

Chemistry 12

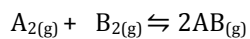
K_{eq} Calculations Worksheet

Name:

Date:

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1. Given the equilibrium equation below:

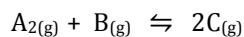


If, at equilibrium, the concentrations are as follows:

$$[A_2] = 3.45 \text{ M}, \quad [B_2] = 5.67 \text{ M} \quad \text{and} \quad [AB] = 0.67 \text{ M}$$

- a) Write the expression for the equilibrium constant, K_{eq}
- b) Find the value of the equilibrium constant, K_{eq} at the temperature that the experiment was done.

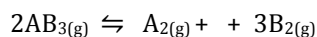
2. For the reaction:



it is found that by adding 1.5 moles of C to a 1.0 L container, an equilibrium is established in which 0.30 moles of B are found.

- a) What is [A] at equilibrium?
- b) What is [B] at equilibrium?
- c) What is [C] at equilibrium?
- d) Write the expression for the equilibrium constant, K_{eq} .
- e) Calculate the value for the equilibrium constant at the temperature at the experiment was done.

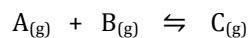
3. Considering the following equilibrium:



If 0.87 moles of AB_3 are injected into a 5.0 L container at 25°C , at equilibrium the final $[A_2]$ is found to be 0.070 M.

- Calculate the equilibrium $[AB_3]$.
- Calculate the equilibrium $[A_2]$.
- Calculate the equilibrium $[B_2]$.

4. Consider the reaction:



- a) In an equilibrium mixture the following concentrations were found:

$[A] = 0.45\text{M}$, $[B] = 0.63\text{M}$ and $[C] = 0.30\text{M}$. Calculate the value of the equilibrium constant for this reaction.

- b) At the same temperature, another equilibrium mixture is analyzed and it is found that $[B] = 0.21\text{ M}$ and $[C] = 0.70\text{ M}$. From this and the information above, calculate the equilibrium $[A]$.
- c) In another equilibrium mixture at the same temperature, it is found that $[A] = 0.35\text{ M}$ and the $[C] = 0.86\text{ M}$. From this and the information above, calculate the equilibrium $[B]$.

5. Two mole of gaseous NH_3 are introduced into a 1.0 L vessel and allowed to undergo partial decomposition at high temperature according to the reaction:



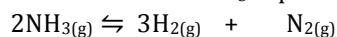
At equilibrium, 1.0 mole of $\text{NH}_{3(g)}$ remains.

- What is the equilibrium $[\text{N}_2]$?
 - What is the equilibrium $[\text{H}_2]$?
 - Calculate the value of the equilibrium constant at the temperature of the experiment.
6. At a high temperature, 0.50 mol of HBr was placed in a 1.0 L container and allowed to decompose according to the reaction:



At equilibrium the $[\text{Br}_2]$ was measured to be 0.13 M. What is K_{eq} for this reaction at this temperature?

7. When 1.0 mol of $\text{NH}_3(\text{g})$ and 0.40 mol of $\text{N}_2(\text{g})$ are placed in a 5.0 L vessel and allowed to reach equilibrium at a certain temperature, it is found that 0.78 mol of NH_3 is present. The reaction is:

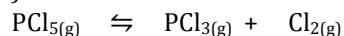


- a) Calculate the equilibrium concentrations of all three species.

$$[\text{NH}_3] = \text{_____} \quad [\text{H}_2] = \text{_____} \quad [\text{N}_2] = \text{_____}$$

- b) Calculate the value of the equilibrium constant at this temperature.

8. When 0.40 mol of PCl_5 is heated in a 10.0 L container, an equilibrium is established in which 0.25 mol of Cl_2 is present. (Make a table and answer the questions below. Be sure to read all questions a-d before making your table!)



- a) Calculate the equilibrium concentration of each species.

$$[\text{PCl}_5] = \text{_____} \quad [\text{PCl}_3] = \text{_____} \quad [\text{Cl}_2] = \text{_____}$$

- b) Calculate the value of the equilibrium constant, K_{eq} at the temperature of the experiment.

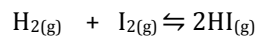
- c) What amount (moles) of PCl_3 is present at equilibrium?

- d) What amount (moles) of PCl_5 is present at equilibrium?

9. A mixture of H_2 and I_2 is allowed to react at 448°C . When equilibrium is established, the concentrations of the participants are found to be:

$$[\text{H}_2] = 0.46 \text{ M}, \quad [\text{I}_2] = 0.39 \text{ M} \quad \text{and} \quad [\text{HI}] = 3.0 \text{ M}.$$

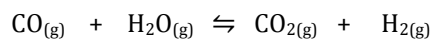
The equation is:



- a) Calculate the value of K_{eq} at 448°C .

