INTUITION EDUCATION

HSC 2026 · PREDICTED PRACTICE PAPER

2026 HSC Chemistry

Original practice material — not a NESA paper

Total marks: 100

GENERAL INSTRUCTIONS

- Reading time — 5 minutes
- Working time — 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A formulae sheet, data sheet and Periodic Table are provided at the back of this paper
- Section I — 20 marks. Attempt Questions 1–20. Allow about 35 minutes for this section
- Section II — 80 marks. Attempt Questions 21–37. Allow about 2 hours and 25 minutes for this section

HOW THIS PAPER WAS BUILT

This full-length practice paper was built from the consensus of a six-model AI panel (fable, opus, gpt-5.6-sol, gemini-3.1-pro, grok, deepseek), each of which independently predicted the 2026 examination from the 2019–2025 papers and NESA marking feedback. The 142 question-level predictions were clustered; every cluster with consensus probability ≥ 0.55 is realised in this paper, the remainder is drawn from the panel's watch list, and Module 8 chemical synthesis is deliberately light in line with the panel's rested call. Each Section II question is tagged with the consensus cluster it realises and the probability that a question of that kind appears in 2026. Every question is original — none is copied from a past paper.

Answers and marking notes are published as a separate PDF — sit the paper first, then download the solutions from intuitioneducation.com.au/hsc-2026/chemistry.

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Section I

20 marks — Attempt Questions 1–20 — Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

Question 1

An aqueous solution of an unknown acid HA is represented below.

DATA PROVIDED IN THE EXAM

particle diagram of a droplet containing twelve intact HA molecules and only two H /A ion pairs, with the particles closely spaced throughout the droplet — i.e. mostly molecular (weak) but with many solute particles per unit volume (concentrated).

Which row of the table best describes this solution?

	Strong	Concentrated
A.		
B.		
C.		
D.		

Question 2

A 0.10 mol L ^{1} solution of hydrochloric acid is diluted by a factor of 100.

What is the pH of the diluted solution?

A. 1.0

B. 2.0

C. 3.0

D. 5.0

Question 3

Consider the following compound.

DATA PROVIDED IN THE EXAM

full structural formula of a six-carbon chain: $CH_3–CH(CH_3)–CH_2–CHCl–CH_2–CH_3$, i.e. a methyl group on the second carbon and a chlorine on the fourth carbon when numbered from the methyl end.

What is the preferred IUPAC name of this compound?

A. 4-chloro-2-methylhexane

B. 3-chloro-5-methylhexane

C. 2-methyl-4-chlorohexane

D. 2-chloro-4-methylhexane

Question 4

Consider the following equilibrium.

$2C(s) + O_2(g) \quad 2CO(g)$

What is the correct equilibrium expression for this reaction?

A. $K = \dfrac{[CO]^2}{[C]^2[O_2]}$

B. $K = \dfrac{[CO]^2}{[O_2]}$

C. $K = \dfrac{[O_2]}{[CO]^2}$

D. $K = \dfrac{[CO]}{[O_2]}$

Question 5

How many carbon environments are present in a molecule of 2,3-dimethylbutane?

A. 6

B. 4

C. 3

D. 2

Question 6

Equal volumes of 4.0×10^{-3} mol L^{-1} lead(II) nitrate solution and 4.0×10^{-3} mol L^{-1} sodium chloride solution are mixed. The Ksp of lead(II) chloride is 1.7×10^{-5}.

Which of the following is correct?

A. A precipitate forms because Q > Ksp

B. A precipitate forms because Q < Ksp

C. No precipitate forms because Q < Ksp

D. No precipitate forms because Q > Ksp

Question 7

The mass spectrum of a haloalkane shows a molecular ion peak at m/z = 136 and a peak of approximately equal intensity at m/z = 138.

Which halogen does the compound contain?

A. Chlorine

B. Bromine

C. Fluorine

D. Iodine

Question 8

A weak monoprotic acid is titrated with a standardised sodium hydroxide solution. The pH at the equivalence point is 8.9.

Which indicator is most appropriate for this titration?

