This print-out should have 7 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Mlib 07 1133
001 10.0 points

What would be the expression for K_c for the reaction

$$4\,NH_3(g) + 5\,O_2(g) \rightleftharpoons 4\,NO(g) + 6\,H_2O(g)$$

at equilibrium?

1. $[NH_3]^4\,[O_2]^5$

2. $[NO]^4\,[H_2O]^6$

3. $\dfrac{[NH_3]^4\,[O_2]^5}{[NO]^4\,[H_2O]^6}$

4. $\dfrac{[NO]^4\,[H_2O]^6}{[NH_3]^4\,[O_2]^5}$ **correct**

5. $\dfrac{[NO]^4\,[H_2O]}{[NH_3]^4}$

Explanation:
To write K_c for a balanced chemical reaction, multiply the concentrations of the products divided by the same (multiply the concentrations) for the reactants, each raised to its coefficient in the reaction.

Msci 17 0517
002 10.0 points

A mixture of $PCl_5(g)$ and $Cl_2(g)$ is placed into a closed container. At equilibrium it is found that $[PCl_5] = 0.75$ M, $[Cl_2] = 0.1$ M and $[PCl_3] = 0.09$ M.

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

What is the value of K_c for the reaction?

1. 0.012 **correct**

2. 0.006

3. 3

4. 0.024

5. 0.036

Explanation:
$[PCl_5] = 0.75$ M $[Cl_2] = 0.1$ M
$[PCl_3] = 0.09$ M

$$K_c = \frac{[Cl_2]\,[PCl_3]}{[PCl_5]} = \frac{(0.1\text{ M})(0.09\text{ M})}{0.75\text{ M}} = 0.012\text{ M}$$

Msci 17 0614
003 10.0 points

A 10.0 L vessel contains 0.0015 mole CO_2 and 0.10 mole CO. If a small amount of carbon is added to this vessel and the temperature is raised to 1000°C

$$CO_2(g) + C(s) \rightleftharpoons 2\,CO(g)\,,$$

will more CO form? The value of K_c for this reaction is 1.17 at 1000°C. Assume that the volume of the gas in the vessel is 10.0 L.

1. Yes, the rate of the forward reaction will increase to produce more CO. **correct**

2. No, the rate of the reverse reaction will increase to produce more CO_2.

3. Unable to determine this from the data provided.

Explanation:
$[CO] = \dfrac{0.1\text{ mol}}{10\text{ L}}$ $[CO_2] = \dfrac{0.0015\text{ mol}}{10\text{ L}}$

Carbon, being a solid, has no effect on equilibrium.

$$[Q] = \frac{[CO]^2}{[CO_2]} = \frac{\left(\dfrac{0.1}{10.0}\text{ M}\right)^2}{\left(\dfrac{0.0015}{10.0}\text{ M}\right)} = 0.666667 < K_c = 1.17$$

Therefore equilibrium will shift to the right.

Msci 17 0637
004 10.0 points

The reaction

$$Br_2(g) + 3\,F_2(g) \rightleftharpoons 2\,BrF_3(g)$$

is exothermic in the forward direction. An increase in the partial pressure of BrF_3 in this reaction at equilibrium would be favored by a (higher, lower) total pressure and by a (higher, lower) temperature.

1. higher; lower **correct**

2. higher; higher

3. lower; higher

4. lower; lower

Explanation:

LeChatelier's Principle states that if a change in conditions occurs to a system at equilibrium, the system responds to relieve the stress and reach a new state of equilibrium. There is more gas on the reactant side of the reaction equation, so adding pressure will cause the reaction to move to the right. The reaction is exothermic; it releases heat. Heat is a product of the reaction. Decreasing temperature will cause the reaction to move to the right.

Msci 17 1101

005 10.0 points

Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G^0 = -3.45$ kcal/mol.

1. 339.157 **correct**

2. 3391.57

3. −339.157

4. 678.314

5. 169.578

Explanation:

$T = 25°\text{C} + 273 = 298$ K

$\Delta G^0 = -3450$ cal/mol

At equilibrium

$$\Delta G^0 = -R\,T\,\ln K$$

$$-3450 = (-1.987\text{ cal/mol}\cdot\text{K}) \times (298\text{ K})(\ln K)$$

$$K = 339.157$$

ChemPrin3e T09 56

006 10.0 points

$K_c = 0.100$ at a certain temperature for the reaction

$$PCl_5(g) \to PCl_3(g) + Cl_2(g)\,.$$

At equilibrium, $[PCl_5] = 2.00$ M and $[PCl_3] = [Cl_2] = 1.00$ M. If suddenly 1.00 M $PCl_5(g)$, $PCl_3(g)$, and $Cl_2(g)$ are added, calculate the equilibrium concentration of $PCl_5(g)$.

1. 1.35 M

2. 4.35 M **correct**

3. 0.65 M

4. essentially zero

5. 2.35 M

Explanation:

ChemPrin3e T09 67

007 10.0 points

For the decomposition of ammonia to nitrogen and hydrogen, the equilibrium constant is 1.47×10^{-6} at 298 K. Calculate the temperature at which $K = 0.01$. For this reaction, $\Delta H^\circ = 92.38\text{ kJ}\cdot\text{mol}^{-1}$.

1. 59 K

2. 241 K

3. 390 K **correct**

4. 117 K

5. 332 K

6. 468 K

Explanation:

Use the van't Hoff equation.

ChemPrin3e T09 71

008 10.0 points

Which of the following equilibrium reactions is NOT affected by changes in pressure?

1. $2\,CO_2(g) \rightarrow 2\,CO(g) + O_2(g)$

2. $H_2(g) + Br_2(\ell) \rightarrow 2\,HBr(g)$

3. $2\,BrCl(g) \rightarrow Br_2(g) + Cl_2(g)$ **correct**

4. $H_2(g) + I_2(s) \rightarrow 2\,HI(g)$

5. $2\,H_2O_2(\ell) \rightarrow 2\,H_2O(\ell) + O_2(g)$

Explanation: