

Be sure to show all work, use the correct number of significant figures, circle final answers and use correct units in all problems.

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1. For the reaction:  $\text{CH}_{4(g)} + 2 \text{O}_{2(g)} \rightleftharpoons \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(g)}$ ,  $K_c = 1.15 \cdot 10^7$  (430. K), held within a 2.00 L flask (10 points)

Write the equilibrium constant expression for  $K_c$ .

Is the reaction at equilibrium if  $[\text{CO}_2] = [\text{H}_2\text{O}] = 0.0350 \text{ M}$ ,  $[\text{O}_2] = 3.31 \cdot 10^{-6} \text{ M}$  and  $[\text{CH}_4] = 3.31 \cdot 10^{-6} \text{ M}$ ? If not, indicate the direction that the reaction must proceed to achieve equilibrium.

What is the value of the equilibrium constant if the reaction is  $2 \text{CH}_{4(g)} + 4 \text{O}_{2(g)} \rightleftharpoons 2 \text{CO}_{2(g)} + 4 \text{H}_2\text{O}_{(g)}$  at 430. K?

What is the value of  $K_c$  at 430. K for the reaction:  $\text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(g)} \rightleftharpoons \text{CH}_{4(g)} + 2 \text{O}_{2(g)}$

2. For the reaction:  $\text{Cl}_{2(g)} + \text{Br}_{2(g)} \rightleftharpoons 2 \text{ClBr}_{(g)}$ ,  $K_c = 10.3$  (150 °C) (4 points)

Is this reaction product-favored or reactant-favored?

If 0.500 mol ClBr in a 1.00 L flask is allowed to reach equilibrium, what are the equilibrium concentrations of  $\text{Cl}_2$ ,  $\text{Br}_2$  and ClBr?

3. For the reaction:  $\text{RX}_{(s)} \rightleftharpoons \text{R}_{(g)} + \text{X}_{(g)}$ ,  $K_c = 1.11 \cdot 10^{-7}$  (200. K) (6 points)

Write the equilibrium constant expression.

Calculate the equilibrium concentrations of R and X if a solid sample of RX is placed in a closed vessel and decomposes until equilibrium is established.

What is the value of  $K_p$  at 200. K?