



**Test Papers
Hub.**

QCAA Chemistry Unit 3 Practice Paper 1

Internal Assessment 1: Data Test (Unit 3)

Perusal 5 minutes · Working time 60 minutes · Internal Assessment 1 (Unit 3) · 21 marks in all

How to use this booklet

- Perusal time – 5 minutes (reading only). Working time – 60 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.
- Attempt ALL questions (1 – 6). Show all working for calculations.
- Worked solutions follow the paper: every question has step-by-step working and a key takeaway.

UNSEEN DATA TEST

21 marks · Attempt ALL questions (1 – 6) · Allow 60 minutes

Use the data in each question to respond. Show all working: marks are awarded for method as well as the final answer.

Question 1 (3 marks)

At equilibrium at a certain temperature the concentrations in the reaction $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ are: $[\text{H}_2] = 0.33 \text{ mol L}^{-1}$, $[\text{I}_2] = 0.43 \text{ mol L}^{-1}$, $[\text{HI}] = 0.34 \text{ mol L}^{-1}$.

(a) Calculate the equilibrium constant, K_c , for this reaction. [2 marks]

(b) What is K_c for the REVERSE reaction at this temperature? [1 mark]

Question 2 (3 marks)

1.2 mol of H_2 and 1.2 mol of I_2 are placed in a 1.00 L flask at a temperature where $K_c = 36.0$ for $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$.

What is the equilibrium concentration of HI?

Question 3 (2 marks)

A 20.0 mL aliquot of sodium hydroxide solution is titrated with 0.200 mol L^{-1} sulfuric acid. The average titre is 27.0 mL.

What is the concentration of the sodium hydroxide solution?

Question 4 (4 marks)

A buffer is made by dissolving 0.37 mol of the conjugate base (the sodium salt of hydrofluoric acid) and 0.28 mol of hydrofluoric acid in water to give 1.00 L of solution. (K_a of hydrofluoric acid = $7.20 \times 10^{-4} \text{ mol L}^{-1}$.)

(a) Calculate the pH of the buffer. [2 marks]

(b) What is the pH after 6.0×10^{-3} mol of HCl is added to the buffer (volume unchanged)? [2 marks]

Question 5 (5 marks)

A 0.640 g antacid tablet containing calcium carbonate is added to 25.0 mL of 0.500 mol L^{-1} hydrochloric acid, which is in excess. The excess acid is titrated with 0.250 mol L^{-1} NaOH and requires 22.0 mL to reach the end point. ($\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$.)

(a) How many moles of HCl reacted with the calcium carbonate? [3 marks]

(b) What mass of calcium carbonate was in the tablet? [2 marks]

Question 6 (4 marks)

A current of 4.0 A flows for 90 minutes through a solution containing silver ions, depositing silver metal at the cathode. (Faraday constant = $96\,485 \text{ C mol}^{-1}$.)

WORKED SOLUTIONS

Answers & worked solutions

UNSEEN DATA TEST

Question 1 (3 marks) [Chemical equilibrium]

At equilibrium at a certain temperature the concentrations in the reaction $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ are: $[\text{H}_2] = 0.33 \text{ mol L}^{-1}$, $[\text{I}_2] = 0.43 \text{ mol L}^{-1}$, $[\text{HI}] = 0.34 \text{ mol L}^{-1}$.

(a) Calculate the equilibrium constant, K_c , for this reaction.

(a) Answer: 0.815

- Write the expression from the coefficients: $K_c = [\text{HI}]^2 \div ([\text{H}_2] \times [\text{I}_2])$.
- $K_c = 0.34^2 \div (0.33 \times 0.43)$
- $K_c = 0.815$

(b) What is K_c for the REVERSE reaction at this temperature?

(b) Answer: 1.23

- Reversing a reaction inverts the equilibrium constant: $K_{\text{reverse}} = 1 \div K_{\text{forward}}$.
- $K = 1 \div 0.815 = 1.23$

LOS: Chemical equilibrium

KEY TAKEAWAY

$K_c = [\text{products}]^{\text{coefficients}} \div [\text{reactants}]^{\text{coefficients}}$ (equilibrium concentrations only; pure solids and liquids are left out); reversing the reaction inverts K .

Question 2 (3 marks) [Chemical equilibrium]

1.2 mol of H_2 and 1.2 mol of I_2 are placed in a 1.00 L flask at a temperature where $K_c = 36.0$ for $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$.

What is the equilibrium concentration of HI?

Answer: 1.80 mol L⁻¹

- ICE table: change in $[\text{H}_2] = -x$, $[\text{I}_2] = -x$, $[\text{HI}] = +2x$.
- $K_c = (2x)^2 \div [(1.2 - x)(1.2 - x)] = 36.0$.
- Take the square root of both sides: $2x \div (1.2 - x) = 6.00$, so $x = 0.900 \text{ mol L}^{-1}$.
- $[\text{HI}] = 2x = 1.80 \text{ mol L}^{-1}$

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.