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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]**.

Section A

1. Which equation represents the deposition of iodine?

- A. $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{l})$
- B. $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g})$
- C. $\text{I}_2(\text{l}) \rightarrow \text{I}_2(\text{s})$
- D. $\text{I}_2(\text{g}) \rightarrow \text{I}_2(\text{s})$

2. The table shows **some** successive ionization energies for an element.

Successive IE	2nd	3rd	4th	5th	6th	7th
kJ mol^{-1}	1817	2745	11 577	14 842	18 379	23 326

In which **group** of the periodic table is this element?

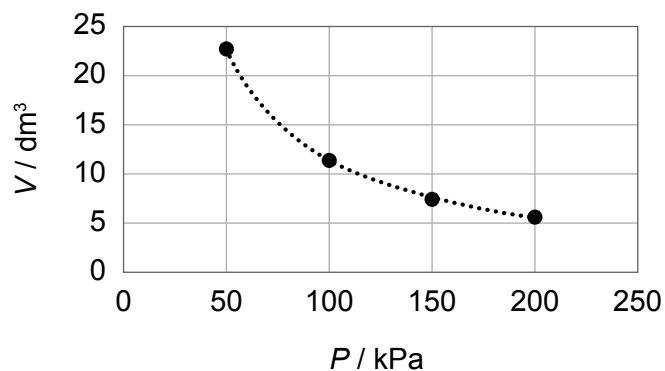
- A. 2
 - B. 13
 - C. 14
 - D. 15
3. What is observed in the emission spectrum of hydrogen?
- A. Continuous spectrum with narrow black lines that converge at higher energies
 - B. Continuous spectrum with narrow black lines that converge at longer wavelength
 - C. Series of narrow lines that converge at longer wavelength
 - D. Series of narrow lines that converge at higher frequencies
4. How many hydrogen atoms are in 0.250 moles of phenylamine $\text{C}_6\text{H}_5\text{NH}_2$?

$$N_{\text{A}} = 6.02 \times 10^{23} \text{ mol}^{-1}$$

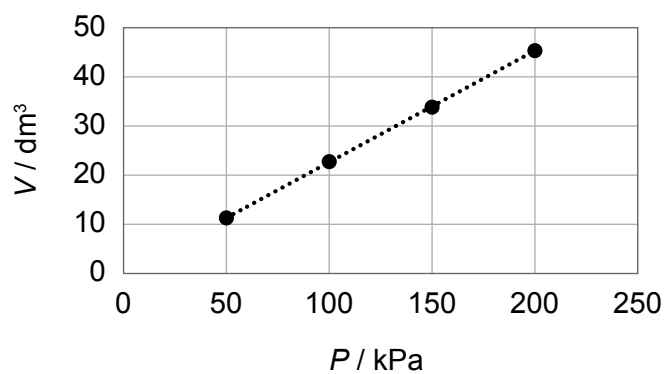
- A. 1.05×10^{24}
- B. 1.05×10^{23}
- C. 4.21×10^{24}
- D. 1.75

5. What is the graphical relationship between P and V when **0.5 moles** of an ideal gas are kept at standard temperature? ($V_m = 22.7 \text{ dm}^3 \text{ mol}^{-1}$)

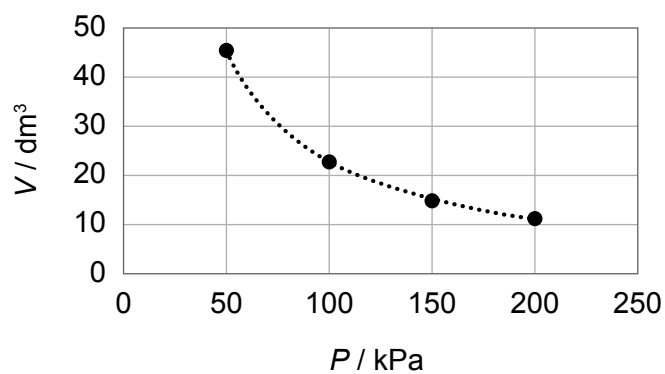
A.



