

ICE ICE Tables

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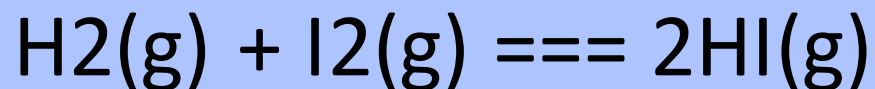
- you can determine the concentration at equilibrium of a reactant or product by using ICE tables and the reaction equation

- I = initial concentration
- C = change in concentration
- E = equilibrium concentration

- Ice tables are used for gas reactions determined through gas spectrophotometers

Example

- At low pressure and high temp, the reaction between hydrogen gas and iodine gas form hydrogen iodide



- If small quantities are injected into a container, a spec. can determine the final concentrations of the iodine gas. This allows for the K_c of the reaction to be determined.

- When given chemical amounts, consider the volume of the container and change the amounts to concentration (mol/L) then enter into the ice table:

mmol/L	H ₂ (g)	I ₂ (g)	HI(g)
Initial	5.30	3.52	19.04
Change			
Equilibrium		2.19	

- Calculate the change in $I_2(g)$, which is also the change in $H_2(g)$ since the ratio is 1:1

mmol/L	$H_2(g)$	$I_2(g)$	$HI(g)$
Initial	5.30	3.52	19.04
Change	<i>-1.33</i>	<i>-1.33</i>	
Equilibrium	3.97	2.19	

- Since 1.33mmol of H₂ and I₂ react in a 1.00L container, 1.33mmol of H₂ forms 2.66mmol of HI (due to the mole ratio)

- Because it is subtracted from the reactants it must be added to the products, so to complete the table

mmol/L	H ₂ (g)	I ₂ (g)	HI(g)
Initial	5.30	3.52	19.04
Change	<i>-1.33</i>	<i>-1.33</i>	<i>+2.66</i>
Equilibrium	<i>3.97</i>	2.19	<i>21.70</i>

- These new values can now be put into an equilibrium expression to determine K_c .

- $$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{21.70^2}{(3.97)(2.19)}$$

- $K_c = 54.16$

ICE tables and K_c

1. Write a balanced chemical equation
2. Write the equilibrium law expression for the balanced equation
3. Substitute the EQUILIBRIUM concentrations (mol/L) for all reactants and products to calculate the value of K_c after completing the ICE table

Important to Know!

- K_c will change as the temp of the system changes
- K_c is not affected by catalysts
- K_c is not affected by the rate of the reaction (fast or slow)
- Units are not included in K_c

- To rank weak acids, compare the ionization of solutions to see which has the lower pH
- If the initial amount concentration of the acid is numerically 1000 times less than its K_a value, the change in concentration is negligible

- If you are asked to find the pH of a weak acid you **MUST** do an ice table as they do not completely dissociate and therefore will reach equilibrium
- If you are asked to find the pH of a strong acid, you do not use an ice table (calculate like chem 20 pH)

%Reaction

Equilibrium concentration of H_3O^+ or OH^- x 100%

Initial concentration of the given substance

Example 2

- In a 500mL stainless steel reaction vessel at 900C, carbon monoxide and water vapour react to produce carbon dioxide and hydrogen. Evidence indicates that this reaction establishes an equilibrium with only partial conversion of reactants to products. Initially, 2.00mol of each reactant is placed in the vessel. K_c for this reaction is 4.20 at 900C. What amount concentration of each substance will be present at equilibrium?

Example 3

- Predict the $[\text{H}_3\text{O}^+]$ and pH for a 0.200M aqueous solution of methanoic acid.

Example 4

- The pH of a 0.400M solution of sulfurous acid is measured to be 1.17. Calculate the K_a for sulfurous acid from this evidence.

Example 5

- Find the pH and hydroxide ion concentration of 0.064M solution of ammonia