Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Higher level
Paper 1A

15 May 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

2 hours [Paper 1A and Paper 1B]

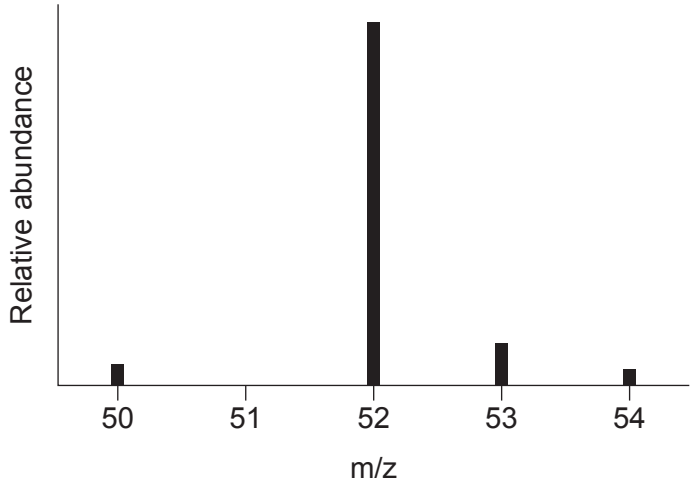
Instructions to students

- 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 **[40 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

2226 – 4222
16 pages

Section A

1. Which element would produce this mass spectrum?



A. Mn

B. V

C. Cr

D. Fe

2. Boron ($A_r = 10.81$) consists of two isotopes, B-10 and B-11. What is the relative abundance of B-11?

A. 19 %

B. 29 %

C. 71 %

D. 81 %

3. Which species has a ground state electron configuration of $[Ar]4s^1 3d^{10}$?

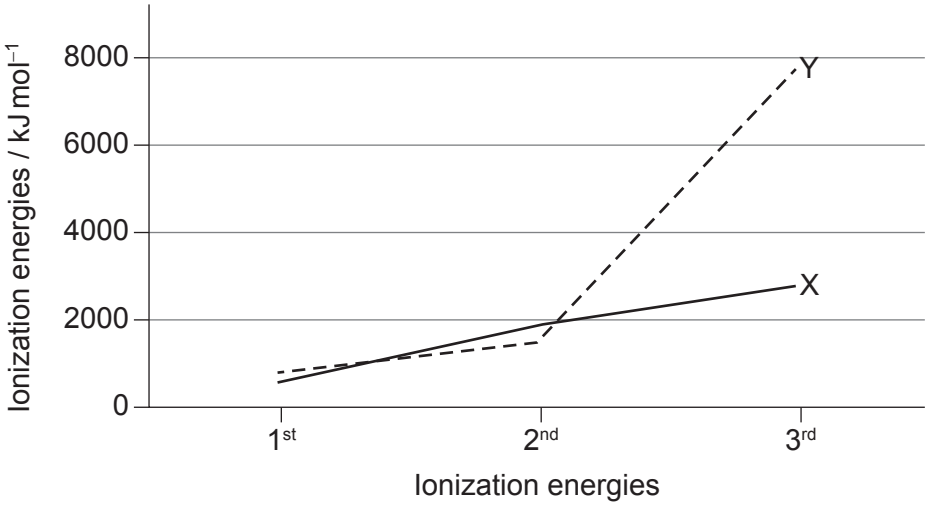
A. Zn^{2+}

B. Cu^{+}

C. Zn

D. Cu

4. The first three ionization energies of elements X and Y are given.



Which pair of elements is X and Y?

	Element X	Element Y
A.	Si	Al
B.	Al	Mg
C.	Na	Mg
D.	Na	Ne

5. What is the reason a balloon containing a real gas would have a smaller volume than one containing the same number of moles of ideal gas, when both balloons are held at 100 K and 100 kPa?