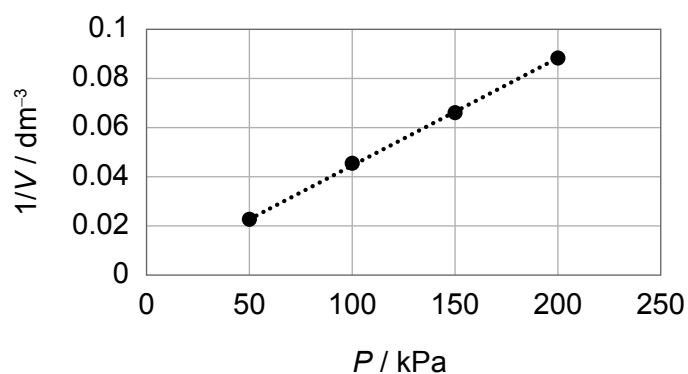
B.



C.



D.



6. Hydrated Mohr's salt has the formula $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$.

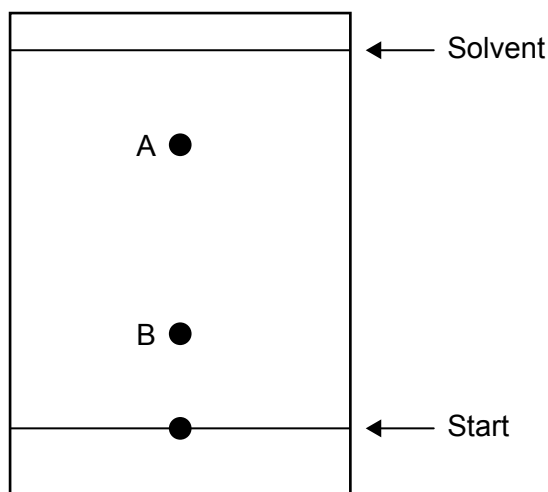
What are the charges of its constituent ions?

A.	Fe^{3+}	NH_4^+	SO_4^{2-}
B.	Fe^{2+}	NH_4^{2+}	SO_4^{3-}
C.	Fe^{2+}	NH_4^+	SO_4^{2-}
D.	Fe^{3+}	NH_4^{2+}	SO_4^{2-}

7. What is correct for substances containing carbon and silicon?

- A. Carbon dioxide and silicon dioxide have the same electron domain geometry around the central atom.
- B. Carbon and silicon only form covalent compounds with low boiling point.
- C. Elemental silicon and silicon dioxide have the same electron domain geometry around the central atom.
- D. Elemental carbon and carbon dioxide both have a high boiling point.

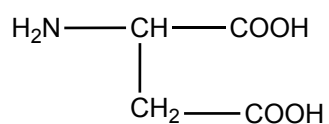
8. The thin layer chromatogram of a mixture of compounds A and B shows the following pattern. The solvent used was **hexane**.



Which combination best represents this chromatogram?

	Estimated R_f	Relative polarity of A and B
A.	0.25 compound B	Compound A is less polar
B.	0.75 compound A	Compound B is less polar
C.	1.33 compound A	Compound A is less polar
D.	4.00 compound B	Compound B is less polar

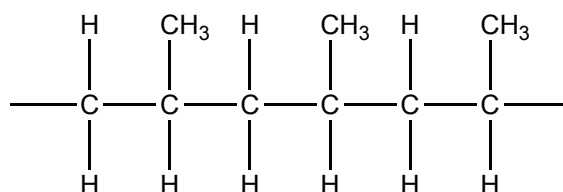
9. The structural formula of the amino acid aspartic acid is shown.



How many sigma (σ) and pi (π) bonds are in the structure?

