Chemistry Paper 2 Mark Scheme

Sample assessment 2026–27

Time allowed: 2 hours Total marks: 70

STAFF ONLY

Credit valid equivalent scientific responses where they meet the approved set-specific marking criteria. Reconcile every maximum mark to the candidate paper and answer booklet.

Section A · Multiple-choice questions

Award 1 mark for each correct answer.

Question	Correct answer
A1	B · It lowers the activation energy. A catalyst provides an alternative pathway with a lower activation energy.
A2	C · Forward and reverse rates are equal. Equal non-zero forward and reverse rates give constant macroscopic composition.
A3	A · 2-Methylpropan-1-ol. The longest chain containing the OH carbon has three carbon atoms; OH is on C1 and methyl on C2.
A4	D · $Cl_2 \rightarrow 2Cl\bullet$. Ultraviolet light causes homolytic fission of the Cl–Cl bond.
A5	D · 2-Bromopropane. Addition predominantly proceeds through the more stable secondary carbocation.
A6	B · 3. The exponents sum to three.
A7	A · First order. A constant half-life is characteristic of first-order decay.
A8	C · The forward change is thermodynamically feasible under those conditions. Thermodynamic feasibility does not determine reaction rate.
A9	A · 3.00. $pH = -\log_{10}(10^{-3}) = 3.00$.
A10	C · Ethanoic acid and sodium ethanoate. An acidic buffer contains a weak acid and a substantial concentration of its conjugate base.
A11	D · A species that donates an electron pair to a central metal atom or ion. The donated pair forms a coordinate bond.
A12	B · Propan-2-ol. Oxidation of this secondary alcohol gives propanone.
A13	B · NO_2^+. The nitronium ion attacks the aromatic ring.
A14	D · All six carbon–carbon bond lengths are equal. Equal carbon–carbon lengths support delocalisation around the ring.

Question	Correct answer
A15	A · Sodium borohydride. $NaBH_4$ reduces the ketone carbonyl group to a secondary alcohol.
A16	C · Ethyl ethanoate. The alcohol-derived group is ethyl and the acid-derived group is ethanoate.
A17	C · Aqueous sodium hydrogencarbonate. Acid and hydrogencarbonate react to form a salt, water and carbon dioxide.
A18	D · 74. A singly charged molecular ion gives the molecular mass directly as m/z.
A19	A · Triplet. The n + 1 rule gives 2 + 1 = 3 lines.
A20	B · They greatly reduce the solvent proton signal. Deuterium is not detected at the proton resonance frequency; small residual solvent signals may remain.

Section A LO map, 1 mark each: A1 LO11; A2 LO12; A3 LO22; A4 LO13; A5 LO15; A6 LO16; A7 LO17; A8 LO18; A9 LO19; A10 LO20; A11 LO21; A12 LO22; A13–A14 LO23; A15 LO24; A16–A17 LO25; A18 LO27; A19–A20 LO28.

Section B · Extended-response marking map

Question B1 · 10 marks

(a) 2 marks1 mark: Second order in A: doubling [A] at fixed [B] quadruples the rate.1 mark: First order in B: doubling [B] at fixed [A] doubles the rate.Mapping: LO16, LO17. (b) 2 marks1 mark: k = 0.00200/(0.100² × 0.100) = 2.00.1 mark: Units: $dm^6\ mol^{-2}\ s^{-1}$.Mapping: LO16. (c) 2 marks1 mark: A larger fraction of particles/collisions has energy at least equal to the activation energy.1 mark: This gives a greater proportion of successful collisions and therefore a larger rate constant.Mapping: LO11, LO16. (d) 2 marks1 mark: It provides an alternative pathway with a lower activation energy.1 mark: A greater fraction of the unchanged energy distribution can overcome that lower barrier.Mapping: LO11. (e) 2 marks1 mark: The rate law is consistent with the data but does not uniquely establish an elementary mechanism.1 mark: Different multistep mechanisms can give the same rate law; further mechanistic evidence is needed.Mapping: LO16, LO17.

Alternative valid responses / allocation: (a) Each mark requires the order and its supporting comparison.
(b) Allow consistent follow-through from (a) with the corresponding units; do not award a units mark inconsistent with the chosen rate law.
(c) Do not require a graph; increased collision frequency alone does not explain the main energy-distribution effect.
(e) Credit a clear equivalent argument; do not require a proposed detailed mechanism.

Question B2 · 10 marks

(a) 3 marks1 mark: Kc = $[HI]^2/([H_2][I_2])$.1 mark: Equilibrium concentrations: [HI] = 0.600; $[H_2] = [I_2]$ = 0.100 mol dm^{-3}.1 mark: Kc = $0.600^2/(0.100 \times 0.100)$ = 36.0; no concentration units remain.Mapping: LO12. (b) 2 marks1 mark: No shift in the equilibrium composition/relative amounts.1 mark: There are equal total stoichiometric moles of gas on each side, so compression does not change the reaction quotient.Mapping: LO12. (c) 3 marks1 mark: $[OH^-]$ = 0.0200 mol dm^{-3}; pOH = $-\log_{10}(0.0200)$ = 1.699.1 mark: Uses pH + pOH = 14.00 at 25 °C, or $[H^+] = Kw/[OH^-]$.1 mark: pH = 12.30.Mapping: LO19. (d) 2 marks1 mark: Ethanoate ions react with added H^+: $CH_3COO^- + H^+ \rightarrow CH_3COOH$.1 mark: Most added H^+ is removed and the acid/base ratio changes only slightly, so the pH changes only slightly.Mapping: LO20.