A. Real gases experience attractions due to intermolecular forces.

B. Ideal gases experience repulsions due to intermolecular forces.

C. Molecules of real gases have greater kinetic energy.

D. Molecules of ideal gases have greater kinetic energy.

6. Which compounds contain ionic bonds?

I. NH_4NO_3

II. $CaCl_2$

III. CH_3OH

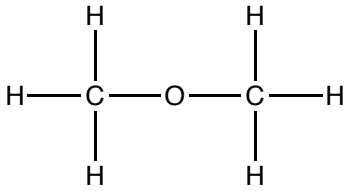
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

7. The formula for methoxymethane is shown.



What is the molecular geometry for the C and O atoms?

	Molecular geometry of C	Molecular geometry of O
A.	Trigonal pyramidal	Bent
B.	Tetrahedral	Linear
C.	Trigonal planar	Linear
D.	Tetrahedral	Bent

8. These isomers have a molar mass of $72\,g\,mol^{-1}$. What is the reason for the increase in boiling points?

Isomer	Structure	Boiling point (°C)
3-methoxyprop-1-ene	$H_2C{=}CH{-}CH_2{-}O{-}CH_3$	43
Butanal	$CH_3{-}CH_2{-}CH_2{-}CHO$	75
But-3-en-2-ol	$H_2C{=}CH{-}CH(OH){-}CH_3$	97

A. Increase in strength of intermolecular forces

B. Decrease in strength of intermolecular forces

C. Increase in number of electrons

D. Change in types of intramolecular bonding

9. Which electrostatic attraction describes the formation of covalent bonds?

A. Between polar molecules

B. Between oppositely charged ions

C. Between a lattice of cations and delocalized electrons

D. Between a shared pair of electrons and the positively charged nuclei

10. Which molecule has an atom with an expanded octet?

A. Al_2Cl_6

B. $SiCl_4$

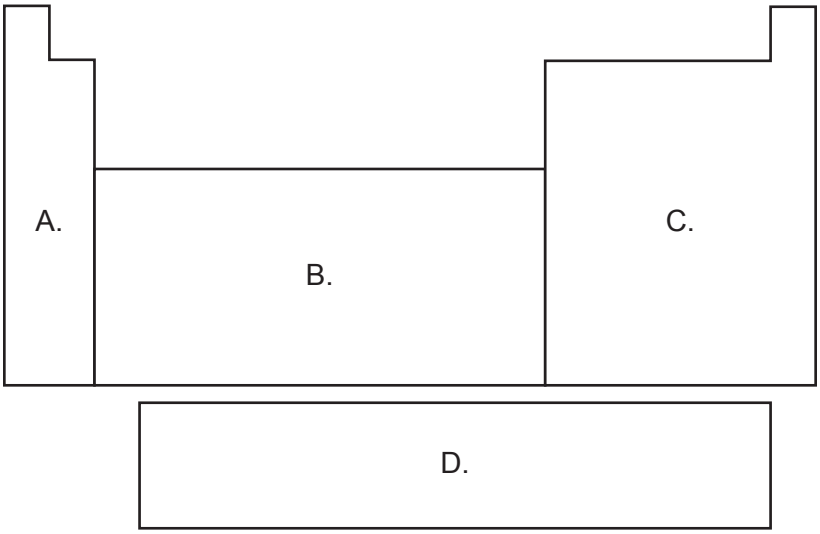
C. SF_4

D. PF_3

11. Which two compounds would produce water in a condensation reaction?

	Compound 1	Compound 2
A.	CH_3CH_2OH	O_2
B.	CH_3COOH	CH_3CH_2OH
C.	CH_3OH	CH_3CHO
D.	CH_3OCH_3	CH_3NH_2

12. Which element is in the d-block?



13. Which factor causes first ionization energy to decrease down a group?

A. Increasing shielding effect

B. Decreasing shielding effect

C. Increasing number of protons

D. Decreasing number of protons

14. Why do alkali metals form 1+ ions?

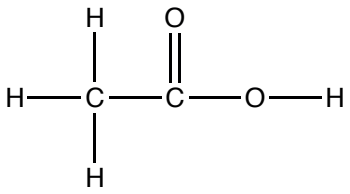
A. Low ionization energy causing the atoms to lose one electron