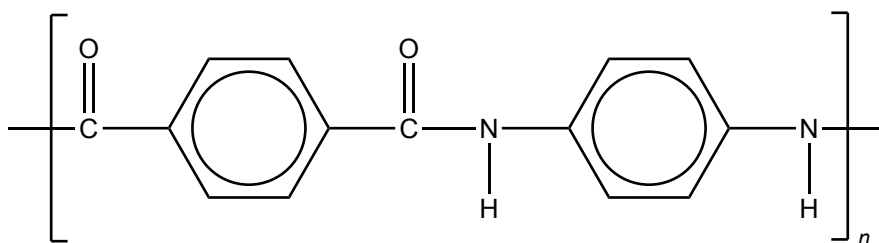
- A. 11 σ and 4 π
 B. 13 σ and 4 π
 C. 13 σ and 2 π
 D. 15 σ and 2 π

10. The diagram shows a portion of an addition polymer.



Which monomer is used to make this polymer?

- A. $\text{CH}_3\text{CH}_2\text{CH}_3$
 - B. $\text{CH}_3\text{CHCHCH}_3$
 - C. CH_2CHCH_3
 - D. $(\text{CH}_3)_2\text{CHCH}_2$
11. The condensation polymer for Kevlar® is shown.



What is correct about one of the monomers used in the synthesis of Kevlar®?

- A. It is an amide
- B. It is $\text{C}_6\text{H}_6\text{NH}_2$
- C. It is $\text{C}_6\text{H}_5\text{CONH}_2$
- D. It is $\text{C}_6\text{H}_4(\text{COOH})_2$

12. What describes the trend in properties of group 1 elements **down** the group?

	Metallic character	Reaction with water	pH of solution
A.	Decreases	Less vigorous	Acidic
B.	Increases	More vigorous	Acidic
C.	Decreases	More vigorous	Basic
D.	Increases	More vigorous	Basic

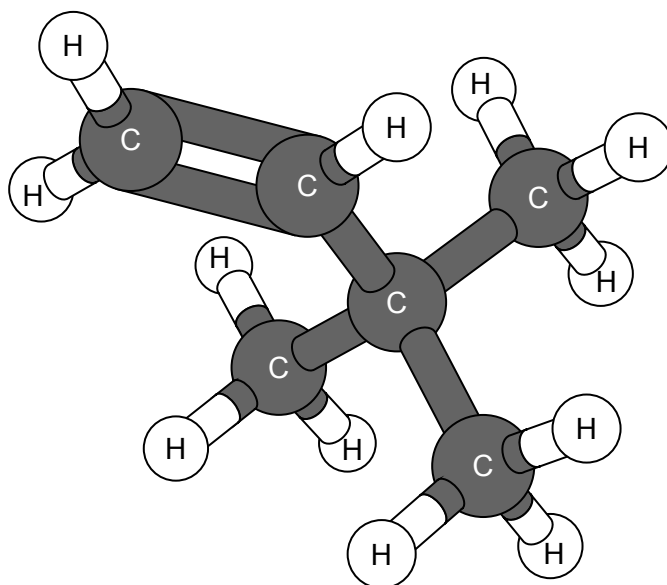
13. Which electron configuration is possible for a **p block** element?

- A. $[\text{Ne}]2s^23d^{10}4p^4$
- B. $[\text{Ar}]4s^23d^84p^6$
- C. $[\text{Ar}]4s^23d^{10}4p^4$
- D. $[\text{Ne}]3s^23d^{10}3p^4$

14. Why is the complex ion $[\text{Ti}(\text{H}_2\text{O})_6]^{4+}$ colourless while the complex ion $[\text{TiCl}_6]^{3-}$ is orange?

	$[\text{Ti}(\text{H}_2\text{O})_6]^{4+}$	Electron configuration of Ti in $[\text{TiCl}_6]^{3-}$
A.	Light is absorbed when an electron is promoted between split d-orbitals	$[\text{Ar}]4s^23d^1$
B.	Electrons cannot be promoted between split d-orbitals	$[\text{Ar}]$
C.	There are no split d-orbitals in this complex ion	$[\text{Ar}]3d^1$
D.	Light is emitted when an electron is promoted between split d-orbitals	$[\text{Ar}]4s^13d^0$

