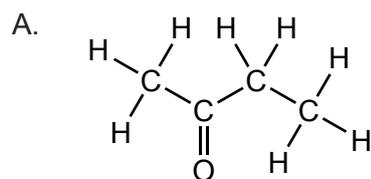
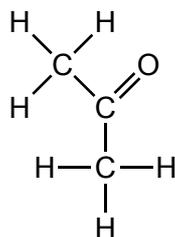
12. Why do group 17 elements have higher first ionization energies than group 1 elements in the same period?

- A. Group 17 elements have more electrons in the valence shell.
- B. Group 17 elements have more filled energy levels.
- C. Group 17 elements have more paired electrons.
- D. Group 17 elements have more protons in the nucleus.

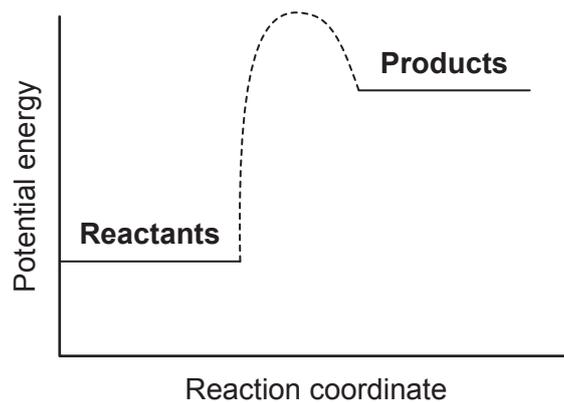
13. What is the oxidation state of nitrogen in  $N_2O_4$ ?

- A. -4
- B. -2
- C. +2
- D. +4

14. Which compound is an isomer of propanone?

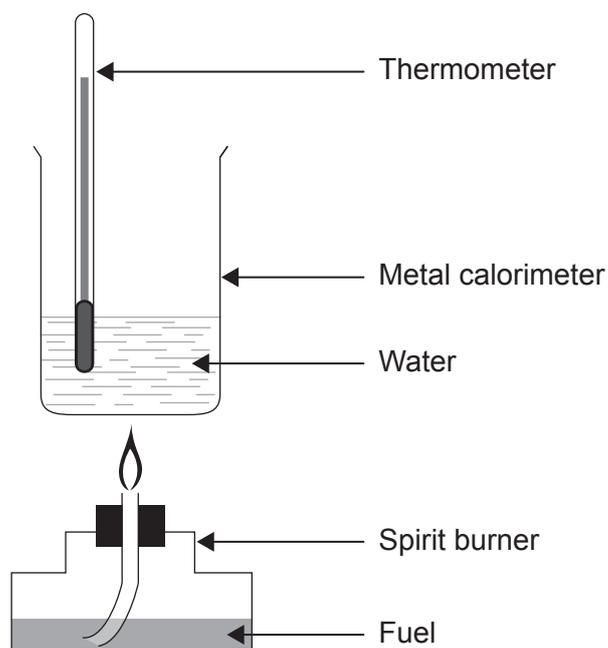


15. What is the correct interpretation of this energy profile?



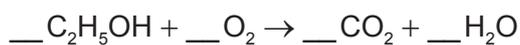
	<b>Relative stability</b>	<b>Temperature of surroundings</b>
A.	reactants more stable than products	decreases
B.	reactants more stable than products	increases
C.	reactants less stable than products	decreases
D.	reactants less stable than products	increases

16. What is the standard enthalpy change,  $\Delta H_{\text{combustion}}^{\ominus}$ , according to the data?



Amount of fuel burned = 0.110 mol  
 Mass of water = 200 g  
 Initial temperature of water = 21.0 °C  
 Final temperature of water = 25.0 °C  
 Specific heat capacity of water,  $c_w = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$   
 $Q = mc\Delta T$

- A.  $-2110 \text{ kJ mol}^{-1}$   
 B.  $-30.4 \text{ kJ mol}^{-1}$   
 C.  $+30.4 \text{ kJ mol}^{-1}$   
 D.  $+2110 \text{ kJ mol}^{-1}$
17. What is the coefficient of oxygen when the equation for the complete combustion of ethanol is balanced using the smallest whole numbers?



- A. 1  
 B. 2  
 C. 3  
 D. 7

18. What are the limiting reactant and theoretical yield of hydrogen when 0.20 mol of magnesium reacts with 0.20 mol of hydrochloric acid?

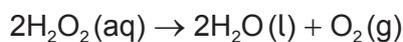


	Limiting reactant	Theoretical yield of H <sub>2</sub> / mol
A.	Mg	0.10
B.	Mg	0.20
C.	HCl	0.05
D.	HCl	0.10

19. Which are units for rate of reaction?

- A. mols
- B. dm<sup>-3</sup>h<sup>-1</sup>
- C. moldm<sup>-3</sup>h<sup>-1</sup>
- D. moldm<sup>-3</sup>s

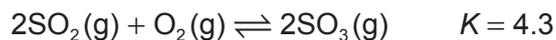
20. Which changes increase the rate of the reaction?