Alternative valid responses / allocation: (a) Correct answer supported by a valid expression earns all three marks. Amounts can be used directly because the powers of volume cancel.
(b) Concentrations themselves rise on compression; do not credit a statement that every concentration remains unchanged.
(c) Correct 12.30 with a valid method earns all three marks; accept 12.3.
(d) A valid verbal reaction description is sufficient for the first mark.

Question B3 · 10 marks

(a) 3 marks1 mark: Uses $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$.1 mark: Converts ΔS° to 0.150 kJ mol^{-1} K^{-1}, so $T\Delta S^\circ$ = 44.7 kJ mol^{-1}.1 mark: $\Delta G^\circ = 40.0 - 44.7 = -4.70$ kJ mol^{-1}.Mapping: LO18. (b) 2 marks1 mark: A negative ΔG° indicates thermodynamic favourability under standard-state conditions, not reaction speed.1 mark: An activation barrier may make the reaction slow; kinetic evidence is needed to establish its rate.Mapping: LO18. (c) 2 marks1 mark: Coordination number six.1 mark: The oxygen atom of each water ligand.Mapping: LO21. (d) 3 marks1 mark: The ligand environment splits the metal d orbitals into groups of different energy.1 mark: An electron can absorb visible light to move between these d energy levels.1 mark: Selective absorption removes particular wavelengths, so the transmitted/reflected light is coloured.Mapping: LO21.

Alternative valid responses / allocation: (a) Accept an equivalent calculation wholly in joules. Correct answer with consistent method earns all three marks.
(b) Do not require quantitative non-standard Gibbs calculations.
(d) Accept the appropriate complementary-colour explanation. Do not require a particular observed hue or splitting diagram.

Question B4 · 10 marks

(a) 4 marks1 mark: Shows Hδ⁺–Brδ⁻ and a curly arrow from the C=C π bond to H.1 mark: Shows a curly arrow from the H–Br bond to Br, forming Br^-.1 mark: Shows the ethyl carbocation intermediate $CH_3CH_2^+$ with the positive charge on carbon.1 mark: Shows a curly arrow from a lone pair on Br^- to the positively charged carbon, and the product CH_3CH_2Br.Mapping: LO13, LO15. (b) 3 marks1 mark: Uses acidified potassium dichromate(VI), or another suitable controlled oxidising reagent.1 mark: Warms/heats gently with controlled or limited oxidant.1 mark: Distils the ethanal as it forms to remove it from the oxidising mixture.Mapping: LO22, LO26. (c) 3 marks1 mark: Correct ester connectivity $CH_3COOCH_2CH_3$.1 mark: Balanced equation $CH_3COOH + CH_3CH_2OH \rightleftharpoons CH_3COOCH_2CH_3 + H_2O$.1 mark: Ethyl ethanoate.Mapping: LO25, LO26.

Alternative valid responses / allocation: (a) Each mark requires its complete stated element. Curly arrows must originate at an electron pair/bond, not at a positive charge. Accept equivalent orientation of the displayed structures.
(b) Accept a scientifically valid alternative route with sufficient conditions. Reflux with excess dichromate does not limit further oxidation.
(c) Accept a single forward arrow and equivalent condensed/displayed structures. State symbols are not required. Award the connectivity mark independently of the equation-balancing mark.

Question B5 · 10 marks

(a) 1 mark1 mark: 58, with no unit.Mapping: LO27. (b) 2 marks1 mark: The C=O bond/carbonyl stretching vibration.1 mark: Both propanal and propanone contain a carbonyl group and absorb in this region.Mapping: LO24, LO27. (c) 3 marks1 mark: X is propanone, CH_3COCH_3.1 mark: Its two equivalent methyl groups give one proton environment containing six hydrogen atoms.1 mark: There are no hydrogen atoms on the adjacent carbonyl carbon, so n + 1 gives a singlet.Mapping: LO28. (d) 2 marks1 mark: Use Tollens' reagent and warm gently in a water bath; propanal gives a silver mirror/deposit.1 mark: Propanone gives no silver mirror/deposit under these conditions.Mapping: LO24, LO26. (e) 2 marks1 mark: Different molecules/isomers can have the same relative molecular mass, so this peak alone is not a unique identification.1 mark: The six-proton singlet distinguishes propanone from the stated propanal alternative by supplying information about proton environments.Mapping: LO27, LO28.

Alternative valid responses / allocation: (d) Accept Fehling's solution warmed: propanal gives a brick-red precipitate and propanone does not; or another valid selective test with both outcomes. Do not credit 2,4-DNPH alone, because both candidates give a precipitate.
(e) The candidate list is restricted in this question; do not demand proof against every possible molecule.

Marking principles

Award one mark for the single correct MCQ option; otherwise award zero. No negative marking. If an answer is clearly replaced, mark the final unambiguous choice.

For Section B, use the stated point allocations and specific calculation rules. Credit equivalent scientifically correct responses; do not double-credit a repeated point.

Where a later calculation uses an earlier incorrect value correctly, credit the independent subsequent method unless this makes the task trivial. Do not award the final accuracy mark for an incorrect result.

Do not penalise spelling unless meaning is unclear or a different scientific term is given. Credit correct chemical reasoning expressed in equivalent language.

All raw marks, marker identities, moderation decisions and release approvals must be recorded through the controlled pack processes.