15. What are the structural isomers of this compound?



- I. 3-ethylpent-1-ene
- II. hex-3-ene
- III. 3-methylpent-2-ene

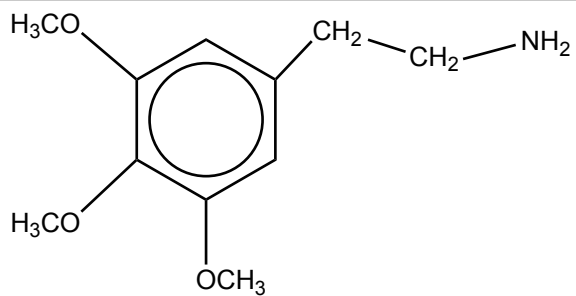
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

16. Which compounds are members of the same homologous series?

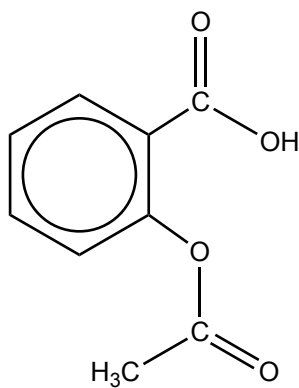
- A. $\text{CH}_3\text{CH}_2\text{OH}$, CH_3OCH_3 , $\text{CH}_3(\text{CH}_2)_3\text{OH}$
- B. $\text{CH}_3\text{COOCH}_3$, $\text{CH}_3\text{COO}(\text{CH}_2)_2\text{CH}_3$, $\text{CH}_3\text{COOCH}_2\text{CH}_3$
- C. $\text{ClCH}_2\text{CH}_2\text{Cl}$, $\text{CH}_3\text{CH}_2\text{CHCl}_2$, $\text{CH}_3\text{CH}_2\text{Cl}$
- D. CH_3COCH_3 , $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CHO}$

17. Which compound can exist as a pair of enantiomers?

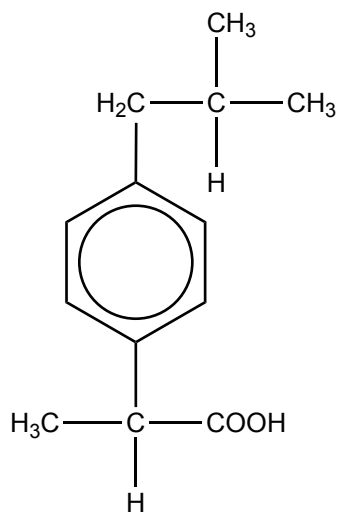
A.



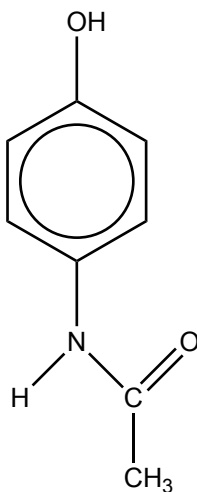
B.



C.

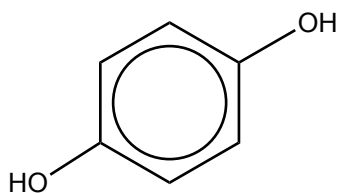


D.



