



HSC Chemistry Practice Paper 1

Year 12 · Modules 5–8 — Practice Examination

**Reading time 5 minutes · Working time 3 hours · Section I: 20 multiple-choice ·
Section II: 80 marks · 100 marks in all**

How to use this booklet

- Reading time – 5 minutes. Working time – 3 hours. Write using black pen. Draw diagrams using pencil.
- Calculators approved for use in the HSC may be used. A data sheet (atomic masses, constants, K_a , K_{sp} and E° values) is provided at the back of the question paper.
- Section I: 20 multiple-choice questions (1 mark each). Section II: 23 written-response questions (80 marks).
- Worked solutions follow the paper: every question has step-by-step working, a key takeaway and (for multiple choice) a note on why each wrong option is wrong.

SECTION I

20 marks · Attempt Questions 1 – 20 · Allow about 35 minutes

Select the alternative A, B, C or D that best answers the question. Each question is worth 1 mark.

1. 50.0 mL of $2.0 \times 10^{-4} \text{ mol L}^{-1}$ lead(II) nitrate solution is mixed with 50.0 mL of $1.0 \times 10^{-3} \text{ mol L}^{-1}$ potassium iodide solution. K_{sp} of PbI_2 is 7.1×10^{-9} . Calculate the ion product, Q , immediately after mixing.

- A 2.50×10^{-11}
- B 5.00×10^{-8}
- C 2.00×10^{-10}
- D 5.00×10^{-6}

2. The K_{sp} of AgCl is 1.8×10^{-10} at 25°C . Solid AgCl is added to a 0.050 mol L^{-1} solution of sodium chloride. Calculate the solubility of AgCl in this solution, in mol L^{-1} . (Assume the ion from the solid is negligible compared with the chloride ion already present.)

- A $1.34 \times 10^{-5} \text{ mol L}^{-1}$
- B $3.60 \times 10^{-9} \text{ mol L}^{-1}$
- C $7.20 \times 10^{-8} \text{ mol L}^{-1}$
- D $9.00 \times 10^{-12} \text{ mol L}^{-1}$

3. For the reaction $\text{A} \rightleftharpoons \text{B}$ at a certain temperature $K_{\text{c}} = 4.00$. A mixture is prepared with $[\text{A}] = 0.42 \text{ mol L}^{-1}$ and $[\text{B}] = 1.1 \text{ mol L}^{-1}$. In which direction will the net reaction proceed?

- A to the right (towards products)
- B it is already at equilibrium
- C to the left (towards reactants)
- D no reaction occurs because the concentrations are not equal

4. The following system is at equilibrium in a closed container: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, $\Delta H = -92 \text{ kJ mol}^{-1}$. The equilibrium is disturbed when the temperature is decreased. What happens to the position of equilibrium?

- A no shift
- B the equilibrium constant changes in a way that must favour products
- C to the left (towards reactants)
- D to the right (towards products)

5. The solubility product of CaF_2 is $K_{\text{sp}} = 3.9 \times 10^{-11}$ at 25°C : $\text{CaF}_2(\text{s}) \rightleftharpoons \text{Ca}^{2+} + 2\text{F}^-$. Calculate the solubility of CaF_2 in water, in mol L^{-1} .

- A $3.90 \times 10^{-11} \text{ mol L}^{-1}$
- B $2.14 \times 10^{-4} \text{ mol L}^{-1}$
- C $6.24 \times 10^{-6} \text{ mol L}^{-1}$
- D $3.12 \times 10^{-6} \text{ mol L}^{-1}$

6. A buffer is made by dissolving 0.28 mol of the conjugate base (the sodium salt of ethanoic acid) and 0.17 mol of ethanoic acid in water to give 1.00 L of solution. (K_{a} of ethanoic acid = $1.74 \times 10^{-5} \text{ mol L}^{-1}$.) Calculate the pH of the buffer.

- A 4.54
- B 5.98
- C 4.98
- D 4.76

7. Ethyl ethanoate is made by heating 41 g of ethanoic acid with excess ethanol and a little concentrated sulfuric acid: $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$. Calculate the theoretical yield of ethyl ethanoate.

- A 31.5 g
- B 60.2 g
- C 120 g
- D 12.3 g

8. A 0.10 mol L^{-1} solution of hydrochloric acid and a 0.10 mol L^{-1} solution of ethanoic acid are compared. Which statement is correct?

- A The hydrochloric acid has a higher pH because it is more concentrated
- B The hydrochloric acid has a lower pH because it ionises completely
- C The ethanoic acid has a lower pH because it is an organic acid
- D The two solutions have the same pH because they have the same concentration

9. A 0.39 mol L^{-1} hydrochloric acid solution is diluted by a factor of 50 with water. What is the pH of the diluted solution?

- A 50.41
- B 0.41
- C 1.41
- D 2.11

WORKED SOLUTIONS

Answers & worked solutions

Multiple-choice answer key

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

SECTION I

1. 50.0 mL of $2.0 \times 10^{-4} \text{ mol L}^{-1}$ lead(II) nitrate solution is mixed with 50.0 mL of $1.0 \times 10^{-3} \text{ mol L}^{-1}$ potassium iodide solution. K_{sp} of PbI_2 is 7.1×10^{-9} . Calculate the ion product, Q , immediately after mixing. [Solubility]

Correct answer: A — 2.50×10^{-11}

- Mixing equal volumes halves each concentration: $[\text{Pb}^{2+}] = 1.0 \times 10^{-4} \text{ mol L}^{-1}$ and $[\text{I}^-] = 5.0 \times 10^{-4} \text{ mol L}^{-1}$.
- $Q = [\text{Pb}^{2+}][\text{I}^-]^2 = 2.50 \times 10^{-11}$.
- Why the other options are wrong:
 - B (5.00×10^{-8}): ignored the coefficient (power) of the anion
 - C (2.00×10^{-10}): did not allow for dilution on mixing
 - D (5.00×10^{-6}): took a square root

LOS: Solubility

KEY TAKEAWAY

Precipitation: dilute each ion on mixing, calculate Q , and compare with K_{sp} ; a precipitate forms only if $Q > K_{\text{sp}}$.

2. The K_{sp} of AgCl is 1.8×10^{-10} at 25°C . Solid AgCl is added to a 0.050 mol L^{-1} solution of sodium chloride. Calculate the solubility of AgCl in this solution, in mol L^{-1} . (Assume the ion from the solid is negligible compared with the chloride ion already present.) [Solubility]

Correct answer: B — $3.60 \times 10^{-9} \text{ mol L}^{-1}$

- $K_{\text{sp}} = [\text{cation}][\text{anion}]$; the chloride concentration is fixed by the dissolved salt at 0.050 mol L^{-1} .
- Solubility = $K_{\text{sp}} \div 0.050 = 1.8 \times 10^{-10} \div 0.050 = 3.60 \times 10^{-9} \text{ mol L}^{-1}$
- Why the other options are wrong:
 - A ($1.34 \times 10^{-5} \text{ mol L}^{-1}$): used the solubility in pure water (ignored the common ion)
 - C ($7.20 \times 10^{-8} \text{ mol L}^{-1}$): squared the concentration
 - D ($9.00 \times 10^{-12} \text{ mol L}^{-1}$): multiplied by the concentration

LOS: Solubility