B. Low electron affinity causing the atoms to gain one electron

C. High ionization energy causing the atoms to gain one electron

D. High electron affinity causing the atoms to lose one electron

15. What is the correct classification of the following molecule?



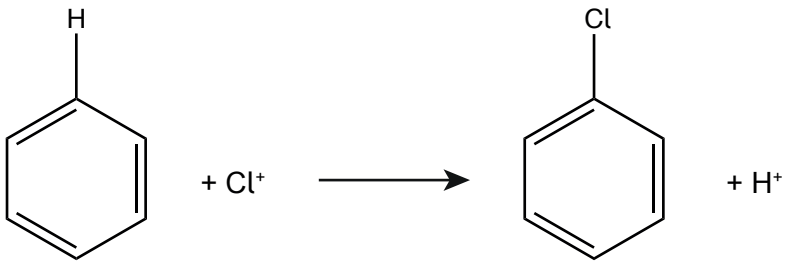
A. Aldehyde

B. Ketone

C. Alcohol

D. Carboxylic acid

16. Which species is the electrophile?



	Electrophile	Reason
A.	C_6H_6	Donates electron pair
B.	C_6H_6	Accepts electron pair
C.	Cl^+	Accepts electron pair
D.	Cl^+	Donates electron pair

17. What is the splitting pattern in the ^{1}H NMR of butanone?

A. Doublet, quartet

B. Singlet, quartet, triplet

C. Triplet, doublet, triplet

D. Singlet, triplet, triplet, quartet

18. Which technique identifies chemical bonds in an organic compound?

A. Polarimetry

B. Mass spectrometry

C. IR spectroscopy

D. NMR spectroscopy

19. Which of the following reactions are exothermic?

I. $Cl(g) + e^{-} \rightarrow Cl^{-}(g)$

II. $H_2O(s) \rightarrow H_2O(l)$

III. $NH_3(g) \rightarrow NH_3(l)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. Which compounds could form if methane (CH_4) undergoes incomplete combustion?

A. CO_2 only

B. CO_2 and H_2O only

C. CO, CO_2 and H_2O

D. C and H_2 only

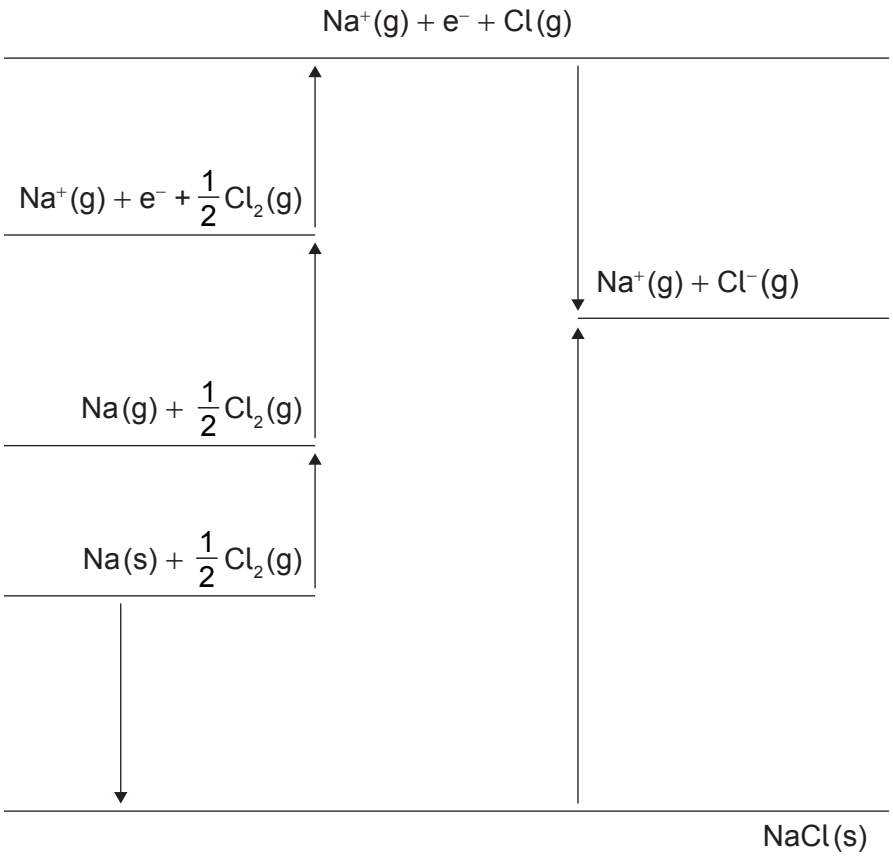
21. What are the electron domain geometry and molecular geometry of phosphorus pentafluoride, PF_5?

