

**Worksheet B      Equilibrium Calculations**

Solve each problem and show all of your work.

1. At equilibrium, a 5.0L flask contains:      0.75 mol of  $\text{PCl}_5$       0.50 mol of  $\text{H}_2\text{O}$       7.50 mol of  $\text{HCl}$       5.00 mol of  $\text{POCl}_3$

Calculate the  $K_{eq}$  for the reaction:       $\text{PCl}_5(g) + \text{H}_2\text{O}(g) \rightleftharpoons 2\text{HCl}(g) + \text{POCl}_3(g)$ 

2.  $K_{eq} = 798$  for the reaction:       $2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$

In a particular mixture at equilibrium,  $[\text{SO}_2] = 4.20 \text{ M}$  and  $[\text{SO}_3] = 11.0 \text{ M}$ . Calculate the equilibrium  $[\text{O}_2]$  in this mixture.

3. Consider the following equilibrium:       $2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$

When a 0.600 moles of  $\text{SO}_2$  and 0.600 moles of  $\text{O}_2$  are placed into a 1.00 litre container and allowed to reach equilibrium, the equilibrium  $[\text{SO}_3]$  is to be 0.250M. Calculate the  $K_{eq}$  value.

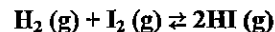
4. Consider the following equilibrium:       $2 \text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4(g)$

If 2.00 moles of  $\text{NO}_2$  are placed in a 1.00 L flask and allowed to react. At equilibrium 1.80 moles  $\text{NO}_2$  are present. Calculate the  $K_{eq}$ .

5.       $2 \text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2 \text{SO}_3(g)$

4.00 moles of  $\text{SO}_2$  and 5.00 moles  $\text{O}_2$  are placed in a 2.00 L container at  $200^\circ\text{C}$  and allowed to reach equilibrium. If the equilibrium concentration of  $\text{O}_2$  is 2.00 M, calculate the  $K_{eq}$ 

6. If the initial  $[\text{H}_2] = 0.200\text{M}$ ,  $[\text{I}_2] = 0.200\text{M}$  and  $K_{eq} = 55.6$  at  $250^\circ\text{C}$  calculate the equilibrium concentrations of all molecules.



7. 1.60 moles  $\text{CO}$  and 1.60 moles  $\text{H}_2\text{O}$  are placed in a 2.00L container at  $690^\circ\text{C}$  ( $K_{eq} = 10.0$ ).

Calculate all equilibrium concentrations.       $\text{CO}(g) + \text{H}_2\text{O}(g) \rightleftharpoons \text{CO}_2(g) + \text{H}_2(g)$ 

8.       $\text{SO}_3(g) + \text{NO}(g) \rightleftharpoons \text{NO}_2(g) + \text{SO}_2(g)$

 $K_{eq} = 0.800$  at  $100^\circ\text{C}$ . If 4.00 moles of each reactant are placed in a 2.00L container, calculate all equilibrium concentrations at  $100^\circ\text{C}$ .

9. Consider the following equilibrium system:       $2\text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4$

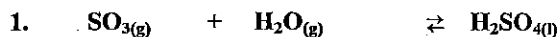
Two sets of equilibrium data are listed for the same temperature.

Container 1	2.00 L	0.12 moles $\text{NO}_2$	0.16 moles $\text{N}_2\text{O}_4$
Container 2	5.00 L	0.26 moles $\text{NO}_2$	? moles $\text{N}_2\text{O}_4$

Determine the number of moles  $\text{N}_2\text{O}_4$  in the second container. Get a  $K_{eq}$  from the first container and use it for the second container.

**Worksheet A      Equilibrium Calculations**

**Solve each problem and show all of your work.**



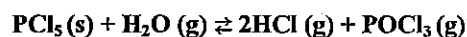
At equilibrium  $[\text{SO}_3] = 0.400\text{M}$        $[\text{H}_2\text{O}] = 0.480\text{M}$        $[\text{H}_2\text{SO}_4] = 0.600\text{M}$

Calculate the value of the equilibrium constant.

2. At equilibrium at  $100^\circ\text{C}$ , a 2.0L flask contains:

0.075 mol of  $\text{PCl}_5$       0.050 mol of  $\text{H}_2\text{O}$       0.750 mol of  $\text{HCl}$       0.500 mol of  $\text{POCl}_3$

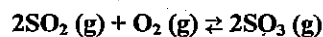
Calculate the  $K_{\text{eq}}$  for the reaction:



3.  $K_{\text{eq}} = 798$  at  $25^\circ\text{C}$  for the reaction:  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ .

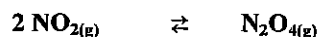
In a particular mixture at equilibrium,  $[\text{SO}_2] = 4.20\text{M}$  and  $[\text{SO}_3] = 11.0\text{M}$ . Calculate the equilibrium  $[\text{O}_2]$  in this mixture at  $25^\circ\text{C}$ .

4. Consider the following equilibrium:

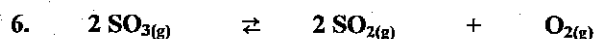


0.600 moles of  $\text{SO}_2$  and 0.600 moles of  $\text{O}_2$  are present in a 4.00 L flask at equilibrium at  $100^\circ\text{C}$ . If the  $K_{\text{eq}} = 680$ , calculate the  $\text{SO}_3$  concentration at  $100^\circ\text{C}$ .

5. Consider the following equilibrium:

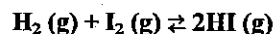


2.00 moles of  $\text{NO}_2$  and 1.60 moles of  $\text{N}_2\text{O}_4$  are present in a 4.00 L flask at equilibrium at  $20^\circ\text{C}$ . Calculate the  $K_{\text{eq}}$  at  $20^\circ\text{C}$ .

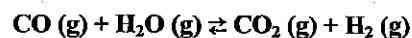


4.00 moles of  $\text{SO}_2$  and 5.00 moles  $\text{O}_2$  are present in a 2.00 L container at  $100^\circ\text{C}$  and are at equilibrium. Calculate the equilibrium concentration of  $\text{SO}_3$  and the number of moles  $\text{SO}_3$  present if the  $K_{\text{eq}} = 1.47 \times 10^{-3}$ .

7. If at equilibrium  $[\text{H}_2] = 0.200\text{M}$  and  $[\text{I}_2] = 0.200\text{M}$  and  $K_{\text{eq}} = 55.6$  at  $250^\circ\text{C}$ , calculate the equilibrium concentration of  $\text{HI}$ .



8. 1.60 moles  $\text{CO}$ , 1.60 moles  $\text{H}_2\text{O}$ , 4.00 moles  $\text{CO}_2$ , 4.00 moles  $\text{H}_2$  are found in a 8.00L container at  $690^\circ\text{C}$  at equilibrium.



Calculate the value of the equilibrium constant.