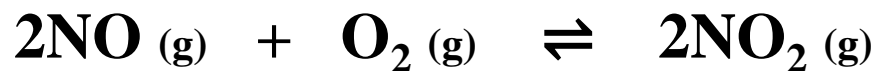


### Ex1:

At a given temperature, 10 moles of (NO) and 8 moles of (O<sub>2</sub>) are placed in a 2L container. After a certain period of time the system is at equilibrium. At equilibrium it is determined that there is 4 moles of (O<sub>2</sub>) remaining. Using the balanced equation determine the equilibrium constant



### Step 1: Find Known Concentrations

$$C = n/V$$

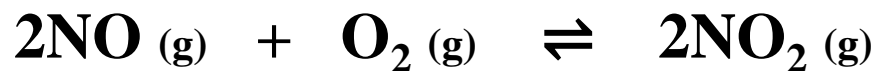
$$\text{Initial [NO]} = \frac{10}{2} = 5\text{mol/L}$$

$$\text{Initial [O}_2] = \frac{8}{2} = 4\text{mol/L}$$

$$\text{Equilibrium [O}_2] = \frac{4}{2} = 2\text{mol/L}$$

Ex1:

At a given temperature, 10 moles of (NO) and 8 moles of (O<sub>2</sub>) are placed in a 2L container. After a certain period of time the system is at equilibrium. At equilibrium it is determined that there is 4 moles of (O<sub>2</sub>) remaining. Using the balanced equation determine the equilibrium constant



Step 2: Fill in TICE table and Solve for unknowns

<u>Theory:</u>	2	1	2
<u>Initial (C<sub>i</sub>):</u>	5	4	<b>0</b>
<u>Change (ΔC):</u>	<b>-4</b>	<b>-2</b>	<b>+4</b>
<u>Equilibrium (C<sub>eq</sub>):</u>	<b>1</b>	2	<b>4</b>

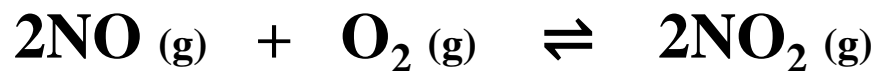
(1) Fill in info using given information

(2) Cross-Multiply the Theory and Change (ΔC) to solve for unknown Changes (ΔC).

(3) Solve for equilibrium concentrations (C<sub>eq</sub>) by adding or subtracting Change (ΔC) from the Initial (C<sub>i</sub>).

Ex1:

At a given temperature, 10 moles of (NO) and 8 moles of (O<sub>2</sub>) are placed in a 2L container. After a certain period of time the system is at equilibrium. At equilibrium it is determined that there is 4 moles of (O<sub>2</sub>) remaining. Using the balanced equation determine the equilibrium constant



Step 3: Using concentrations at equilibrium, calculate K<sub>c</sub>

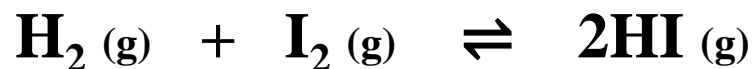
$$K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 \cdot [\text{O}_2]}$$

$$K_c = \frac{(4)^2}{(1)^2 \cdot (2)}$$

$$\underline{\underline{K_c = 8}}$$

Ex2:

At a 1100K, the equilibrium constant for the following reaction is 25.



The initial concentrations of the reactants are  $[H_2] = 2\text{mol/L}$  , and  $[I_2] = 3\text{mol/L}$ .  
What are the concentrations of each substance at equilibrium ?

Step 1: Fill in TICE table and Solve for unknowns

<b><u>T</u></b>	1	1	2
<b><u>I</u></b>	2	3	<b>0</b>
<b><u>C</u></b>	<b>-x</b>	<b>-x</b>	<b>+2x</b>
<b><u>E</u></b>	<b>2 - x</b>	<b>3 - x</b>	<b>2x</b>

(1)  
Fill in info using  
given information

(2)  
Cross-Multiply the  
Theory and Change  
( $\Delta C$ ) to solve for  
unknown Changes ( $\Delta C$ ).

(3)  
Solve for equilibrium  
concentrations ( $C_{eq}$ ) by  
adding or subtracting  
Change ( $\Delta C$ ) from the  
Initial ( $C_i$ ).

<u>T</u>	1	1	2
<u>I</u>	2	3	0
<u>C</u>	-x	-x	+2x
<u>E</u>	2 - x	3 - x	2x

Step 2: Fill in Equilibrium Constant equation:

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2] \cdot [\text{I}_2]}$$

$$25 = \frac{(2x)^2}{(2-x) \cdot (3-x)}$$

$$25 = \frac{4x^2}{6 - 2x - 3x + x^2}$$

$$25 = \frac{4x^2}{6 - 5x + x^2}$$

$$25(6 - 5x + x^2) = 4x^2$$

$$150 - 125x + 25x^2 = 4x^2$$

$$150 - 125x + 25x^2 - 4x^2 = 0$$

$$150 - 125x + 21x^2 = 0$$

$$21x^2 - 125x + 150 = 0$$

*Solve using Quadratic Equation*

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-125) \pm \sqrt{(-125)^2 - 4(21)(150)}}{2(21)}$$

$$x = \underline{\underline{4.29}} \text{ or } \underline{\underline{1.67}}$$

*Which value is correct ??*

Step 4: Determine which value of x is correct:

<u>I</u>	1	1	2
<u>I</u>	2	3	0
<u>C</u>	-x	-x	+2x
<u>E</u>	2 - x	3 - x	2x

$$x = \underline{4.29} \text{ or } \underline{1.67}$$

*Which value is correct ??*

*The Value of 4.29 is impossible since it would yield negative concentrations at equilibrium !*

*Therefore 1.67 is correct.*

Step 5: Replace x on the TICE table to solve for Concentrations at equilibrium:

*x = 1.67 is correct.*

<b><u>T</u></b>	1	1	2
<b><u>I</u></b>	2	3	<b>0</b>
<b><u>C</u></b>	<b>-x</b>	<b>-x</b>	<b>+2x</b>
<b><u>E</u></b>	<b>2 - x</b>	<b>3 - x</b>	<b>2x</b>

Step 5: Replace x on the TICE table to solve for Concentrations at equilibrium:

*x = 1.67 is correct.*

<b><u>T</u></b>	1	1	2
<b><u>I</u></b>	2	3	<b>0</b>
<b><u>C</u></b>	<b>-1.67</b>	<b>-1.67</b>	<b>+2(1.67)</b>
<b><u>E</u></b>	<b>2 - 1.67</b>	<b>3 - 1.67</b>	<b>2(1.67)</b>

**[H<sub>2</sub>] =  
0.33mol/L**

**[I<sub>2</sub>] =  
1.33mol/L**

**[HI] =  
3.34mol/L**

---