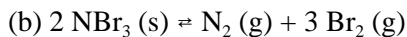
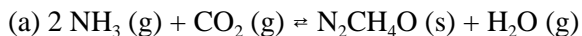


1) Write the equilibrium expressions for K_{eq} and K_p for the following reactions:

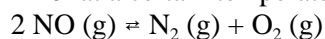


(c) Solid potassium chlorate decomposes into solid potassium chloride and oxygen gas

(d) Solid copper (II) oxide reacts with hydrogen gas to form liquid copper and water vapor

2) Consider the reaction of solid iron and oxygen gas forming solid iron (III) oxide at a certain temperature. At equilibrium, the mixture contains 1.0 mole of iron, 1.0×10^{-3} moles of oxygen gas, and 2.0 moles of iron (III) oxide, all in a 2.0-liter container. Calculate the value of K_{eq} for this reaction. [8.0 x 10⁹]

3) The equilibrium constant is 2.4×10^3 at a certain temperature for the reaction



For which of the following sets of conditions is the system at equilibrium? For those that are not at equilibrium, in which direction will the system shift?

(a) A 1.0 L flask containing 0.024 mol NO, 2.0 mol N_2 and 2.6 mol O_2

(b) A 2.0 L flask containing 0.032 mol NO, 0.62 mol N₂, and 4.0 mol O₂

(c) A 3.0 L flask containing 0.060 mol NO, 2.4 mol N₂, and 1.7 mol O₂

- 4) For the decomposition reaction of water vapor into hydrogen gas and oxygen gas, the equilibrium constant is 2.4×10^{-3} at a given temperature. At equilibrium it is found that the concentration of water vapor is 1.1×10^{-1} M and hydrogen gas is 1.9×10^{-2} M. What is the concentration of oxygen gas at equilibrium under these conditions? [8.0×10^{-2} M]

- 5) A 1.00-L flask was filled with 2.00 mol of gaseous sulfur dioxide and 2.00 mol of gaseous nitrogen dioxide and heated. After equilibrium was reached, it was found that 1.30 moles of gaseous nitrogen monoxide were present. Assume the reaction
- $$\text{SO}_2(\text{g}) + \text{NO}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g}) + \text{NO}(\text{g})$$
- occurs under these conditions. Calculate the value of K_{eq} for the reaction. [3.4]

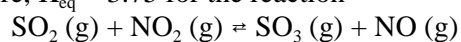
- 6) At a particular temperature, 12.0 mol of SO_3 is placed into a 3.0-L rigid container, and the SO_3 decomposes by the reaction



At equilibrium, 3.0 mol of SO_2 are present. Calculate K_{eq} for this reaction.

[0.056]

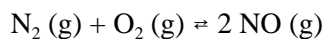
- 7) At a particular temperature, $K_{\text{eq}} = 3.75$ for the reaction



If all four gases had initial concentrations of 0.800 M, calculate the equilibrium concentrations of the gases.

$$[\text{SO}_3] = [\text{NO}] = 1.06 \text{ M}, [\text{SO}_2] = [\text{NO}_2] = 0.54 \text{ M}$$

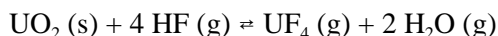
- 8) At 2200 °C, K_p is 0.050 for the reaction



What is the partial pressure of NO in equilibrium with N_2 and O_2 that were placed in a flask at initial pressures of $\text{N}_2 = 0.80 \text{ atm}$ and $\text{O}_2 = 0.20 \text{ atm}$?

[7.8 x 10⁻² atm]

9) Suppose the reaction system



has already reached equilibrium. Predict the effect that each of the following changes will have on the equilibrium position. Tell whether the equilibrium will shift to the right, will shift to the left, or will not be affected.

(a) Additional $\text{UO}_2(\text{s})$ is added to the system [no effect]

(b) The reaction is performed in a glass vessel; $\text{HF}(\text{g})$ reacts with glass [shift left]

(c) Water vapor is removed [shift right]

10) An important reaction in the commercial production of hydrogen is



How will the system at equilibrium shift in each of the five following cases?

(a) Gaseous carbon dioxide is removed. [right]

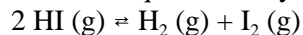
(b) Water vapor is added. [right]

(c) The pressure is increased by adding helium gas. [no effect]

(d) The temperature is increased. [left]

(e) The pressure is increased by decreasing the volume of the reaction container. [no effect]

11) In which direction will the position of the equilibrium system



be shifted for each of the following changes?

(a) $\text{H}_2(\text{g})$ is added [left]

(b) $\text{I}_2(\text{g})$ is removed [right]

(c) $\text{HI}(\text{g})$ is removed [left]

(d) Some $\text{Ar}(\text{g})$ is added [no effect]

(e) The volume of the container is doubled [no effect]

(f) The temperature is decreased. (The reaction is exothermic) [right]