	Electron domain geometry	Molecular geometry
A.	Trigonal bipyramidal	Square planar
B.	Octahedral	Square pyramidal
C.	Octahedral	Trigonal bipyramidal
D.	Trigonal bipyramidal	Trigonal bipyramidal

22. Which combination will result in the largest value of lattice enthalpy?

	Ionic charges	Ionic radii
A.	High	Large
B.	Low	Small
C.	Low	Large
D.	High	Small

23. Consider the Born–Haber Cycle for the formation of sodium chloride, NaCl.



$\Delta H^{\ominus}_{sub}(Na)$	$+107\,kJ\,mol^{-1}$
$\Delta H^{\ominus}_{IE}(Na)$	$+496\,kJ\,mol^{-1}$
$\Delta H^{\ominus}_{bond}(Cl{-}Cl)$	$+242\,kJ\,mol^{-1}$
$\Delta H^{\ominus}_{EA}(Cl)$	$-349\,kJ\,mol^{-1}$
$\Delta H^{\ominus}_{lattice}(NaCl)$	$+790\,kJ\,mol^{-1}$

What is the enthalpy of formation, in $kJ\,mol^{-1}$, of sodium chloride, NaCl?

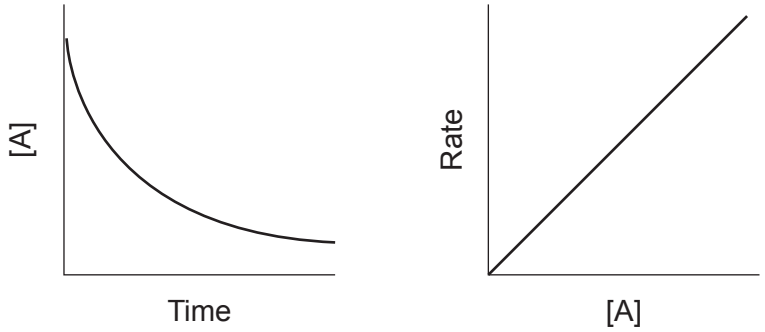
A. $-107 - 496 - 242 + 349 + 790$

B. $-107 - 496 + 242 - 349 - 790$

C. $107 + 496 + 121 - 349 - 790$

D. $107 + 496 - 121 + 349 + 790$

24. What is the order of reaction with respect to A?



A. Zero order

B. First order

C. Second order

D. Cannot be determined

25. Ammonium phosphate, $(NH_4)_3PO_4$, reacts with silver nitrate, $AgNO_3$, to produce a precipitate of silver phosphate, Ag_3PO_4, and an aqueous solution of ammonium nitrate, NH_4NO_3.

$$\_\_(NH_4)_3PO_4(aq) + \_\_AgNO_3(aq) \rightarrow \_\_Ag_3PO_4(s) + \_\_NH_4NO_3(aq)$$

What is the ratio of coefficients of silver nitrate to silver phosphate in the balanced equation?

