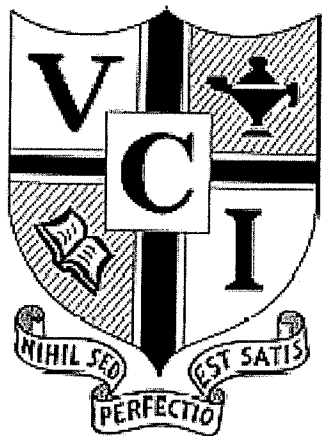


Science Notebook



40S

Chemistry

**Chemical
Equilibrium**

Student Name: _____ Date: _____

40S Chemistry Chemical Equilibrium Assignment 1

Write the equilibrium equation for each of the following physical equilibria:

1. Iodine solid in equilibrium with iodine vapour.
2. Bromine liquid in equilibrium with bromine vapour.
3. Saturated sodium chloride solution.
4. Gold at its melting point.
5. Water at its boiling point.

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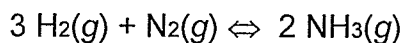
40S Chemistry Chemical Equilibrium Assignment 2

Answer these questions in your Chemistry notebook. Show all work when solving problems.

1. Write the equilibrium laws for each of the following reactions:

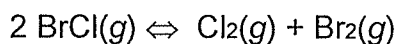
- a) $\text{SO}_2(g) + \text{NO}_2(g) \rightleftharpoons \text{SO}_3(g) + \text{NO}(g)$
- b) $2 \text{C}(s) + 3 \text{H}_2(g) \rightleftharpoons \text{C}_2\text{H}_6(g)$
- c) $3 \text{O}_2(g) \rightleftharpoons 2 \text{O}_3(g)$
- d) $\text{MgCO}_3(s) \rightleftharpoons \text{CO}_2(g) + 2 \text{MgO}(s)$
- e) $2 \text{Bi}_3^+(aq) + 3 \text{H}_2\text{S}(g) \rightleftharpoons 2 \text{Bi}_2\text{S}_3(s) + 6 \text{H}^+(aq)$
- f) $\text{I}_2(aq) \rightleftharpoons \text{I}_2(s)$
- g) $\text{Cl}_2(g) + \text{PCl}_3(g) \rightleftharpoons \text{PCl}_5(g)$

2. The formation of ammonia from hydrogen and nitrogen occurs by the reaction below:



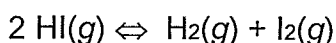
Analysis of an equilibrium mixture of nitrogen, hydrogen, and ammonia contained in a 1.0 L flask at 300°C gives the following results: hydrogen 0.15 moles; nitrogen 0.25 moles; ammonia 0.10 moles. Calculate K_c for the reaction.

3. Bromine chloride, BrCl, decomposes to form bromine and chlorine.



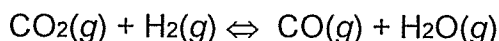
At a certain temperature the equilibrium constant for the reaction is 11.1, and the equilibrium mixture contains 4.00 mol of Cl_2 in a 1.0 L flask. How many moles of Br_2 and BrCl are present in the equilibrium mixture.

4. The decomposition of hydrogen iodide to hydrogen and iodine occurs by the reaction

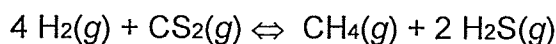


Hydrogen iodide is placed in a 1.0L container at 450°C an equilibrium mixture containing 0.50 moles of hydrogen iodide. The equilibrium constant is 0.020 for the reaction. How many moles of iodine and hydrogen iodide are present in the equilibrium mixture?

5. Chemists have determined the equilibrium constants for several reactions. In which of these reactions are the products favoured over the reactants?
- $K_{\text{eq}} = 1.0 \times 10^5$
 - $K_{\text{eq}} = 3.5$
 - $K_{\text{eq}} = 0.030$
 - $K_{\text{eq}} = 6.0 \times 10^{-4}$
6. A mixture at equilibrium at 827°C contains 0.552 moles of CO_2 , 0.552 moles H_2 , 0.448 moles CO , and 0.448 moles of H_2O in a 1.00 L container. What is the K_c constant?

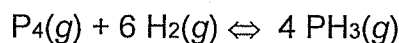


7. The equilibrium constant for the reaction

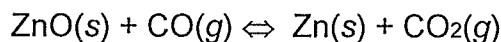


at 755°C is 0.256. What is the equilibrium concentration of H_2S if at equilibrium $[\text{CH}_4] = 0.00108 \text{ mol/L}$, $[\text{H}_2] = 0.316 \text{ mol/L}$, $[\text{CS}_2] = 0.0898 \text{ mol/L}$?

8. Find the value of K if at equilibrium there is 25.0 moles of P_4 , 10.0 moles of H_2 and 5.00 moles of PH_3 , in a 5.00 L container. The equation is

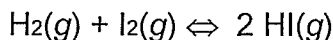


9. Find the value of K for the equilibrium system



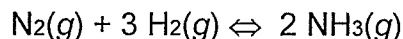
if at equilibrium there are 3.0 moles of CO , 4.0 moles of Zn and 4.0 moles of CO_2 in a 500.0 mL container.

10. If $K = 46.0$ for



what $[\text{I}_2]$ would be in equilibrium with 0.50 mol/L HI and 0.10 mol/L H_2 ?

11. If $K = 10.0$ for



how many **moles** of NH_3 , at equilibrium, will be in a 2.00 L container if $[\text{H}_2]$ is 0.600 mol/L and $[\text{N}_2]$ is 0.100 mol/L?

