CHEMICAL EQUILIBRIUM WORKSHEET

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

_____ 1. Equilibrium position

_____ 2. Law of chemical equilibrium

_____ 3. Reaction quotient

_____ 4. Law of mass action

_____ 5. Equilibrium constant

a. used to determine if a reaction has reached equilibrium
b. depends on the initial concentrations of the substances in a reaction
c. states that every reaction proceeds to an equilibrium state with a specific K_{eq}
d. expresses the relative concentration of reactants and products at equilibrium in terms of an 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 $H_2(g) + I_2(g) \text{ <==> } 2HI(g)$?

7. What is the equilibrium expression for the equation $NH_4Cl(s) \text{ <==> } NH_3(g) + HCl(g)$?

8. What is the equilibrium expression for the equation $As_4O_6(s) + 6C(s) \text{ <==> } As_4(g) + 6CO(g)$?

9. What is the equilibrium expression for the equation $SnO_2(s) + 2CO(g) \text{ <==> } Sn(s) + 2CO_2(g)$?

10. What is the equilibrium expression for the equation $CaCO_3(s) \text{ <==> } CaO(s) + CO_2(g)$?

11. For the reaction $2CO(g) \text{ <==> } C(s) + CO_2(g)$, $K_{eq} = 7.7 \times 10^{-15}$. At a particular time, the following concentrations are measured: $[CO]=0.034$ M, $[CO_2] = 3.6\times10^{-17}$ M. Is this reaction at equilibrium? If not which direction will the reaction proceed?

12. For the reaction $N_2O_4(g) \text{ <==> } 2NO_2(g)$, $K_{eq} = 0.2$. 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 $2ICl(g) \text{ <==> } I_2(g) + Cl_2(g)$, $K_{eq} = 0.11$. 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 $Fe_2O_3(s) + 3H_2(g) \text{ <==> } 2Fe(s) + 3H_2O(g)$ 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.

_____ 16. The equilibrium concentration of products is much less than that of reactants

_____ 17. There is a considerable amount of both reactants and products at equilibrium

a. K_{eq} is much greater than 1.
b. K_{eq} is about equal to 1.
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.

$N_2(g) + 3H_2(g) <==> 2NH_3(g) + 22.0$ kcal

Stress	Equilibrium Shift	$[N_2]$	$[H_2]$	$[NH_3]$	K
18. Add N_2	right	-------	decreases	increases	Remains the same
19. Add H_2			-------		
20. Add NH_3				------	
21. Remove N_2		-------			
22. Remove H_2			------		
23. Remove NH_3				------	
24. Increase Temperature					
25. Decrease Temperature					
26. Increase Pressure					
27. Decrease Pressure					

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

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