**Unit 12 Review**

*Equilibrium*

*Prep*

1. A chemical system tends towards \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ enthalpy and \_\_\_\_\_\_\_\_\_\_\_ entropy.
2. For each of the following reactions, give the direction of the enthalpy drive and the entropy drive. Predict if the reaction will favor the products (spontaneous reaction), the reactants (non-spontaneous reaction), or result in equilibrium (reversible reaction)
   1. 2N2 (g) + O2 (g) + 4H2O (g) + 237 kJ/mol ⇔ 2NH4NO3 (s)
   2. 4CH3NH2 (g) + 9O2 (g) ⇔ 4CO2 (g) + 10H2O (g) + 2N2 (g) + 2934 kJ/mol
   3. Cl2 (g) + 3F2 (g) ⇔ 2ClF3 (g) + 326.4 kJ/mol
3. Le Châtelier’s principle states. If a system in \_\_\_\_\_\_\_\_\_\_\_\_ is subjected to a change, then processes occur that then to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ that change, and the system reaches a \_\_\_\_\_\_\_\_\_\_\_ state of equilibrium.
4. Explain what would happen to concentration of each substance after each of the following stresses.

2NOBr (g) + 48.4 kJ/mol ⇔ 2NO (g) + Br2 (g)

* 1. Increase [NOBr]

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [NO] | [Br2] |  |

* 1. Increase volume

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [NO] | [Br2] | [NOBr] |

* 1. Decrease temperature

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [NO] | [Br2] | [NOBr] |

* 1. Increase pressure

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [NO] | [Br2] | [NOBr] |

1. Explain what would happen to concentration of each substance, state the color observed, and draw a graph that sketches the concentrations after each of the following stresses.

3O2 (g) + 285.4 kJ/mol ⇔2O3 (g)

* 1. Decrease temperature

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [O2] | [O3] |  |

* 1. Increase [O2]

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [O3] |  |  |

* 1. Increase volume

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [O2] | [O3] |  |

* 1. Increase pressure

|  |  |  |  |
| --- | --- | --- | --- |
| EQ | [O2] | [O3] |  |

1. Write a Keq expression for each of the following equilibria.
   1. CH3OH (l) + NH3 (g) ⇔ CH3NH2 (g) + H2O (l)
   2. 2F2 (g) + 2H2O (l) ⇔ O2 (g) + 4HF (aq)
2. Write a Keq expression for each of the following equilibria. Determine the value of Keq. Does the reaction favor the reactants or the products?
   1. PH3BCl3 (g) ⇔ PH3 (g) + BCl3 (g)

At equilibrium, [PH3BCl3]=0.080 M, [PH3]=0.010 M, and [BCl3]=0.015 M

* 1. 3H2 (g) + N2 (g) + 2CO (g) ⇔2HCONH2 (g)

At equilibrium there are 2.00 mol of H2, 1.40 mol of N2, 1.50 mol of CO, and 3.20 mol of HCONH2 in a 2.00 L container.

1. Consider the following equilibrium

I2 (g) + Br2 (g) ⇔ 2IBr (g) Keq= 120

Write a Keq expression for the equilibrium. At equilibrium [I2]= 0.0250 M and [Br2]=0.0250 M. Determine the equilibrium concentration of IBr