A. Methyl orange (range 3.1–4.4)

B. Bromophenol blue (range 3.0–4.6)

C. Litmus (range 5.0–8.0)

D. Phenolphthalein (range 8.3–10.0)

Question 9

What is the conjugate acid of the hydrogen carbonate ion, HCO_3^-?

A. CO_3^{2-}

B. H_2CO_3

C. H_3O^+

D. CO_2

Question 10

Soap is added to water containing a droplet of grease, and the mixture is agitated so that a micelle forms around the droplet.

Which statement best describes the arrangement of the soap anions in the micelle?

A. The non-polar hydrocarbon tails embed in the grease and the charged carboxylate heads face the surrounding water.

B. The charged carboxylate heads embed in the grease and the non-polar hydrocarbon tails face the surrounding water.

C. Both the heads and the tails embed in the grease, encapsulating it completely.

D. The soap anions dissolve entirely in the water, and the grease is dispersed by collisions with water molecules.

Question 11

The following equilibrium is established in aqueous solution.

$[Co(H_2O)_6]^{2}$ (aq) + 4Cl (aq) $[CoCl_4]^{2}$ (aq) + $6H_2O(l)$ (forward reaction endothermic)

The $[Co(H_2O)_6]^{2}$ ion is pink and the $[CoCl_4]^{2}$ ion is blue.

What is observed when a violet equilibrium mixture is heated, and why?

A. The mixture turns pink, because the reverse reaction is favoured.

B. The mixture turns blue, because the endothermic forward reaction is favoured.

C. The mixture turns pink, because the endothermic forward reaction is favoured.

D. The mixture becomes colourless, because both complexes decompose.

Question 12

A reaction is non-spontaneous at low temperatures but becomes spontaneous at high temperatures.

Which row of the table shows the signs of ΔH and ΔS for this reaction?

	ΔH	**ΔS**
A.	> 0	< 0
B.	< 0	< 0
C.	< 0	> 0
D.	> 0	> 0

Question 13

Methanol is refluxed with propanoic acid in the presence of concentrated sulfuric acid.

What is the name of the ester produced?

A. Propyl methanoate

B. Methyl propanoate

C. Propyl ethanoate

D. Ethyl propanoate

Question 14

The molar solubility of silver chromate, Ag_2CrO_4, is s mol L^{-1}.

Which expression gives its solubility product, Ksp?

A. s^2

B. $2s^3$

C. $4s^3$

D. $27s^4$

Question 15

Which analytical technique is most appropriate for determining the concentration of lead ions present at very low levels in a sample of drinking water?

A. Gravimetric analysis

B. Acid–base titration

C. Atomic absorption spectroscopy

D. Infrared spectroscopy

Question 16

DATA PROVIDED IN THE EXAM

titration curve with volume of titrant (mL) on the x-axis (0 to 40 mL) and pH on the y-axis (0 to 14). The curve starts at pH 2.9, rises gradually through a buffer region around pH 4.9, then jumps steeply from pH about 7 to pH about 11 at 20.0 mL, and flattens near pH 12.5.

The titration curve shown was obtained by adding titrant to a 25.0 mL sample.

Which combination produced this curve?

A. A weak acid titrated with a strong base

B. A strong acid titrated with a strong base

C. A weak base titrated with a strong acid

D. A strong base titrated with a weak acid

Question 17

Which pair of monomers can react to form a polyester?

A. Ethene and chloroethene

B. Benzene-1,4-diamine and hexanedioic acid

C. Ethene and ethane-1,2-diol

D. Ethane-1,2-diol and hexanedioic acid

Question 18

Which of the following correctly describes the ^{1}H NMR spectrum of chloroethane, CH_3CH_2Cl?

A. A triplet of relative integration 3 and a quartet of relative integration 2

B. A quartet of relative integration 3 and a triplet of relative integration 2

C. Two singlets of relative integration 3 and 2

D. A doublet of relative integration 3 and a septet of relative integration 2

Question 19

25.0 mL of 0.10 mol L^{-1} sodium hydroxide solution is mixed with 25.0 mL of 0.050 mol L^{-1} hydrochloric acid.

What is the pH of the resulting solution?

A. 1.60

B. 7.00

C. 12.40

D. 12.70

Question 20

A solution of ethanoic acid is diluted with distilled water at constant temperature.

