

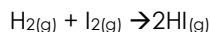
Equilibrium Problems

1. At 250°C the equilibrium constant for the following gaseous reaction is 0.041.

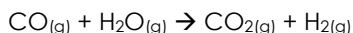


Calculate the concentrations of all of the substances present at equilibrium if 0.20 mol of PCl_5 are placed in a 4.0 L reaction vessel.

2. At 448°C the equilibrium constant for the following reaction is 50.0.

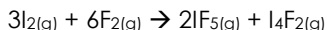


- How many moles of HI will be present at equilibrium when 1.0 mol of $\text{H}_{2(g)}$ and 1.0 mol of $\text{I}_{2(g)}$ are allowed to react in a 1.0 L container?
 - How many moles of H_2 and I_2 remain unreacted?
 - If the container was an open system and the reaction of H_2 and I_2 was complete (ie not an equilibrium reaction), how many moles of HI should be produced?
 - What is the percent yield of the equilibrium mixture?
3. A 1.0 L container contains 0.750 mol of CO and 0.275 mol of H_2O . After one hour, equilibrium is reached according to the following equation:

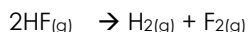


Analysis shows that 0.25 mol of CO_2 is present. What is the equilibrium constant for the reaction?

4. Consider the equilibrium:



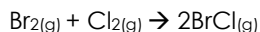
- At a certain temperature, 3.0 mol of F_2 and 2.0 mol of I_2 are placed into a 10.0 L container. At equilibrium, the concentration of IF_5 is 0.020 mol/L. Calculate K_{eq} for the reaction.
 - At a different temperature (this means that K_{eq} will be different than part a)), 6.0 mol of IF_5 and 8.0 mol of I_4F_2 are placed in a 10.0 L container. At equilibrium, 6.0 mol of I_4F_2 are left. Calculate the K_{eq} for the new temperature.
5. At a certain temperature, $K_{eq} = 4.0$ for the following reaction.



Predict the direction in which the reaction will shift, if any, when the following amounts of substances are introduced into a 1.0 L container.

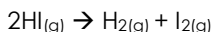
- 3.0 mol of HF, 2.0 mol of H_2 and 4.0 mol of F_2
- 0.20 mol of HF, 0.50 mol of H_2 and 0.60 mol of F_2
- 0.30 mol of HF, 1.8 mol of H_2 and 0.20 mol of F_2

6. The equilibrium constant for the following reaction is 7.0.



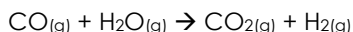
If 0.080 mol of Br_2 and 0.60 mol of Cl_2 are placed into a 2.0 L container, what are the equilibrium concentrations for the reaction?

7. At 425°C, the equilibrium constant is 1.82×10^{-2} for the reaction:

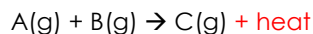


Equilibrium is reached by adding HI to the reaction vessel.

- What are the concentrations of H_2 and I_2 in equilibrium with 0.0100 mol/L HI?
 - What was the initial concentration of HI (i.e. before equilibrium was reached)?
 - What percent of HI reacted?
8. 1.00 mol of CO(g) and 1.00 mol $\text{H}_2\text{O(g)}$ are placed in a 10.0 L container. At equilibrium, 0.665 mol of CO_2 and 0.665 mol of H_2 are present. The reaction proceeds as follows:



- What are the equilibrium concentrations of all four gases?
 - What is the value of K_{eq} ?
9. Using the reaction below and assuming that equilibrium has already been established.



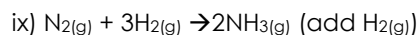
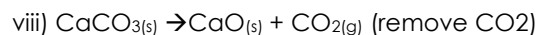
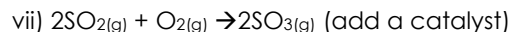
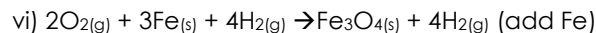
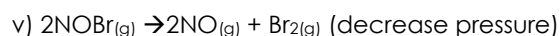
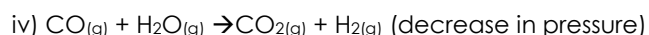
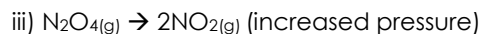
How would the concentration of C change with:

- an increase in temperature?
- an increase in pressure?
- an addition of A?
- the addition of a catalyst?
- the removal of B?
- the removal of C?

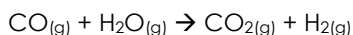
How would the value of K_{eq} change with

- an addition of A?
- an increase in temperature?
- an addition of a catalyst?

10. For each of the following equilibrium systems:
- Write the equilibrium expression
 - State which direction the reaction would shift to re-establish equilibrium.



11. When at equilibrium, a reaction mixture contains: 0.20 mol H_2 , 0.70 mol CO_2 , 0.20 mol CO and 0.30 mol H_2O in a 1.0 L container. The reaction is as follows:



How many moles of CO_2 would have to be added to increase the amount of CO to 0.30 mol?