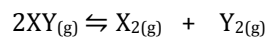
- b) In another equilibrium mixture of the same species at 448°C , the concentrations of I_2 and H_2 are both 0.050 M . What is the equilibrium concentration of HI ?

10. At a certain temperature the reaction:



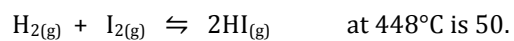
has a $K_{\text{eq}} = 0.400$. Exactly 1.00 mol of each gas was placed in a 100.0 L vessel and the mixture was allowed to react. Find the equilibrium concentration of each gas.

11. The reaction:



has a $K_{eq} = 35$ at 25°C . If 3.0 moles of XY are injected into a 1.0 L container at 25°C , find the equilibrium $[X_2]$ and $[Y_2]$.

12. The equilibrium constant for the reaction:



a) If 1.0 mol of H_2 is mixed with 1.0 mol of I_2 in a 0.50 L container and allowed to react at 448°C , what is the equilibrium $[HI]$?

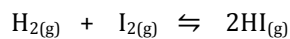
b) How many moles of HI are formed at equilibrium? (Actual yield)

13. Given K_{eq} for the reaction:



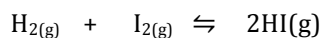
is 0.042 at 250°C, what will happen if 2.50 mol of PCl_5 , 0.600 mol of Cl_2 and 0.600 mol of PCl_3 are placed in a 1.00 flask at 250°C? (Will the reaction shift left, right, or not occur at all?)

14. Given the equilibrium equation:



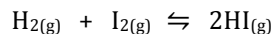
at 448°C, $K_{eq} = 50$. If 3.0 mol of HI, 2.0 mol of H_2 , and 1.5 mol of I_2 are placed in a 1.0 L container at 448°C, which way does the reaction shift?

15. Given the equilibrium equation:



at 448°C, $K_{eq} = 50$. If 5.0 mol of HI, 0.7071 mol of H_2 , and 0.7071 mol of I_2 are placed in a 1.0 L container at 448°C, which way does the reaction shift?

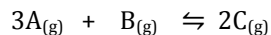
16. Determine the equilibrium constant for the reaction:



given that an equilibrium mixture is analyzed and found to contain the following concentrations:

$$[\text{H}_2] = 0.0075 \text{ M}, [\text{I}_2] = 0.000043 \text{ M} \text{ and } [\text{HI}] = 0.0040 \text{ M}$$

17. Given the equilibrium equation:

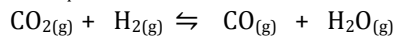


If 2.50 moles of A and 0.500 moles of B are added to a 2.00 L container, an equilibrium is established in which the [C] is found to be 0.250 M.

a) Find [A] and [B] at equilibrium.

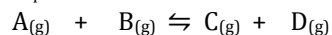
b) Calculate the value of the equilibrium constant K_{eq} .

18. At 800°C, the equilibrium constant $K_{\text{eq}} = 0.279$ for the reaction:



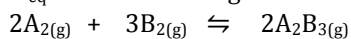
If 1.50 moles of CO_2 and 1.50 moles of H_2 are added to a 1.00 L container, what would the [CO] be at equilibrium?

19. Given that the equilibrium constant $K_{eq} = 0.015$ at 25°C for the reaction:



if 1.0 mole of each gas is added to a 1.0 L container at 25°C , which way will the equation shift in order to reach equilibrium?

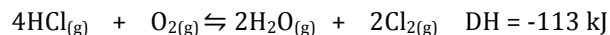
20. Calculate the equilibrium constant K_{eq} for the following reaction:



given that the partial pressure of each substance at equilibrium is as follows:

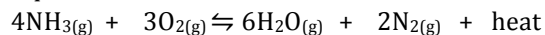
Partial Pressure of $\text{A}_2 = 20.0$ kPa, Partial Pressure of $\text{B}_2 = 30.0$ kPa, Partial Pressure of $\text{A}_2\text{B}_3 = 5.00$ kPa.

21. Given the reaction:



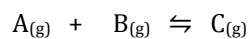
How will the value of the equilibrium constant K_{eq} at 550°C compare with its value at 450°C ? Explain your answer.

22. The following system is at equilibrium, in a closed container:



- How is the amount of N_2 in the container affected if the volume of the container is doubled?
- How is the rate of the forward reaction affected if more water vapor is introduced into the container?
- How is the amount of O_2 in the container affected if a catalyst is added?

23. Consider the following equilibrium system:



1.0 mole of A and 2.0 moles of B are simultaneously injected into an empty 1.0 L container. After 5.0 minutes, equilibrium is reached and [C] is found to be 0.20 M. Make calculations and draw graphs to show how each of [A], [B] and [C] change with time over a period of 10.0 minutes.

(HINT: You have to make a table first.)