Which row of the table describes the effect of the dilution?

	Ka	Degree of ionisation
A.	Unchanged	Increases
B.	Unchanged	Decreases
C.	Decreases	Decreases
D.	Decreases	Increases

Section II

80 marks — Attempt Questions 21–37 — Allow about 2 hours and 25 minutes for this section

Answer the questions in the spaces provided. Show all relevant working in questions involving calculations.

Question 21 *(2 marks)*

Consider the following organic reaction.

$CH_3–CH=CH_2 + H_2O \rightarrow$ organic product

The reaction proceeds only in the presence of substance X, and the major organic product contains a hydroxyl group on the central carbon atom.

Identify substance X and give the IUPAC name of the major organic product. **(2)**

Substance X	IUPAC name of major organic product

Question 22 *(5 marks)*

A student determined the enthalpy of combustion of propan-1-ol (molar mass 60.09 g mol $^{-1}$) using a spirit burner to heat water in an uninsulated aluminium can.

DATA PROVIDED IN THE EXAM

results table — mass of water in can 250.0 g; initial temperature of water 21.5 °C; final temperature of water 41.5 °C; mass of spirit burner before heating 185.230 g; mass of spirit burner after heating 184.380 g (mass of propan-1-ol burned 0.850 g); specific heat capacity of water 4.18 J g $^{-1}$ K $^{-1}$.

(a) Calculate the molar enthalpy of combustion of propan-1-ol obtained in this experiment. **(3)**

(b) The accepted value for the molar enthalpy of combustion of propan-1-ol is −2021 kJ mol $^{-1}$. Explain why the experimental value is significantly less exothermic than the accepted value, and justify ONE change to the procedure that would improve the accuracy of the result. **(2)**

Question 23 *(4 marks)*

Sodium ethanoate, CH_3COONa, dissolves completely in water to give a basic solution.

Calculate the pH of a 0.25 mol L^{-1} solution of sodium ethanoate at 25 °C. Include a relevant equilibrium equation in your answer, and justify any approximation you make. The Ka of ethanoic acid is 1.8×10^{-5}. **(4)**

Question 24 *(4 marks)*

The following equilibrium is established in a sealed vessel of fixed volume at constant temperature.

$2NO_2(g) \rightleftharpoons N_2O_4(g)$

NO_2 is brown and N_2O_4 is colourless.

At time t_1, an additional amount of NO_2 gas is injected into the vessel.

(a) On the axes provided, sketch the concentration of N_2O_4 from before t_1 until the system reaches a new equilibrium. **(1)**

DATA PROVIDED IN THE EXAM

axes with Time on the x-axis (marked t_1 partway along) and $[N_2O_4]$ on the y-axis; a horizontal line is shown up to t_1. Expected sketch: the line remains continuous at t_1 (no instantaneous jump), then rises with decreasing slope to a new, higher plateau.

(b) Explain, in terms of collision theory, how the system responds to the addition of NO_2. In your answer, refer to the relative changes in the forward and reverse reaction rates. **(3)**

Question 25 *(4 marks)*

The following equilibrium is established in a sealed 1.00 L vessel at 700 K, at which temperature Keq = 49.0.

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

At equilibrium, the vessel contains 0.200 mol of H_2, 0.200 mol of I_2 and 1.40 mol of HI.

An additional amount of iodine gas is then injected into the vessel at constant temperature. When equilibrium is re-established, the concentration of HI is 1.60 mol L^{-1}.

Calculate the amount, in moles, of iodine gas that was added. **(4)**

Question 26 *(5 marks)*

A 25.0 mL sample of barium hydroxide solution was titrated with 0.100 mol L $^{-1}$ sulfuric acid while the electrical conductivity of the mixture was recorded.

DATA PROVIDED IN THE EXAM

graph of conductivity (arbitrary units) against volume of H_2SO_4 added (mL). The conductivity starts high (about 8 units), falls in a straight line to almost zero at 22.0 mL, then rises in a straight line to about 5 units at 35 mL, giving a sharp V shape with its minimum at 22.0 mL.

