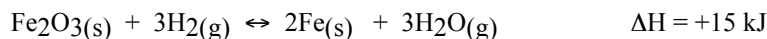


Teacher's Tools[®] Chemistry

Chemical Equilibrium: Worksheet

MULTIPLE CHOICE

For questions 1-6, consider the reaction:



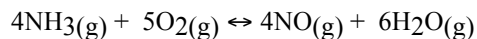
- _____ 1. The equilibrium concentrations under certain conditions were found to be
[H₂O] = 1.0 M [H₂] = 2.5 M
What is the value for K_c?
(A) 0.40 (B) 0.064 (C) 15.6 (D) Insufficient information to calculate.
- _____ 2. K_p is
(A) less than K_c. (B) greater than K_c. (C) equal to K_c. (D) insufficient information to calculate.

Use the following choices for questions # 3 - 6 to indicate the effect of each of the following changes made to the equilibrium system shown above. A choice may be used once, more than once, or not at all.

- (A) Systems shifts to the LEFT
(B) Systems shifts to the RIGHT
(C) No change
(D) Cannot be predicted

- _____ 3. The volume of the container is decreased.
- _____ 4. Some solid Fe₂O₃ is added
- _____ 5. Some steam is removed
- _____ 6. The temperature is increased

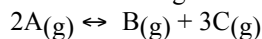
-
- _____ 7. For the reaction:



ΔH is negative. The position of this equilibrium would be shifted to the left by

- (A) removing NO(g).
(B) adding O₂(g).
(C) increasing the pressure by decreasing the volume of the container.
(D) decreasing the temperature.
(E) None of these

- _____ 8. Calculate the equilibrium constant K_p for the following reaction:



given that a 1.0 L vessel was initially filled with 5.0 atm of pure A and the partial pressure of gas A was found to be 3.5 atm at equilibrium.

- (A) 11.1 (B) 0.70 (C) 3.8 (D) 0.48 (E) None of these

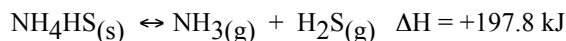
- _____ 9. Increasing the volume of the reaction vessel in question 8 would have what effect?
(A) Increasing the value of the equilibrium constant.
(B) Forcing the reaction to proceed to the right.
(C) Forcing the product ratio [C]/[B] to be greater than 3.
(D) Only (A) and (B) are correct.
(E) (A), (B), and (C) are correct.

Teacher's Tools[®] Chemistry

Chemical Equilibrium: Worksheet

For questions 10-13, use the following choices to indicate the effect of each of the following stresses on the partial pressure of ammonia. An answer may be used once, more than once, or not at all.

- (A) Ammonia partial pressure increases
- (B) Ammonia partial pressure decreases
- (C) There is no change in the partial pressure of ammonia



- _____ 10. A small quantity of H₂S is added.
- _____ 11. The temperature of the system is increased.
- _____ 12. A quantity of N₂ is added.
- _____ 13. A quantity of NH₃ is added.

PROBLEMS Show work on separate sheets

1.
$$\text{CO}_2\text{(g)} \leftrightarrow \text{CO(g)} + \frac{1}{2} \text{O}_2\text{(g)}$$
A 1.00 mole sample of CO₂ is placed in a 1.00 L container and allowed to come to equilibrium at 2500 K. When equilibrium is reached at 2500 K, 17.6% of the original CO₂ has decomposed to CO and O₂. Calculate the value of the equilibrium constant, K_c, for the dissociation reaction at 2500 K.

-
2. Ammonium chloride is a crystalline solid that decomposes as follows:



- (A) Some solid NH₄Cl is placed in an evacuated vessel at 25°C. After equilibrium is attained, the total pressure inside the vessel is found to be 0.659 atm. Some solid NH₄Cl remains in the vessel at equilibrium. For this decomposition, write the expression for K_p and calculate its numerical value at 25°C.
- (B) Some extra NH₃ gas is injected into the vessel containing the sample described in part (A). When equilibrium is reestablished at 25°C, the partial pressure of NH₃ in the vessel is twice the partial pressure of HCl. Calculate the numerical value of the partial pressure of NH₃ and the partial pressure of HCl in the vessel after the NH₃ has been added and equilibrium has been reestablished.
- (C) In a different experiment, NH₃ gas and HCl gas are introduced into an empty 1.00 L vessel at 25°C. The initial partial pressure of each gas is 0.500 atm. Calculate the number of moles of solid NH₄C that is present when equilibrium is established.

Teacher's Tools[®] Chemistry

Chemical Equilibrium: Worksheet

3. Given the following reaction at equilibrium:



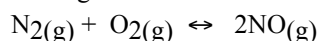
Initially, 0.0400 mol $\text{N}_2\text{O}_4(\text{g})$ are placed in a previously evacuated flask and heated to 100°C . When equilibrium is established at 100°C , the equilibrium concentration of $\text{N}_2\text{O}_4(\text{g})$ is found to be 0.0134 M. The volume of the flask is 1.00 L.

(A) Calculate the equilibrium concentration of $\text{NO}_2(\text{g})$.

(B) Calculate the equilibrium constant, K_c , for the reaction at 100°C .

(C) In another experiment, equilibrium was approached from the other direction by injecting a quantity of $\text{NO}_2(\text{g})$ into a previously evacuated flask. After equilibrium is established in this system at 100°C , the equilibrium concentration of NO_2 is found to be 0.0243 M. Find the equilibrium concentration of N_2O_4 in the system. (*Hint: No initial/change equilibrium table is needed.*)

4. The equilibrium constant, K_c , for the following reaction:



is 4.00×10^{-2} at a very high temperature. The reaction is at equilibrium at this temperature with $[\text{N}_2] = [\text{O}_2] = 0.100 \text{ M}$ and $[\text{NO}] = 0.0200 \text{ M}$ in a 2.00 liter flask.



If 0.120 mol of NO is suddenly added to the reaction mixture, what will be the concentrations of all species when equilibrium is reestablished? (*It's an algebra problem.*)

5.
$$\text{H}_2(\text{g}) + \text{CO}_2(\text{g}) \leftrightarrow \text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g})$$

For the reaction above, an equilibrium mixture in a 5.0 L container at a certain temperature was analyzed and found to contain

$\text{H}_2 = 0.585$ moles, $\text{CO}_2 = 1.585$ moles, $\text{H}_2\text{O} = 0.665$ moles, and $\text{CO} = 0.665$ moles.

(A) Calculate the equilibrium constant K_c .

(B) If the volume of the system at equilibrium were increased, how would the new quantity of H_2O (after equilibrium is re-established) compare to the original equilibrium quantity?

6. The reaction



has a K_c value of 4.0 at 500°C . Calculate the concentration of all species at equilibrium starting with:

(A) $[\text{CO}] = [\text{H}_2\text{O}] = 0.100 \text{ M}$ and $[\text{CO}_2] = [\text{H}_2] = 0.00 \text{ M}$

(B) $[\text{CO}] = [\text{H}_2\text{O}] = [\text{CO}_2] = [\text{H}_2] = 0.040 \text{ M}$