A. 1:1

B. 3:1

C. 1:3

D. 3:3

26. Hydrogen peroxide, H_2O_2 ($M_r = 34\,g\,mol^{-1}$), decomposes to form water vapour and oxygen gas.

$$2H_2O_2(g) \rightarrow 2H_2O(g) + O_2(g)$$

What volume (dm^3) of oxygen is produced from 68 g of hydrogen peroxide at STP?

A. $22.7\,dm^3$

B. $24.1\,dm^3$

C. $27.6\,dm^3$

D. $34.1\,dm^3$

27. What is activation energy?

I. Difference between the energy of the transition state and the products

II. Energy required for a successful collision

III. Difference between the energy of the reactants and transition state

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

28. What is the equilibrium constant expression for the forward reaction?

$$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$$

A. $K = \dfrac{[NH_3]^2}{[H_2]^3[N_2]}$

B. $K = \dfrac{2[NH_3]}{3[H_2][N_2]}$

C. $K = \dfrac{2[NH_3]}{3[H_2] + [N_2]}$

D. $K = \dfrac{[H_2]^3[N_2]}{[NH_3]^2}$

29. What is the role of $NOBr_2$ in the reaction mechanism?

$$NO(g) + Br_2(g) \rightleftharpoons NOBr_2(g) \text{ (fast)}$$

$$NOBr_2(g) + NO(g) \rightarrow 2NOBr(g) \text{ (slow)}$$

A. Transition state

B. Catalyst

C. Intermediate

D. Activated complex

30. The system $A + B \rightleftharpoons 2C$ has an equilibrium constant of $K = 10^3$.

What is correct about the direction of the spontaneous process when $Q = 0.01$?

	Excess	Favoured process
A.	Reactants	Right to form more products
B.	Products	Left to form more reactants
C.	Reactants	Left to form more reactants
D.	Products	Right to form more products