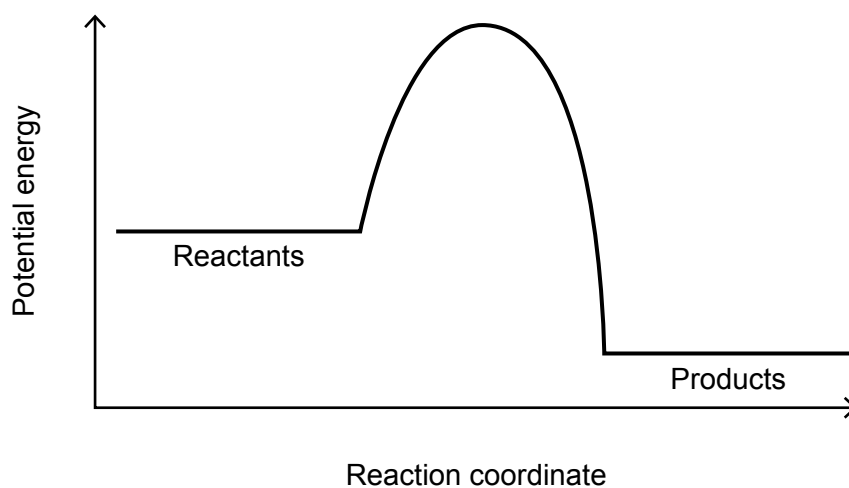
Turn over

18. What would be shown in the ^1H NMR spectrum of this compound?



	Number of signals	Relative area under signals
A.	2	1:2
B.	2	1:1
C.	3	1:2:1
D.	4	1:2:2:1

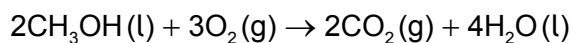
19. The potential energy profile for a reaction is shown.



What is a possible enthalpy change (ΔH) for this reaction?

- A. $+733 - 504$
- B. $+504 + 733$
- C. $-504 + 733$
- D. $-733 + 504$

20. What is correct about the reactions at the electrodes in a direct methanol fuel cell?

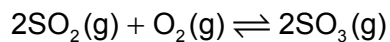


	At the cathode	At the anode
A.	Oxygen gains electrons	Methanol is oxidized
B.	Hydrogen gains electrons	Oxygen is oxidized
C.	Oxygen is reduced	Methanol gains electrons
D.	Hydrogen gains electrons	Methanol is oxidized

21. Which reaction has the most negative $\Delta H^\ominus$ value?

- A. $\text{K}^+(\text{g}) + \text{F}^-(\text{g}) \rightarrow \text{KF}(\text{s})$
- B. $\text{CaF}_2(\text{s}) \rightarrow \text{Ca}^{2+}(\text{g}) + 2\text{F}^-(\text{g})$
- C. $\text{Mg}^{2+}(\text{g}) + 2\text{F}^-(\text{g}) \rightarrow \text{MgF}_2(\text{s})$
- D. $\text{BaF}_2(\text{s}) \rightarrow \text{Ba}^{2+}(\text{g}) + 2\text{F}^-(\text{g})$

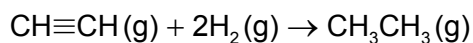
22. At which temperatures does this reaction have a negative $\Delta G^\ominus$ value?



$$\Delta H^\ominus = -196 \text{ kJ mol}^{-1}$$

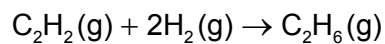
- A. Low temperatures only
- B. High temperatures only
- C. Any temperatures
- D. No temperatures

23. What is the standard enthalpy change of hydrogenation of ethyne?



Substance	$\Delta H_{\text{combustion}}^\ominus / \text{kJ mol}^{-1}$
$\text{CH}\equiv\text{CH(g)}$	–1301
$\text{CH}_3\text{CH}_3\text{(g)}$	–1561
$\text{H}_2\text{(g)}$	–286

- A. $-1561 + 1301 + (2 \times 286)$
- B. $-1301 - (2 \times 286) + 1561$
- C. $-1561 + 1301$
- D. $-1301 - 286 - 1561$
24. $60 \text{ dm}^3 \text{ C}_2\text{H}_2$ and 80 dm^3 hydrogen react to produce C_2H_6 , all measured at the same temperature and pressure.

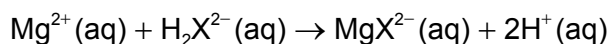


What is the percentage yield if 30 dm^3 of C_2H_6 is produced?

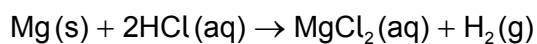
- A. 21 %
- B. 30 %
- C. 50 %
- D. 75 %

25. What is the mass of magnesium carbonate, MgCO_3 , in the analysed sample if its titration requires 24.7 cm^3 of $0.500 \text{ mol dm}^{-3}$ EDTA solution, represented as H_2X^{2-} ?

$$M(\text{MgCO}_3) = 84.32 \text{ g mol}^{-1}$$

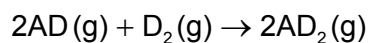


- A. 0.300 g
- B. 1.04 g
- C. 2.08 g
- D. 3.00 g
26. Which changes will increase the **initial rate** of the reaction between 100 cm^3 of 1.0 mol dm^{-3} $\text{HCl}(\text{aq})$ and excess magnesium ribbon, $\text{Mg}(\text{s})$?

