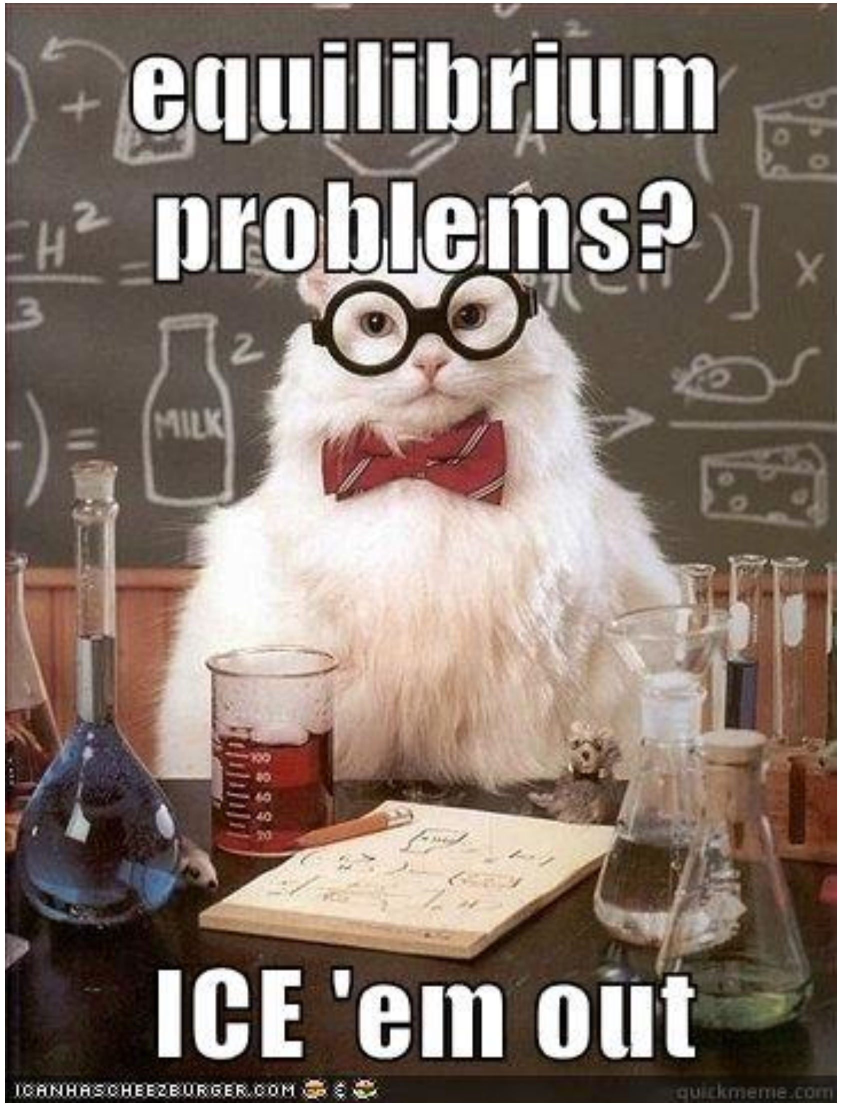
ICE Problems



Outcome:

Solve problems involving equilibrium constants.

Equilibrium Problem Type 1:

We are given **INITIAL CONCENTRATIONS** (usually reactants), and the **EQUILIBRIUM CONCENTRATION** of a **PRODUCT**.

Example:

For the reaction, $H_{2(g)} + F_{2(g)} \leftrightarrow 2HF_{(g)}$

1.00 moles of H_2 and 1.00 moles of F_2 are sealed in a 1.0L flask at 150°C, and allowed to react. At Equilibrium, 1.32 moles of HF are present. Find K_{eq}.

Equilibrium Problem Type 2:

We are given **INITIAL CONCENTRATIONS** and **K_{eq}**, and must calculate the **EQUILIBRIUM CONCENTRATIONS** of reactants and/or products.

Example:

For the reaction, $N_{2(g)} + O_{2(g)} \leftrightarrow 2NO_{(g)}$

The equilibrium constant is 6.76. If 6.0 moles of N_2 and O_2 are placed in a 1.0L container, find the concentrations of all reactants and products at equilibrium.

Try these ones…

1. Given the reaction ***$2SO_{2(g)}$ + $O_{2(g)}$ ←→ $2SO_{3(g)}$***, if initially 2.00 mol of SO_2, 1.00 mol O_2 and 0.100 mol SO_3 are all mixed in a 15.0L container, and at equilibrium, there are 0.200 mol of O_2 left, calculate $K_{eq.}$

Try these ones…

2. Given the reaction, $\boldsymbol{N_{2(g)} + O_{2(g)} \leftrightarrow 2NO_{(g)}}$. 0.500 mol N_2 and 0.500mol O_2 are placed in a 1L flask at 430°C If Keq is 54.3 at this temperature, find the concentrations of all species in the system at equilibrium.

The Reaction Quotient (Q)

- Allows us to determine **WHETHER** a system is at **EQUILIBRIUM**, and which reaction is **FAVOURED**.
- Uses the equilibrium law, but with concentrations determined in **EXPERIMENT**.
- Instead of **Keq** we use **Q**.
- We then compare **Q** to the value of **Keq**.

1. **If Q=Keq:**

   - The system is at **EQUILIBRIUM**

The Reaction Quotient (Q)

2. **If Q>Keq:**
   - The system is **NOT** at **EQUILIBRIUM** (more **PRODUCTS**)
   - The **REVERSE** reaction will be **FAVOURED** to bring the
   - reactant-product **RATIO EQUAL** to Keq

3. **If Q<Keq:**
   - The system is **NOT** at **EQUILIBRIUM** (more **REACTANTS**)
   - The **FORWARD** reaction will be **FAVOURED** to bring the reactant-product **RATIO EQUAL** to Keq

The Reaction Quotient (Q)

Example:

For the reaction, $\mathbf{N_{2(g)} + O_{2(g)} \leftrightarrow 2NO_{(g)}}$ It was found that 8.5 moles of N2, 11 moles of O2 and 2.20 moles of NO were in a 5.00L container. If Keq=0.035,

a) Is the system at equilibrium?

b) If it is not at Equilibrium, which reaction is favoured?

c) Which concentrations are increasing and decreasing?