



**Test Papers
Hub.**

QCAA Chemistry Units 3 & 4 Practice Paper 1

External Assessment: Paper 1 — Multiple Choice & Short Response

**Perusal 10 minutes · Working time 90 minutes · Section I: 20 multiple-choice ·
Section II: 38 marks · 58 marks in all**

How to use this booklet

- Perusal time – 10 minutes. Working time – 90 minutes. Write using black or blue pen.
- A QCAA-approved scientific or graphics calculator may be used. A formula and data sheet is provided at the back of the paper.
- Section I: 20 multiple-choice questions (1 mark each). Section II: 10 short-response questions (38 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 30 minutes

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

1. 0.54 mol of H_2 and 0.54 mol of I_2 are placed in a 1.00 L flask at a temperature where $K_c = 9.00$ for $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$. What is the equilibrium concentration of HI?

- A 0.648 mol L^{-1}
- B 0.216 mol L^{-1}
- C 0.324 mol L^{-1}
- D 1.30 mol L^{-1}

2. 50.0 mL of $2.0 \times 10^{-4} \text{ mol L}^{-1}$ magnesium chloride solution is mixed with 50.0 mL of 0.010 mol L^{-1} sodium hydroxide solution. K_{sp} of $\text{Mg}(\text{OH})_2$ is 5.6×10^{-12} . Calculate the ion product, Q , immediately after mixing.

- A 5.00×10^{-7}
- B 5.00×10^{-5}
- C 2.50×10^{-9}
- D 2.00×10^{-8}

3. A 0.21 mol L^{-1} hydrochloric acid solution is diluted by a factor of 5 with water. What is the pH of the diluted solution?

- A 1.38
- B 0.68
- C 5.68
- D 1.68

4. A galvanic cell is constructed from a Ag^+/Ag half-cell ($E^\circ = 0.80 \text{ V}$) and a Mg^{2+}/Mg half-cell ($E^\circ = -2.36 \text{ V}$), joined by a salt bridge, under standard conditions. Calculate the standard cell potential, E°_{cell} .

- A 0.800 V
- B -1.56 V
- C 3.16 V
- D -3.16 V

5. The mass spectrum of ethanol ($\text{C}_2\text{H}_6\text{O}$) shows a molecular ion peak and fragment peaks at m/z 31, 29, 15. What is the m/z value of the molecular ion peak? (Use the integer masses $\text{C} = 12$, $\text{H} = 1$, $\text{O} = 16$.)

- A 47
- B 32
- C 46
- D 45

6. The condensed structural formula of an organic compound is $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$. Write the IUPAC name of this compound.

- A isoheptanoic acid
- B octanoic acid
- C heptanoic acid
- D heptanoic acid

7. The concentration of a coloured ion in a water sample is determined by UV-visible spectroscopy. Standards of known concentration give absorbances as shown (path length 1.00 cm): $1.0 \times 10^{-4} \text{ mol L}^{-1} \rightarrow 0.360$; $2.0 \times 10^{-4} \text{ mol L}^{-1} \rightarrow 0.720$; $3.0 \times 10^{-4} \text{ mol L}^{-1} \rightarrow 1.08$; $4.0 \times 10^{-4} \text{ mol L}^{-1} \rightarrow 1.44$; $5.0 \times 10^{-4} \text{ mol L}^{-1} \rightarrow 1.80$. The water sample has an absorbance of 1.19. Determine the concentration of the ion in the sample.

- A 4280 mol L^{-1}
- B $3.30 \times 10^{-3} \text{ mol L}^{-1}$
- C $1.65 \times 10^{-4} \text{ mol L}^{-1}$
- D $3.30 \times 10^{-4} \text{ mol L}^{-1}$

8. The ^1H NMR spectrum of 2-methylpropanoic acid ($\text{C}_4\text{H}_8\text{O}_2$) is recorded. Ignore any splitting caused by hydrogen atoms on oxygen. How many signals appear in the spectrum?

- A 4
- B 3
- C 8
- D 2

WORKED SOLUTIONS

Answers & worked solutions

Multiple-choice answer key

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

SECTION I

1. 0.54 mol of H_2 and 0.54 mol of I_2 are placed in a 1.00 L flask at a temperature where $K_c = 9.00$ for $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$. What is the equilibrium concentration of HI? [Chemical equilibrium]

Correct answer: A — 0.648 mol L^{-1}

- ICE table: change in $[\text{H}_2] = -x$, $[\text{I}_2] = -x$, $[\text{HI}] = +2x$.
- $K_c = (2x)^2 \div [(0.54 - x)(0.54 - x)] = 9.00$.
- Take the square root of both sides: $2x \div (0.54 - x) = 3.00$, so $x = 0.324 \text{ mol L}^{-1}$.
- $[\text{HI}] = 2x = 0.648 \text{ mol L}^{-1}$
- Why the other options are wrong:
- B (0.216 mol L^{-1}): gave the $[\text{H}_2]$ left over
- C (0.324 mol L^{-1}): gave x instead of $2x$
- D (1.30 mol L^{-1}): doubled $2x$

LOS: Chemical equilibrium

KEY TAKEAWAY

ICE tables: Initial, Change, Equilibrium. When the expression is a perfect square (equal reactant amounts, $\Delta n = 0$) take the square root of both sides to avoid a quadratic.

2. 50.0 mL of $2.0 \times 10^{-4} \text{ mol L}^{-1}$ magnesium chloride solution is mixed with 50.0 mL of 0.010 mol L^{-1} sodium hydroxide solution. K_{sp} of $\text{Mg}(\text{OH})_2$ is 5.6×10^{-12} . Calculate the ion product, Q , immediately after mixing. [Solubility]

Correct answer: C — 2.50×10^{-9}

- Mixing equal volumes halves each concentration: $[\text{Mg}^{2+}] = 1.0 \times 10^{-4} \text{ mol L}^{-1}$ and $[\text{OH}^-] = 5.0 \times 10^{-3} \text{ mol L}^{-1}$.
- $Q = [\text{Mg}^{2+}][\text{OH}^-]^2 = 2.50 \times 10^{-9}$.
- Why the other options are wrong:
- A (5.00×10^{-7}): ignored the coefficient (power) of the anion
- B (5.00×10^{-5}): took a square root
- D (2.00×10^{-8}): did not allow for dilution on mixing