QUIZ 2 CHEMICAL EQUILIBRIA ANSWERS NAME:

Record the answers in the space provided, you MUST show all work clearly for full credit. Quiz is worth 50 pts.

1. 10 PTS For the rusting of iron initially at equilibrium, predict the shift in the reaction with each perturbation.

3 Fe(s) + 4 H2O (g) ⇔ Fe3O4 (s) + 4 H2 (g) + heat

1. Increase the amount of water \_\_\_\_\_\_\_\_**TO PRODUCTS**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Decrease the volume by half \_\_\_\_\_\_\_\_\_**NO SHIFT**\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) Remove Fe3O4 as it is formed \_\_\_\_\_\_\_\_\_**NO SHIFT**\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) Add hydrogen to the mixture \_\_\_\_\_\_\_\_\_**TO REACTANTS**\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e) Increase the temperature \_\_\_\_\_\_\_\_\_**TO REACTANTS**\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. 10 PTS Hydrogen chloride reacts with oxygen to yield chlorine and water. Equilibrium can be established with this reaction. An experiment was performed in a closed vessel starting with a mixture of 0.50 M HCl and 0.050 M O2. The amount of chlorine was monitored until no change was observed, at 0.048 M chlorine.

a) What is Kc for this reaction, and what are the equilibrium concentrations of all relevant components?

4 HCl + O2 ⇔ Cl2 + 2 H2O

**Kc = 25 M-2**

|  |  |  |  |
| --- | --- | --- | --- |
| 4 HCl | O2 | Cl2 | 2 H2O |
| 0.5 | 0.05 | 0 | 0 |
| -4X | -X | X | 2X |
| 0.308 | 0.002 | 0.048 | -.096 |

Where X=0.048,

Kc = [Cl2] [H2O]2 / [HCl]4 [O2]

b) What is Kp for this reaction if the final temperature is 25oC?

Kp = Kc \* (RT)-2

Kp = (25 M-2) \* (0.082 L atm/ mol K \* 298K)-2

**Kp = 0.041 atm-2**

3. 15 PTS At 450oC ammonia gas decomposes into hydrogen and nitrogen gases. An experiment starts by placing 2.25 moles of ammonia in a 3.00 L container and heating it to 450oC. At equilibrium there are 0.522 moles of ammonia. Based on this information determine the final concentration of each gas and the Kc of the reaction.

2.25 MOL NH3 / 3.00L = 0.750 M NH3 initial 0.522 MOL NH3 / 3L = 0.174 M final

2 NH3 ⇔ N2 + 3 H2

|  |  |  |
| --- | --- | --- |
| NH3 | N2 | H2  **N2 = 0.288 M**  **H2 = 0.864 M**  **NH3 = 0.174 M**  **Kc = 6.14** |
| 0.750 | 0 | 0 |
| -2X | X | 3X |
| 0.174 | X | 3X |

4. 15 PTS If 6.0 moles of C2H6(g) reacted with 6.0 moles of Cl2(g) originally in a 3.00 liter container at 10.0° C, what would be the equilibrium concentrations. K for this reaction at 10.0° C is 0.10

C2H6(g) + Cl2(g) ⇔ C2H5Cl(s) + HCl(g)

6 mols / 3L = 2 M

C2H6  + Cl2 ⇔ C2H2Cl + HCl

|  |  |  |  |
| --- | --- | --- | --- |
| C2H6 | Cl2 | C2H2Cl | HCl |
| 2M | 2M | - | 0 |
| -X | -X | - | X |
| 2-X | 2 -X | - | X |

K = [HCl] / [C2H2] [Cl2] = 0.10

**C2H6 \_\_1.71 M\_\_\_\_**

**Cl2 \_\_1.71 M\_\_\_**

**C2H5Cl \_\_\_N/A\_\_\_\_\_**

**HCl \_\_\_0.29 M\_\_\_**

0.40 – 0.40X + 0.1X2 = 0

X = [1.4 + √(1.96 – 0.16) ] / 0.2

X = 0.29