(a) Explain the shape of the graph, naming the ions responsible for the conductivity in each region. Include a balanced chemical equation in your answer. **(4)**

(b) Calculate the concentration of the barium hydroxide solution. **(1)**

Question 27 *(5 marks)*

The concentration of copper ions in wastewater discharged from an electroplating factory was determined by atomic absorption spectroscopy.

A 25.00 mL sample of the wastewater was diluted to 250.0 mL with distilled water. The absorbance of the diluted sample was 0.264.

DATA PROVIDED IN THE EXAM

calibration table and graph — standards of 0.0, 1.0, 2.0, 3.0 and 4.0 mg L $^{-1}$ Cu^{2+} giving absorbances 0.000, 0.110, 0.220, 0.330 and 0.440 respectively; the calibration graph is a straight line through the origin with gradient 0.110 L mg $^{-1}$.

(a) Determine the concentration of copper ions, in mg L $^{-1}$, in the undiluted wastewater. **(3)**

(b) The local discharge limit for copper is 8.0×10^{-5} mol L $^{-1}$. Determine, with calculations, whether the factory complies with the discharge limit. The molar mass of copper is 63.55 g mol $^{-1}$. **(2)**

Question 28 *(4 marks)*

A 25.0 mL sample of 0.100 mol L $^{-1}$ propanoic acid was titrated with 0.100 mol L $^{-1}$ sodium hydroxide solution, and the pH was recorded throughout.

DATA PROVIDED IN THE EXAM

titration curve with volume of NaOH (mL) on the x-axis (0–40 mL) and pH on the y-axis (0–14). The curve starts at pH 2.9, passes through pH 4.87 at 12.5 mL (half-equivalence, buffer plateau), rises steeply through the equivalence point at 25.0 mL where the pH is 8.8, and levels off near pH 12.3. The points (12.5 mL, pH 4.87) and (25.0 mL, pH 8.8) are readable from the graph.

(a) Use the titration curve to determine the Ka of propanoic acid. Show your reasoning on or beside the curve. **(2)**

(b) Explain why the pH at the equivalence point is greater than 7. Include a relevant equation in your answer. **(2)**

Question 29 *(6 marks)*

A solution is known to contain ONE of the cations Ba^{2+}, Ca^{2+} or Pb^{2+}.

A student added a few drops of dilute sulfuric acid to a sample of the solution. A white precipitate formed, and the student concluded that the solution contained Ba^{2+}.

(a) Explain why the student's conclusion is not valid. Support your answer with at least one balanced net ionic equation. **(2)**

(b) Design a valid sequence of tests that would identify which of the three cations is present. For each test, state the expected observation for each possible cation and include balanced net ionic equations, with states, for any precipitation reactions. **(4)**

Question 30 *(3 marks)*

Ammonia is synthesised industrially from nitrogen and hydrogen.

$N_2(g) + 3H_2(g) \quad 2NH_3(g)$ $\Delta H = -92$ kJ mol^{-1}

Explain why a moderate temperature of about 450 °C is used in this process, rather than a low temperature that would maximise the equilibrium yield of ammonia. **(3)**

Question 31 *(7 marks)*

The label of an antacid product states that each tablet contains 300 mg of calcium carbonate.

A student analysed one tablet of mass 1.200 g by back titration:

1. The crushed tablet was added to 50.00 mL of 0.500 mol L^{-1} hydrochloric acid and stirred until the reaction was complete.
2. The resulting solution was transferred to a volumetric flask and made up to 250.0 mL with distilled water.
3. 25.00 mL aliquots of this solution were titrated with 0.100 mol L^{-1} sodium hydroxide solution.

DATA PROVIDED IN THE EXAM

titration results table — Titre 1: 20.10 mL; Titre 2: 19.20 mL; Titre 3: 19.15 mL; Titre 4: 19.25 mL.

(a) Write balanced chemical equations for the two neutralisation reactions that occur in this analysis. **(1)**

(b) Calculate the mass of calcium carbonate in the tablet. The molar mass of $CaCO_3$ is 100.09 g mol^{-1}. **(5)**

(c) Assess whether the analysis supports the claim on the label. **(1)**

Question 32 *(4 marks)*

A buffer is prepared by dissolving equal amounts of ethanoic acid and sodium ethanoate in water.

Explain, with reference to an equilibrium equation, how this buffer resists changes in pH when a small amount of hydrochloric acid is added AND when a small amount of sodium hydroxide is added. **(4)**

Question 33 *(5 marks)*

A solution contains barium ions and calcium ions, each at a concentration of 0.010 mol L^{-1}. Solid sodium sulfate is added gradually with stirring. Assume the volume of the solution does not change.

$K_{sp}(BaSO_4) = 1.08 \times 10^{-10}$ $K_{sp}(CaSO_4) = 4.93 \times 10^{-5}$

(a) Show by calculation that barium sulfate precipitates first. **(2)**

(b) Calculate the concentration of barium ions remaining in solution at the point where calcium sulfate just begins to precipitate, and hence explain why this procedure could be used to separate the two ions. **(3)**

Question 34 *(4 marks)*

Calcium carbonate decomposes on strong heating.

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ $\Delta H = +178$ kJ mol^{-1}, $\Delta S = +161$ J K^{-1} mol^{-1}

(a) Calculate ΔG for this reaction at 25 °C and state whether the reaction is spontaneous at this temperature. **(2)**

(b) Calculate the minimum temperature at which the decomposition becomes spontaneous. Assume ΔH and ΔS do not change with temperature. **(2)**

Question 35 *(6 marks)*

The flow chart shows a series of reactions beginning with 2-methylpropene.

DATA PROVIDED IN THE EXAM

flow chart — Compound A (2-methylpropene, $(CH_3)_2C=CH_2$) reacts with H_2O in the presence of dilute H_2SO_4 to give two isomeric alcohols, Compound B (the major product) and Compound C (the minor product). Compound C is heated under reflux with excess acidified potassium dichromate to give Compound D. Compound D is heated under reflux with ethanol and concentrated sulfuric acid to give Compound E. An arrow from Compound B to acidified potassium dichromate is labelled "no reaction".

(a) Draw the full structural formulae of compounds B, C and D, and give the IUPAC name of each. **(3)**

(b) Draw the structural formula of compound E and give its IUPAC name. **(2)**

(c) Explain why compound B does not react with acidified potassium dichromate. **(1)**

Question 36 *(3 marks)*

A student used a simple calorimeter to measure the molar enthalpy of neutralisation of sodium hydroxide with hydrochloric acid, and then with ethanoic acid of the same concentration. The reaction with ethanoic acid was found to be significantly less exothermic per mole of water formed.

Explain this observation. **(3)**

Question 37 *(9 marks)*

An ester, compound X, was produced by refluxing an alcohol with ethanoic acid in the presence of concentrated sulfuric acid. Elemental analysis shows that X has the molecular formula $C_5H_{10}O_2$.

The following spectra of purified X were obtained.

DATA PROVIDED IN THE EXAM

mass spectrum — molecular ion peak at m/z = 102 (low intensity, labelled M); base peak at m/z = 43 (100%, labelled); other significant peaks at m/z = 87 (weak) and m/z = 59 (moderate).

DATA PROVIDED IN THE EXAM

infrared spectrum — strong sharp absorption at 1743 cm ¹; absorptions at 2870–2990 cm ¹; strong absorptions at 1240 cm ¹ and 1050 cm ¹; NO broad absorption in the 2500–3300 cm ¹ region.

DATA PROVIDED IN THE EXAM

¹³C NMR spectrum — four signals: δ 170.7, δ 67.3, δ 21.8 and δ 21.3 ppm.

DATA PROVIDED IN THE EXAM

¹H NMR data table with separate columns for chemical shift, splitting and relative integration — δ 4.99 ppm, septet, 1H; δ 2.01 ppm, singlet, 3H; δ 1.22 ppm, doublet, 6H.

Determine the structure of compound X, and identify the alcohol from which it was made.

In your answer:

- draw the full structural formula of X and give its IUPAC name
- justify the structure with reference to ALL FOUR spectra, including the identity of the fragment responsible for the base peak in the mass spectrum
- give the IUPAC name of the alcohol used in the synthesis. **(9)**

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