

IB Chemistry HL — Paper 1A (May 2026, TZ A)

Mark Scheme — Section A (Questions 1–40)

Q	Answer	Explanation / Working
1	B	Ag has atomic number 47 (47 protons). Mass 108, so neutrons = $108 - 47 = 61$. Ag^+ has lost 1 electron \rightarrow 46 electrons.
2	C	Using combined gas law: $V_2 = (2.00 \times 100 \times 298.15) / (200 \times 323.15) \approx 0.923 \text{ dm}^3$.
3	A	Bromine ($Z = 35$): $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$. The 3d subshell fills before 4p.
4	C	Large jump between 6th (8495) and 7th (27108) IE indicates 6 valence electrons \rightarrow Group 16 \rightarrow Sulfur.
5	D	100 g $\text{CaCO}_3 = 1 \text{ mol}$. Each formula unit gives 2 ions ($\text{Ca}^{2+} + \text{CO}_3^{2-}$). Total = $2 \times 6.02 \times 10^{23} = 1.2 \times 10^{24}$ ions.
6	C	C: $52/12 = 4.33$; H: $13/1 = 13$; O: $35/16 = 2.19$. Dividing by 2.19 gives ratio $\approx 2:6:1 \rightarrow \text{C}_2 \text{H}_6 \text{O}$.
7	D	KF is ionic: soluble in water, high melting point, does not conduct as solid, conducts when molten.
8	D	BrF_5 : 5 bonding pairs + 1 lone pair = 6 electron domains \rightarrow octahedral EDG. One lone pair gives square pyramidal molecular geometry.
9	C	$[\text{H}_3 \text{O}]^+$ forms when $\text{H}_2 \text{O}$ donates a lone pair to H^+ , creating a coordinate (dative) bond.
10	A	$\text{CH}_2 \text{Cl}_2$ is polar (asymmetric). $\text{CH}_3 \text{Cl}$ is polar. CCl_4 is non-polar (symmetric, dipoles cancel). \rightarrow I and II only.
11	B	But-1-yne: $\text{HC}\equiv\text{C}-\text{CH}_2-\text{CH}_3$. Triple bond = $1\sigma + 2\pi$. Total σ bonds: $1(\text{C}\equiv\text{C}) + 1(\text{C}-\text{C}) + 1(\text{C}-\text{C}) + 1(\text{C}-\text{H}) + 2(\text{CH}_2) + 3(\text{CH}_3) = 9$. Pi bonds = 2.
12	B	Caesium = alkali metal (Group 1); Tungsten = transition element; Iodine = halogen; Krypton = noble gas.
13	A	$\text{Na}_2 \text{O} + \text{H}_2 \text{O} \rightarrow 2\text{NaOH}$ (strong base). Metal oxides form bases; non-metal oxides (CO_2 , SO_2) form acids.
14	C	N bonded to three carbon atoms = tertiary amino. $-\text{OH}$ group = hydroxyl. $-\text{OCH}_3$ group = alkoxy.
15	C	Pentanal = $\text{C}_5 \text{H}_{10} \text{O}$; Pentan-2-ol = $\text{C}_5 \text{H}_{12} \text{O}$; 2,2-dimethylpropan-1-ol = $\text{C}_5 \text{H}_{12} \text{O}$. II and III share the same molecular formula.
16	B	Ligand field strength: $\text{NH}_3 > \text{H}_2 \text{O} > \text{Cl}^-$. $[\text{Cu}(\text{NH}_3)_4 (\text{H}_2 \text{O})_2]^{2+}$ has the strongest ligands, so greatest d-orbital splitting.
17	A	But-2-ene: two different groups on each C of $\text{C}=\text{C} \rightarrow$ cis-trans possible. 1,2-dichloroethene: same. But-1-ene: terminal alkene ($\text{CH}_2=$), two identical H atoms on one end \rightarrow no cis-trans. \rightarrow I and II only.
18	D	$\text{M}^+ = 60$ (propan-2-ol, MW = 60). Key fragments: $m/z = 45$ (loss of CH_3 , M-15) and $m/z = 15$ (CH_3^+). Characteristic of propan-2-ol.
19	C	Heat is released (shown on product side) \rightarrow exothermic. Surroundings gain heat \rightarrow temperature increases. Products ($\text{Al}_2 \text{O}_3$, Cu) are more stable.

