

7.4 Calculating the Equilibrium Constant

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS ice table 初始 • equilibrium constant 平衡常数

Objective

Build the skills to answer exam questions on **calculating the equilibrium constant** from equilibrium concentrations.

You must be able to:

- substitute equilibrium concentrations into the K expression
- use an **ICE table** 初始-变化-平衡 (Initial, Change, Equilibrium)
- solve for K

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Straight substitution

Given the equilibrium concentrations, put them into the K expression. For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ with $[\text{H}_2] = 0.1$, $[\text{I}_2] = 0.1$, $[\text{HI}] = 0.8$:

$$K = \frac{(0.8)^2}{(0.1)(0.1)} = 64.$$

■ The ICE table

When only starting amounts and one change are given, use an **ICE** table: write **I**nitial, the **C**hange ($\pm x$ scaled by coefficients), and the **E**quilibrium row. Then substitute.

■ A worked ICE

$\text{A} \rightleftharpoons \text{B}$, start $[\text{A}] = 1.0$, $[\text{B}] = 0$. At equilibrium $[\text{B}] = 0.6$, so $x = 0.6$ and $[\text{A}] = 1.0 - 0.6 = 0.4$. Then $K = \frac{0.6}{0.4} = 1.5$.

■ Watch the coefficients

The change x is multiplied by each species' coefficient (e.g. a "2" species changes by $2x$).

2 Practice

Now apply the methods above.

2.1 For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ with $[\text{H}_2] = [\text{I}_2] = 0.2$, $[\text{HI}] = 0.8$, find K . [2]

2.2 In an ICE table, what do I, C, and E stand for? [1]

2.3 $\text{A} \rightleftharpoons \text{B}$ starts at $[\text{A}] = 2.0$, $[\text{B}] = 0$; at equilibrium $[\text{B}] = 0.5$. Find $[\text{A}]$ at equilibrium. [1]

3 Exam-style questions

3.1 To find K , you substitute the _____ concentrations into the expression. [1]

A	B
C	D

- A initial
B equilibrium
C standard
D average

3.2 For $\text{A} \rightleftharpoons 2\text{B}$, start $[\text{A}] = 1.0$ M, $[\text{B}] = 0$. At equilibrium $[\text{A}] = 0.6$ M.

(a) Find $[\text{B}]$ at equilibrium (note the coefficient 2). [2]

(b) Calculate K . [2]

3.3 For $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, the equilibrium concentrations are $[\text{N}_2] = 0.20$, $[\text{H}_2] = 0.20$, $[\text{NH}_3] = 0.40$. Calculate K . [3]