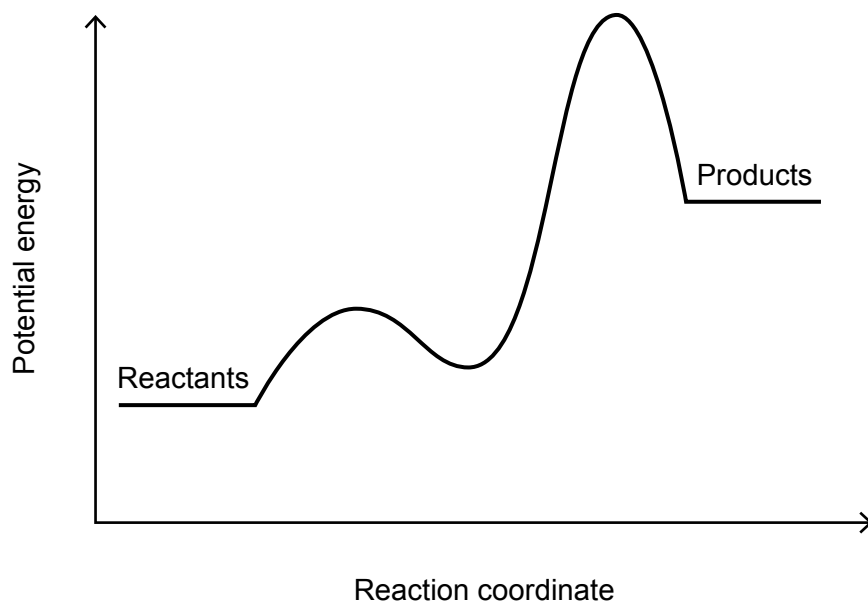


- I. Using 200 cm^3 of 1.0 mol dm^{-3} HCl
- II. Increasing the temperature
- III. Using the same mass of powdered magnesium
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

27. The reaction between compounds AD and D₂ involves two steps. The overall reaction is:



The energy profile diagram is:



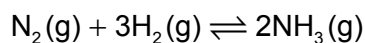
Two possible mechanisms are proposed:

Step	Mechanism X	Mechanism Y
1	$\text{AD}(\text{g}) + \text{D}_2(\text{g}) \rightarrow \text{AD}_2(\text{g}) + \text{D}(\text{g})$ slow	$\text{AD}(\text{g}) + \text{D}_2(\text{g}) \rightarrow \text{AD}_3(\text{g})$ fast
2	$\text{AD}(\text{g}) + \text{D}(\text{g}) \rightarrow \text{AD}_2(\text{g})$ fast	$\text{AD}(\text{g}) + \text{AD}_3(\text{g}) \rightarrow 2\text{AD}_2(\text{g})$ slow

Which mechanism better accounts for the energy profile diagram?

- A. X
- B. Y
- C. Neither X nor Y
- D. Both X and Y

28. The following equilibrium represents the synthesis of ammonia at a given temperature.



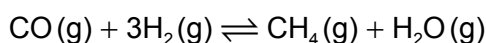
$$K = 5.0 \times 10^{-5}$$

What is the value for the equilibrium constant of the **reverse reaction** at the same temperature?

- A. 2.5×10^{-5}
 B. 5.0×10^{-4}
 C. 2.0×10^4
 D. 5.0×10^5
29. What can be deduced from the Arrhenius equation?

$$k = Ae^{\frac{-E_a}{RT}}$$

- A. The dependence of the activation energy, E_a , on temperature
 B. The change in the Arrhenius factor, A , with temperature
 C. The dependence of the activation energy, E_a , on the Arrhenius factor, A
 D. The dependence of the rate constant, k , on temperature
30. The equilibrium constant, K , for the following reaction at 1200 K is 3.93.