Q	Answer	Explanation / Working
20	D	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3 = \text{C}_4\text{H}_{10}$ (isobutane). Balanced: $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$. Sum of coefficients = $2+13+8+10 = 33$.
21	A	Using Hess's law with coefficients $a = -1$, $b = \frac{1}{2}$, $c = -\frac{1}{2}$ applied to the three equations: $\Delta H = (-1)(-x) + (\frac{1}{2})(+y) + (-\frac{1}{2})(+z) = +x + 0.5y - 0.5z$.
22	D	$\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$: two moles of gas \rightarrow one mole solid. Fewer particles, more ordered state = decrease in entropy.
23	B	At higher temperature, the distribution is broader with more molecules at higher energies. The peak shifts to the right (higher KE) and is lower (same total area under curve).
24	B	Mole ratio $\text{C}_3\text{H}_8 : \text{O}_2 = 1 : 5$. For 50.0 cm^3 propane, oxygen required = $5 \times 50.0 = 250 \text{ cm}^3$.
25	A	$n(\text{Mg}) = 1.2/24 = 0.05 \text{ mol}$. $n(\text{HCl}) = 0.20 \text{ dm}^3 \times 1.0 \text{ mol/dm}^3 = 0.20 \text{ mol}$. Need 0.10 mol HCl for 0.05 mol Mg . Mg is limiting \rightarrow all Mg consumed, excess HCl remains. Products: $\text{HCl}(\text{aq})$ and $\text{MgCl}_2(\text{aq})$.
26	B	Increasing particle size of CaCO_3 reduces surface area, decreasing the frequency of collisions between reactant particles \rightarrow slower reaction \rightarrow more time to completion.
27	C	$\Delta H = +320 \text{ kJ/mol}$ (endothermic). Increasing temperature favors the endothermic direction (products). Moles of gas equal on both sides, so pressure has no effect.
28	D	K increases from 100 to 300 as temperature rises \rightarrow endothermic reaction. $K = 100 > 1$ and $K = 300 > 1 \rightarrow$ [products] > [reactants] at equilibrium.
29	A	The Arrhenius pre-exponential factor A accounts for collision frequency and the fraction of collisions with the correct orientation (steric factor).
30	A	To plate copper (Y) with silver: Y (copper) = cathode (negative). X (silver) = anode (dissolves). Z = silver nitrate solution (source of Ag^+ ions).
31	B	KHCO_3 : K^+ is neutral; HCO_3^- is the conjugate base of the weak acid $\text{H}_2\text{CO}_3 \rightarrow$ basic solution. KCl is neutral; NH_4NO_3 and NH_4HCO_3 both contain NH_4^+ (acidic cation).
32	B	In OF_2 , F is -1 (most electronegative) and O is $+2$. F goes from 0 to -1 (reduced) \rightarrow F_2 is the oxidizing agent. O goes from 0 to $+2$ (oxidized).
33	C	Halogen reactivity: $\text{Cl} > \text{Br} > \text{I}$. $\text{NaI} + \text{Br}_2$: Br displaces I \checkmark . $\text{NaBr} + \text{Cl}_2$: Cl displaces Br \checkmark . $\text{NaCl} + \text{Br}_2$: Br cannot displace Cl \times . \rightarrow II and III only.
34	A	Zinc is more reactive \rightarrow oxidized at anode. Copper is reduced at cathode. In galvanic cells: cathode = positive (+), anode = negative (-). \rightarrow Cathode = copper, Anode = zinc, cathode sign -, anode sign +.
35	B	Aqueous CaBr_2 : At cathode, H^+ is preferentially reduced over $\text{Ca}^{2+} \rightarrow$ hydrogen gas. At anode, Br^- is preferentially oxidised over $\text{OH}^- \rightarrow$ bromine.
36	B	Br^- donates its lone pair to the carbocation C_3H_7^+ \rightarrow Lewis base (electron pair donor).
37	D	BF_3 acts as an electrophile (Lewis acid) by accepting a lone pair from NH_3 to form F_3BNH_3 . An electrophile is an electron pair acceptor.
38	D	Nitration of benzene proceeds via electrophilic aromatic substitution. The electrophile is the nitronium ion, NO_2^+ , generated from $\text{HNO}_3/\text{H}_2\text{SO}_4$ mixture.

Q	Answer	Explanation / Working
39	A	All are tertiary haloalkanes undergoing SN1. Rate depends on leaving group ability: $I^- > Br^- > Cl^- > F^-$. $(CH_3)_3C-I$ has the weakest C-X bond and best leaving group \rightarrow fastest reaction.
40	C	$Fe(II) = +2$; 4 $H_2O = 0$ each; 2 $OH^- = -1$ each = -2 total. Overall charge = $+2 + 0 + (-2) = 0$.

Maximum mark: 40