31. Which products are formed when $HBr(aq)$ reacts with $Na_2CO_3(aq)$?

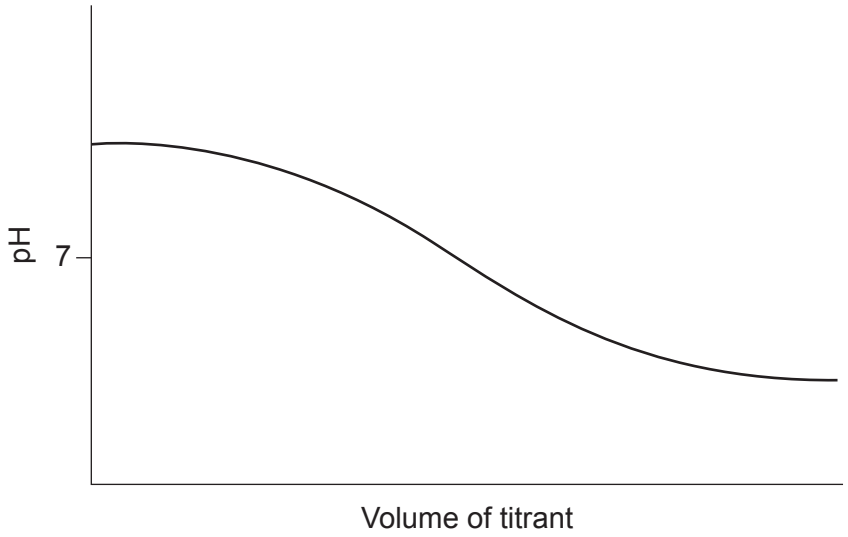
A. $H_2CO_3(s)$ and $NaBr(aq)$

B. $H_2O(l)$, $CO_2(g)$ and $NaBr(s)$

C. $H_2O(l)$, $CO_2(g)$, $Na^+(aq)$, and $Br^-(aq)$

D. $H_2O(l)$, $CO_2(g)$, and $H_2CO_3(s)$

32. Which solutions could produce the titration curve?



A. Strong base added to weak acid

B. Strong acid added to weak base

C. Weak base added to weak acid

D. Weak acid added to weak base

33. What is the conjugate base of methanoic acid (HCOOH)?

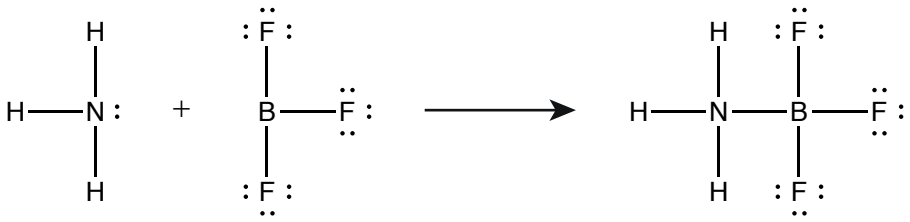
A. H_2COOH^+

B. $HCOO^-$

C. $HCOOH_2^+$

D. OH^-

34. Which species behaves as a Lewis acid?



A. NH_3

B. BF_3

C. $H_3N - BF_3$

D. None

35. How does the acidity of a solution change when the pH increases from 1 to 3?

A. Increases 3 times

B. Increases 100 times

C. Decreases 3 times

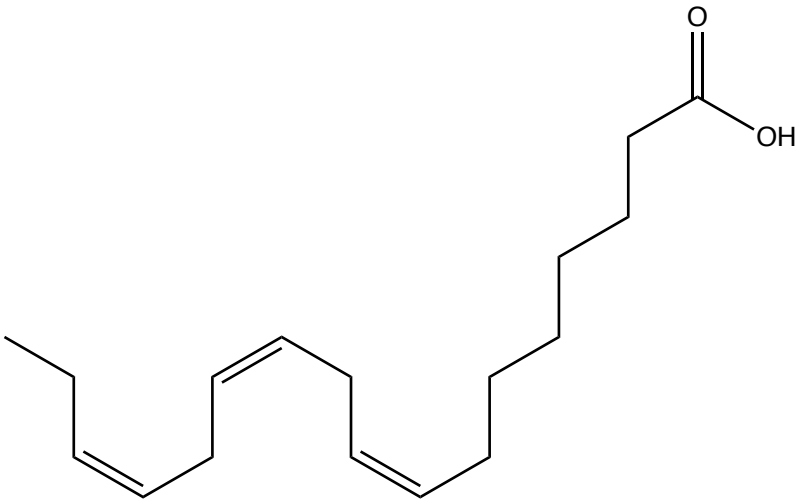
D. Decreases 100 times

36. What happens to hydrogen in this reaction?

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

	Hydrogen	Change in oxidation state
A.	oxidized	From +1 to 0
B.	oxidized	From 0 to +1
C.	reduced	From +1 to 0
D.	reduced	From 0 to +1

37. How many sigma bonds and pi bonds are in a molecule of norlinolenic acid, $C_{17}H_{28}O_2$?



	Sigma bonds	Pi bonds
A.	17	4
B.	34	6
C.	38	8
D.	46	4

38. Which statement describes HNO_3 and CH_3COOH?

A. Both fully dissociate in water.

B. Both partially dissociate in water.

C. HNO_3 dissociates partially and CH_3COOH dissociates fully in water.

D. HNO_3 dissociates fully and CH_3COOH dissociates partially in water.

39. What occurs during the operation of a galvanic cell containing iron, Fe, and lead, Pb?

$$Fe \mid Fe^{2+} \parallel Pb^{2+} \mid Pb$$

I. Fe is oxidized to become Fe^{2+}

II. Pb^{2+} is reduced to Pb

III. Metallic lead is plated at the anode

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

40. What is correct about the following galvanic cell?

$$Zn \mid Zn^{2+} \parallel Cu^{2+} \mid Cu \qquad E^{\ominus} = +1.10\,V$$

	Gibbs energy change ($\Delta G^{\ominus}$)	**Spontaneity**
A.	Positive	Spontaneous
B.	Negative	Spontaneous
C.	Positive	Non-spontaneous
D.	Negative	Non-spontaneous