

## CHEMICAL EQUILIBRIUM WORKSHEET

On the line at the left, write the letter of the description that best matches each term.

- |       |                                |  |
|-------|--------------------------------|--|
| _____ | 1. Equilibrium position        | a. used to determine if a reaction has reached equilibrium   |
| _____ | 2. Law of chemical equilibrium | b. depends on the initial concentrations of the substances in a reaction   |
| _____ | 3. Reaction quotient           | c. states that every reaction proceeds to an equilibrium state with a specific $K_{eq}$                              |
| _____ | 4. Law of mass action          | d. expresses the relative concentration of reactants and products at equilibrium in terms of an equilibrium constant |
| _____ | 5. Equilibrium constant        | e. the ratio of product concentration to reactant concentration at equilibrium                                       |

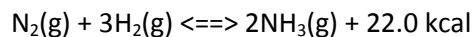
Answer each of the following in the space provided

6. What is the equilibrium expression for the equation  $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ ?
7. What is the equilibrium expression for the equation  $NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$ ?
8. What is the equilibrium expression for the equation  $As_4O_6(s) + 6C(s) \rightleftharpoons As_4(g) + 6CO(g)$ ?
9. What is the equilibrium expression for the equation  $SnO_2(s) + 2CO(g) \rightleftharpoons Sn(s) + 2CO_2(g)$ ?
10. What is the equilibrium expression for the equation  $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ ?
11. For the reaction  $2CO(g) \rightleftharpoons C(s) + CO_2(g)$ ,  $K_{eq} = 7.7 \times 10^{-15}$ . At a particular time, the following concentrations are measured:  $[CO]=0.034$  M,  $[CO_2]=3.6 \times 10^{-17}$  M. Is this reaction at equilibrium? If not which direction will the reaction proceed?
12. For the reaction  $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ ,  $K_{eq} = 0.2$ . At a particular time, the following concentrations are measured:  $[N_2O_4]=2.0$  M,  $[NO_2] = 0.2$  M. Is this reaction at equilibrium? If not which direction will the reaction proceed?
13. For the reaction  $2ICl(g) \rightleftharpoons I_2(g) + Cl_2(g)$ ,  $K_{eq} = 0.11$ . At a particular time, the following concentrations are measured:  $[ICl]=2.5$  M,  $[I_2] = 2.0$  M,  $[Cl_2]= 1.2$  M. Is this reaction at equilibrium? If not which direction will the reaction proceed?
14. At 340 °C,  $K_{eq} = 0.064$  for the reaction  $Fe_2O_3(s) + 3H_2(g) \rightleftharpoons 2Fe(s) + 3H_2O(g)$  Given that  $[H_2]=0.45$  M and  $[H_2O]=0.37$  M, find Q and predict how the reaction will proceed.

Match each statement with the appropriate letter. Each letter can be used once, more than once, or not at all.

- |       |   |                                     |
|-------|---|-------------------------------------|
| _____ | 15. The equilibrium concentration of products is much greater than that of reactants. | a. $K_{eq}$ is much greater than 1. |
| _____ | 16. The equilibrium concentration of products is much less than that of reactants     | b. $K_{eq}$ is about equal to 1.    |
| _____ | 17. There is a considerable amount of both reactants and products at equilibrium      | c. $K_{eq}$ is much less than 1.    |

Complete the following charts by writing left, right or none for equilibrium shift, and decreases, increases or remains the same for the concentrations of reactants and products and for the value of K.



Stress	Equilibrium Shift	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	K
18. Add N <sub>2</sub>	right	-----	decreases	increases	Remains the same
19. Add H <sub>2</sub>			-----		
20. Add NH <sub>3</sub>				-----	
21. Remove N <sub>2</sub>		-----			
22. Remove H <sub>2</sub>			-----		
23. Remove NH <sub>3</sub>				-----	
24. Increase Temperature					
25. Decrease Temperature					
26. Increase Pressure					
27. Decrease Pressure					

NaOH(s)  $\rightleftharpoons$  Na<sup>+</sup>(aq) + OH<sup>-</sup>(aq) + 10.6 kcal (Remember that pure solids and liquids do not affect equilibrium values)

Stress	Equilibrium Shift	Amount NaOH(s)	[Na <sup>+</sup> ]	[OH <sup>-</sup> ]	K
28. Add NaOH(s)		-----			
29. Add NaCl (adds Na <sup>+</sup> )			-----		
30. Add KOH (Adds OH <sup>-</sup> )				-----	
31. Add H <sup>+</sup> (Removes OH <sup>-</sup> )				-----	
32. Increase Temperature					
33. Decrease Temperature					
34. Increase Pressure					
35. Decrease Pressure					