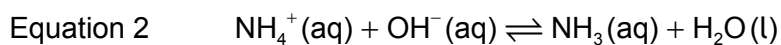
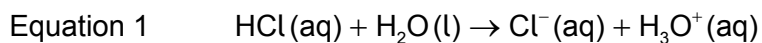
$$K = [\text{CH}_4][\text{H}_2\text{O}]/[\text{H}_2]^3[\text{CO}]$$

What can be concluded if these concentrations are measured at a given time?

Compound	CO	H ₂	CH ₄	H ₂ O
Concentration mol dm ⁻³	1.50	2.20	0.0100	0.0200

- A. The system is at equilibrium and no change in any concentrations will occur.
 B. The system is at equilibrium and K will not change with temperature.
 C. The system is not at equilibrium and the reaction will proceed to the reactants side.
 D. The system is not at equilibrium and the reaction will proceed to the products side.

31. These equations represent acid–base reactions:



Which combination is correct?

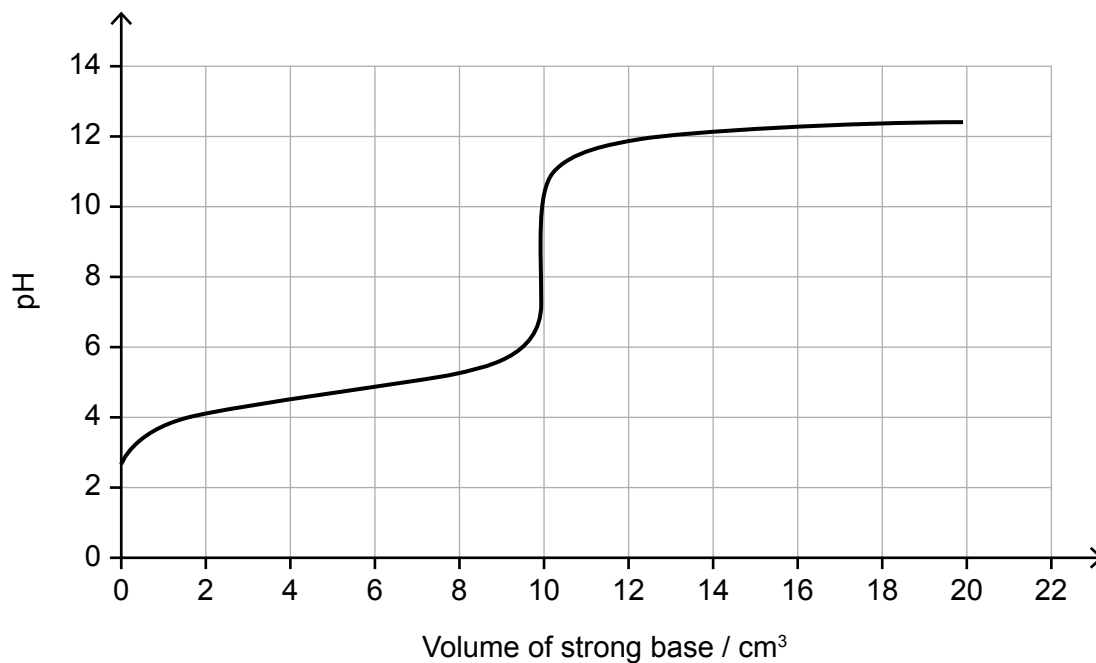
	Equation 1	Equation 2
A.	H ₂ O behaves as a Brønsted–Lowry acid	NH ₃ behaves as a Brønsted–Lowry base
B.	H ₂ O behaves as a Brønsted–Lowry base	NH ₄ ⁺ behaves as a Brønsted–Lowry acid
C.	HCl behaves as a Brønsted–Lowry acid	H ₂ O behaves as a Brønsted–Lowry base
D.	HCl behaves as a Brønsted–Lowry base	OH [–] behaves as a Brønsted–Lowry base

32. 10.0cm³ of HCl solution with a pH of 2.0 is diluted to 1000 cm³ with distilled water.