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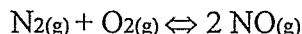
40S Chemistry Chemical Equilibrium Assignment 3

Answer the following questions in your Chemistry notebook:

1.
$$\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \leftrightarrow 2 \text{HCl}(\text{g})$$
 at 516°C

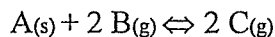
A student places 2.00 mol H_2 and 2.00 mol Cl_2 into a 0.500 L container and the reaction is allowed to go to equilibrium at 516°C . If K_{eq} is 76.0, what are the equilibrium concentrations of H_2 , Cl_2 and HCl ?

2. If $K = 1.00 \times 10^{-4}$ for the reaction



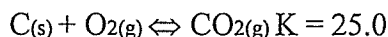
Find the number of moles of NO in a 10.0 L container if the initial $[\text{N}_2]$ and $[\text{O}_2]$ is 1.00 mol/L.

3. If $K = 78.0$ for the reaction



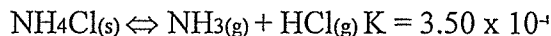
and initially there are 5.00 moles of A and 4.84 moles of B in a 2.00 L container, how many moles of B are left at equilibrium?

4. For the reaction:



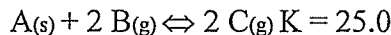
Find the moles of CO_2 at equilibrium, if initially there are 100.0 moles of C, 50.0 moles of O_2 and 2.0 moles of CO_2 in a 2.00 L container.

5. For the reaction:



Find the concentration of NH_3 in a 1.00 L container at equilibrium if initially there were 0.200 moles of NH_3 added to 0.200 moles of HCl .

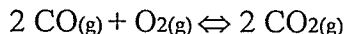
6. For the reaction:



$[\text{A}] = 12.0 \text{ mol/L}$ $[\text{B}] = 2.0 \text{ mol/L}$ $[\text{C}] = 30.0 \text{ mol/L}$

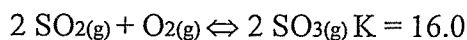
- Is the system at equilibrium.
- Which reaction is faster (favoured), forward or reverse?
- Which concentrations are increasing or decreasing?

7. There exists an equilibrium if 5.0 moles of CO_2 , 5.0 moles of CO and 0.20 moles of O_2 are in a 2.0 L container at 562°C . Find K_c for the reaction



Would the system be at equilibrium if $[\text{CO}_2] = 15.8 \text{ mol/L}$, $[\text{CO}] = 10.0 \text{ mol/L}$ and $[\text{O}_2] = 0.25 \text{ mol/L}$? If not, which reaction is favoured?

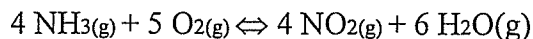
8. For the reaction:



Initially, $[\text{SO}_2] = 5.0 \text{ mol/L}$, $[\text{O}_2] = 10.0 \text{ mol/L}$ and $[\text{SO}_3] = 0$.

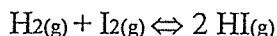
After two hours $[\text{O}_2] = 7.9 \text{ mol/L}$. Is the system at equilibrium? If not, which substances are increasing and which are decreasing?

9. The reaction



is at equilibrium when $[\text{H}_2\text{O}] = 0.100 \text{ mol/L}$, $[\text{O}_2] = 2.00 \text{ mol/L}$, $[\text{NO}] = 0.200 \text{ mol/L}$ and $[\text{NH}_3] = 0.500 \text{ mol/L}$. If 0.75 moles of H_2O , 12.0 moles of NO , 30.0 moles of O_2 and 0.30 moles of NH_3 are in a 3.0 L container at the same temperature, is equilibrium achieved? If not, which reaction is favoured?

10. $K = 46.0$ for the reaction



Initially there are 6.90 moles of H_2 and 2.40 moles of I_2 in a 1.00 L container. After 5 hours there is still 1.00 moles of I_2 left. Is the system at equilibrium? If not, which substances are increasing and which are decreasing?

Student Name: _____ Date: _____

40S Chemistry

Chemical Equilibrium

Le Châtelier's Principle Questions

Use Le Châtelier's Principle to explain the effect of the given changes upon the equilibrium systems shown.

Use the scheme:

1. Tell what the stress is
2. Tell what the system tries to do to reduce the stress
3. Tell what concentrations increase, decrease.
4. Tell whether the equilibrium shifts left, right or no change.

1. Effect of adding more hydrogen (H₂) to the system:



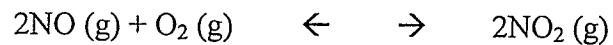
2. Effect of raising the temperature (adding more heat) to the system:



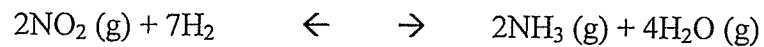
3. Effect of removing some $I_2(g)$ (i.e. decreasing I_2 concentration).



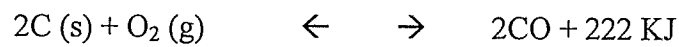
4. Effect of increasing the pressure on the system by decreasing the volume of the container:



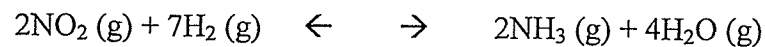
5. Effect of adding more ammonia, NH_3 , to the system:



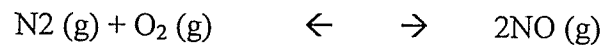
6. Effect of reducing the temperature (removing heat) on this system:



7. Effect of removal of some Nitrogen Dioxide, NO_2 , from the system:



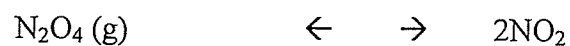
8. Effect of decreasing the volume on the system:



9. What is the effect of reducing the concentration of Zn^{+2} on the following reaction:



10. Explain the effect of compressing this system to a smaller volume:



Le Châtelier's Principle

Shift LEFT

Shift RIGHT

NO shift