- I. Introducing a catalyst
- II. Increasing concentration of H<sub>2</sub>O<sub>2</sub>(aq)
- III. Increasing pressure

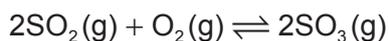
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
21. Why does rate of reaction increase with temperature?
- A. A higher proportion of collisions have the proper orientation
  - B. A higher proportion of collisions have sufficient energy
  - C. Activation energy decreases
  - D. Activation energy increases

22. The following system is at equilibrium.



What is the value of the equilibrium constant,  $K$ , for the reverse reaction?

- A.  $\sqrt{\frac{1}{4.3}}$   
 B. 4.3  
 C.  $\frac{1}{4.3}$   
 D.  $\sqrt{4.3}$
23. What is the effect of doubling the pressure on the equilibrium? All other conditions remain unchanged.



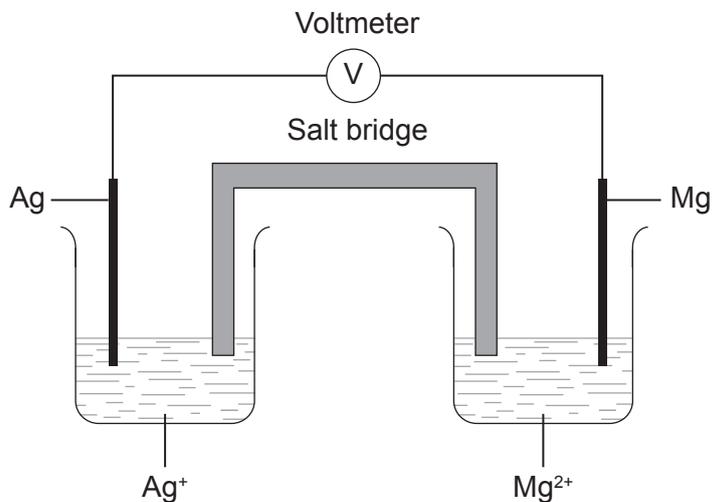
	Effect on equilibrium position	Effect on equilibrium constant, $K$
A.	shifts right	no change
B.	shifts left	no change
C.	shifts right	increases
D.	shifts left	decreases

24. What is required to convert a base into its conjugate acid?
- A. A negative charge  
 B. A hydrogen atom  
 C. An electron pair  
 D. A proton

25. Which solution has a pH of 9.0?
- A.  $10^{-9} \text{ mol dm}^{-3} \text{ NH}_3(\text{aq})$
  - B.  $10^{-9} \text{ mol dm}^{-3} \text{ NaOH}(\text{aq})$
  - C.  $10^{-5} \text{ mol dm}^{-3} \text{ NH}_3(\text{aq})$
  - D.  $10^{-5} \text{ mol dm}^{-3} \text{ NaOH}(\text{aq})$
26. What is the main reason why sulfuric acid has a lower pH than methanoic acid of the same concentration?
- A. Sulfuric acid is diprotic, whereas methanoic acid is monoprotic.
  - B. Sulfuric acid ionizes more than methanoic acid.
  - C. Sulfuric acid has a stronger conjugate base than methanoic acid.
  - D. Sulfuric acid is more soluble in water than methanoic acid.
27. In which compound does sulfur have an oxidation state of +4?
- A.  $\text{H}_2\text{S}$
  - B.  $\text{SO}_3$
  - C.  $\text{H}_2\text{SO}_3$
  - D.  $\text{H}_2\text{SO}_4$

28. Magnesium displaces silver from aqueous silver nitrate.

What is the correct description of the silver electrode in the cell shown?



	Sign	Electrode
A.	+	cathode
B.	+	anode
C.	-	cathode
D.	-	anode

29. Which change represents oxidation of the functional group?

- A.  $\text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{CHO}$
- B.  $\text{H}_2\text{CO} \rightarrow \text{HCOOH}$
- C.  $\text{HCCH} \rightarrow \text{H}_2\text{CCH}_2$
- D.  $\text{H}_2\text{CO} \rightarrow \text{CH}_3\text{OH}$

30. Which equation represents propagation in a radical substitution mechanism?

- A.  $\text{CH}_4 + \text{Cl}\cdot \rightarrow \cdot\text{CH}_3 + \text{HCl}$
- B.  $\cdot\text{CH}_3 + \text{Cl}\cdot \rightarrow \text{CH}_3\text{Cl}$
- C.  $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
- D.  $\text{CH}_3\text{Cl} + \text{Cl}\cdot \rightarrow \text{CH}_2\text{Cl}_2 + \text{H}\cdot$