Dougherty Valley HS Chemistry
Equilibrium – ICE Tables

Worksheet #6

Name: **Period:** **Seat#:**

Directions:

- Answer these on binder paper!
- The first couple problems are "chunked" for you to help you think through the steps.
- For ICE Table Problems, show your ICE Table and any algebra.
- If assuming the 5% rule, show that you checked that it was a valid assumption at the end.
  - Remember can only use 5% rule if K < 1
    - And usually K = 1000x smaller than initial [ ]'s is a better guess of when to use it
  - If $\frac{x}{initial\ [\ ]}\ x\ 100 < 5\%$ then it is a valid assumption
- If 5% rule turns out not valid, then show your algebra or quadratic equation calculation
  - For quadratic equation make sure to indicate which answer for x is valid.
- For all other questions show calculations or give explanations when appropriate.
- Some answers are provided at the end. They are underlined.

---

1) For the reaction, $A \leftrightarrow 2B$, Kc = 2.
Suppose 3.0 moles of B and 3.0 moles of A are introduced into a 2.00 L flask.

a. Calculate the [A] and [B]
b. Is this system at equilibrium? Justify with showing a calculation.
c. In which direction will the reaction proceed to reach equilibrium?
d. As the system moves towards equilibrium what happens to the [ ]'s of each chemical, increase or decrease?

2) $N_2(g) + O_2(g) \leftrightarrow 2\ NO(g)$ The initial $[N_2]$ = 0.80 M and the initial $[O_2]$ = 0.20 M Kc = 1.0×10^{-5}

a. Based on the information given, and not doing any calculation, which direction does the reaction have to proceed to reach equilibrium? Explain your answer.
b. Looking at the size of the Kc value, and the initial concentrations, do you predict that the 5% rule will be a valid assumption? Show why you think yes or no.
c. Calculate the equilibrium concentrations for the reaction. *$[N_2]$ = 0.8M, $[O_2]$ = 0.2M, [NO] = 1.26E-3M*

3) $2NO_2 \leftrightarrow 2NO + O_2$ If 0.50 mol of NO_2 is placed in a 2.0L flask to create NO and O_2 Keq = 1.2×10^{-5}

a. Calculate the $[NO_2]$
b. Which way will the reaction proceed, right or left?
c. As the system moves towards equilibrium what happens to the [ ]'s of each chemical, increase or decrease?
d. Looking at the size of the Kc value, and the initial concentrations, do you predict that the 5% rule will be a valid assumption? Show why you think yes or no.
e. Calculate all the concentrations of each chemical once it reaches equilibrium.
$[NO_2]$ = 0.25M, [NO] = 0.0114M, $[O_2]$ = 0.00572M

4) Calculate the equilibrium concentrations of all species if 3.000 moles of H_2 and 6.000 moles of F_2 are placed in a 3.000 L container. $H_2(g) + F_2(g) \leftrightarrow 2HF(g)$, Kc = 1.15×10^{-3} *$[H_2]$ = 1M, $[F_2]$ = 2M, [HF] = 0.048M*

5) At 650°C, the reaction below has a K_{eq} value of 0.771. If 2.00 mol of both hydrogen and carbon dioxide are placed in a 4.00 L container and allowed to react, what will be the equilibrium concentrations of all four gases? *$[H_2]$ = 0.266M, $[CO_2]$ = 0.266M, [CO] = 0.234M, $[H_2O]$ = 0.234M*

$$H_2\,(g) + CO_2\,(g) \leftrightarrow CO\,(g) + H_2O\,(g)$$

6) $2HI \leftrightarrow H_2 + I_2$ Keq = 0.016. The system starts with 0.010 M H_2 and I_2 and 0.096 M of HI

a. Is this system at equilibrium? Justify with showing a calculation.
b. In which direction will the reaction proceed to reach equilibrium?
c. As the system moves towards equilibrium what happens to the [ ]'s of each chemical, increase or decrease
d. Calculate all the concentrations of each chemical once it reaches equilibrium.
[HI] = 0.0925M, [H_2] = 0.01175M, [I_2] = 0.01175M

7) 3.00 moles of N_2 gas and 1.00 mole of H_2 gas are combined in a 1 L reaction vessel. At equilibrium 0.663 moles of H_2 remain. $N_2 + 3H_2 \leftrightarrow 2NH_3$

a. What are the resulting concentrations? *[N_2] = 2.89M, [H_2] = 0.663M, [NH_3] = 0.224M*
b. What is the value of the equilibrium constant at this particular temperature? *Keq = .0596*

8) *Careful! There is something tricky about this problem!* ☺ Find the equilibrium constant, Keq, for the following equilibrium situation. The initial concentrations of AB and A_2D are 0.30 M before they are mixed and when equilibrium is reached, the equilibrium concentration of A_2D is 0.20 M. *Keq = 1.25*

$2\,AB_{(g)} + C_2D_{(s)} \leftrightarrow A_2D_{(g)} + 2\,CB_{(s)}$

9) At a particular temperature, Phosphorus pentachloride decomposes into Phosphorous trichloride and Chlorine gas. 0.500 moles of pure Phosphorus pentachloride is placed in a 2.00 L bottle and 0.7 M is the concentration of the chlorine gas in the same bottle. What are the resulting concentrations if the equilibrium constant at this particular temperature is Kc = 6.5×10^{-4} ? *[PCl_5] = 0.25M, [PCl_3] = 2.32E-4M, [Cl_2] = 0.7M*

10) ***NOT REQUIRED*** - *an extra one that has a quadratic equation in case you feel like you want to practice this kind. If you complete this and get it right I will give you some tickets* ☺ $2HI \leftrightarrow H_2 + I_2$ If Kp = 50.5 and the initial pressures are HI = 0.975 atm, H_2 = 0.105 atm and I_2 = 0.215 atm, what are the equilibrium pressures for all the substances?