What is the [H⁺] of the diluted solution?

	[H ⁺]
A.	1.0×10^{-4}
B.	2.0×10^{-4}
C.	1.0×10^{-3}
D.	2.0×10^{-2}

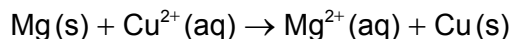
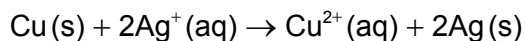
33. The titration curve is obtained when a sample of a weak monoprotic acid is titrated with NaOH $0.100 \text{ mol dm}^{-3}$.



What is the $\text{p}K_{\text{a}}$ of the acid?

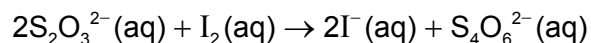
- A. 2.9
 B. 4.8
 C. 6.0
 D. 8.5
34. How many structural isomers of alcohols with the molecular formula $\text{C}_4\text{H}_9\text{OH}$ will undergo oxidation with acidified potassium dichromate(VI)?
- A. 2
 B. 3
 C. 4
 D. 5

35. The following reactions proceed spontaneously at room temperature.



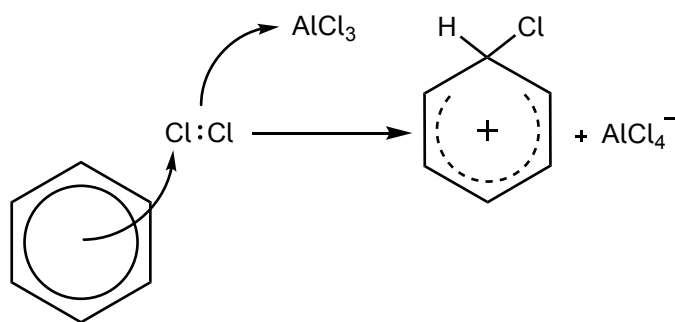
What could be deduced for a primary voltaic cell made with the half-cells $\text{Ag(s)}/\text{Ag}^+(\text{aq})$ and $\text{Mg(s)}/\text{Mg}^{2+}(\text{aq})$?

- A. The Mg anode will oxidize.
 - B. Ag^+ will oxidize.
 - C. The Ag anode will oxidize.
 - D. Mg^{2+} will oxidize.
36. What is correct for the reaction between iodine and thiosulfate ions?



- A. Iodine is the reducing agent.
 - B. $\text{S}_2\text{O}_3^{2-}$ is the oxidising agent.
 - C. $\text{S}_4\text{O}_6^{2-}$ is oxidised.
 - D. Iodine is reduced.
37. What is the product of the reaction between $(\text{CH}_3)_2\text{CHC}\equiv\text{CH}$ and excess $\text{H}_2(\text{g})$?
- A. 2-methylbutane
 - B. 3-methylbutane
 - C. 1,1-dimethylpropane
 - D. Pentane

38. What is correct for AlCl_3 in the chlorination of benzene?



- A. Acts as a Lewis acid
- B. Acts as a Lewis base
- C. Acts as a nucleophile
- D. Catalyses the homolytic fission of Cl_2

39. What is correct for the reaction between HBr and but-1-ene?

- I. Two structural isomers are produced in 1:1 molar ratio.
 - II. A secondary halogenoalkane is the major product of the reaction.
 - III. The major product of the reaction depends on the relative stability of the intermediate carbocation.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

40. Which reactions represent nucleophilic substitution?

- I. $\text{OH}^- + \text{CH}_3\text{CH}_2\text{Cl} \rightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{Cl}^-$
- II. $\text{OH}^- + \text{CH}_3\text{CH}_2\text{Cl} \rightarrow \text{CH}_2\text{CH}_2 + \text{Cl}^- + \text{H}_2\text{O}$
- III. $\text{N}_3^- + \text{CH}_3\text{Cl} \rightarrow \text{CH}_3\text{N}_3 + \text{Cl}^-$

- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
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