

HSC 2026 CHEMISTRY

QUICK SOLUTIONS

SECTION I · MULTIPLE CHOICE

1	B	2	A	3	A	4	B	5	C	6	B	7	D	8	D	9	A	10	C
11	A	12	C	13	C	14	B	15	D	16	A	17	D	18	B	19	B	20	A

SECTION II · FINAL ANSWERS AND KEY POINTS

21	$\text{Cd}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{CdS}(\text{s})$
22	Polystyrene-cup calorimeter with lid, 0.1 °C thermometer; 50.0 mL of each solution; record the initial temperature of both; mix, stir, record the maximum temperature; record volumes (≈ 100 g) and ΔT ; repeat $\times 3$
23	Water is polar ($\text{O}\delta^-$, $\text{H}\delta^+$); O ends attracted to Na^+ , H ends to Cl^- (ion-dipole); these overcome the lattice's ionic attractions; ions hydrated and dispersed; labelled diagram
24	$\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$; added H^+ is removed by CH_3COO^- (shift left), so pH falls only slightly; the ratio $[\text{A}^-]/[\text{HA}]$ falls gradually; near X the buffer capacity is reached
25(a)	Fermentation of sugars from crops by yeast, anaerobic, ~ 37 °C, then distillation: $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
25(b)	E10: $0.9(35\,293) + 0.1(23\,412) = 3.41 \times 10^4 \text{ kJ L}^{-1}$, about $1.19 \times 10^3 \text{ kJ L}^{-1}$ (3.4%) less than octane; ethanol is partly oxidised
25(c)	Ethanol is near carbon neutral (photosynthesis) vs fossil octane, so less net CO_2 ; contains O, so more complete combustion (less CO , soot); but only 10%, more fuel per km, and land/fertiliser impacts
26(a)	A = 1-methylcyclopentan-1-ol (tertiary: not oxidised); B = 2-methylcyclopentan-1-ol (secondary $\rightarrow$ ketone C)
26(b)	IR: A broad O–H $3230\text{--}3550 \text{ cm}^{-1}$; C sharp C=O $1680\text{--}1750 \text{ cm}^{-1}$. ^{13}C : C has a C=O peak at $190\text{--}220 \text{ ppm}$; A has C–O at $50\text{--}90 \text{ ppm}$ (A 4 peaks, C 6 peaks)
27	Two lines meet at 10.0 mL (precipitation starts); $[\text{Ba}^{2+}] = [\text{F}^-] = 9.9 \times 10^{-3} \text{ M}$; $K_{\text{sp}} = [\text{Ba}^{2+}][\text{F}^-]^2 = 9.7 \times 10^{-7} (\approx 1 \times 10^{-6})$
28(a)	A = benzene-1,4-dicarboxylic acid, $\text{HOOC-C}_6\text{H}_4\text{-COOH}$; B = ethane-1,2-diol, $\text{HO-CH}_2\text{CH}_2\text{-OH}$
28(b)	Ethanol has one OH, so it esterifies a chain-end -COOH and caps it (no group left to react); chains stop early, so the average chain length decreases
29	Mean titre 29.70 mL (33.00 rough, left out); excess KOH $2.970 \times 10^{-2} \text{ mol}$; reacted 0.0953 mol; acid 0.04765 mol; $M = 125.9 \text{ g mol}^{-1}$; $n = 2$: $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
30	Both: dispersion (propanamide slightly stronger) and dipole-dipole (C=O); only propanamide has N–H, so it hydrogen bonds: strongest force, so higher boiling point
31(a)	$\text{ClO}^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{OH}^-$; assume $[\text{ClO}^-] \approx 0.75$ and $[\text{HClO}] = [\text{OH}^-]$; $[\text{OH}^-] = \sqrt{(3.45 \times 10^{-7} \times 0.75)} = 5.1 \times 10^{-4} \text{ M}$
31(b)	$\text{NaClO}(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$; NaClO limiting (0.75 mol); $V = 0.75 \times 24.79 = 18.6 \text{ L}$
32	Heat: rate (collision theory) outweighs the tiny yield loss ($\Delta H = -3.6 \text{ kJ mol}^{-1}$); H_2SO_4 catalyst (lower E_{a}) and dehydrating agent (removes water, shifts right); reflux ≥ 30 min reaches equilibrium without losing volatiles. Safety: flammables (mantle or water bath, open condenser); corrosive H_2SO_4 (add slowly, boiling chips)
33(a)	$\Delta G = -2803 - 298(0.262) = -2881 \text{ kJ mol}^{-1} < 0$: spontaneous
33(b)	Very exothermic (strong C=O, O–H bonds formed); $\Delta S > 0$; $\Delta G < 0$ at all temperatures, reverse never spontaneous ($K \approx 10^{505}$); goes to completion, gases escape: not an equilibrium
34	$\text{Co}_3(\text{PO}_4)_2$, $M = 366.73$; $n = 2.296 \times 10^{-3} \text{ mol}$; $\text{PO}_4^{3-} 4.592 \times 10^{-3} \text{ mol} = 0.436 \text{ g}$; $\div 25.0 \text{ g} \times 10^6 = 1.74 \times 10^4 \text{ ppm}$
35	A CO_3^{2-} ; B I^- ; C PO_4^{3-} ; D Cu^{2+} ; E Pb^{2+} ; F and G $\text{Mg}^{2+}/\text{Ba}^{2+}$ (identical results); Cl^- absent. Add dilute H_2SO_4 (white BaSO_4 only with Ba^{2+}), NaOH (heavy white $\text{Mg}(\text{OH})_2$ only with Mg^{2+}) or a flame test (Ba^{2+} pale green)
36	M/M+2 at 106/108 (3 : 1): one Cl; $\text{C}_5\text{H}_{11}\text{Cl}$; NMR 6H triplet ($2 \times \text{CH}_3$), 4H multiplet ($2 \times \text{CH}_2$), 1H multiplet at 3.60 ppm (CHCl): 3-chloropentane , $\text{CH}_3\text{CH}_2\text{CHClCH}_2\text{CH}_3$

Sigma Science suggested answers, written on exam day; NESA's official marking guidelines may differ. Full working, mark-by-mark steps and "where marks are lost" are in *HSC 2026 Chemistry Solutions*.