You know that there is no term for C(s) in this expression because _____.

The concentration of hydrogen gas is squared because _____.

You already have the values of the equilibrium constant and the hydrogen gas concentration. From this information, make use of the equilibrium expression to determine the unknown concentration.

Work a Solution

Since you are solving for the methane concentration, rearrange the equilibrium expression so that methane is isolated on the left side of the equation.

$$[CH_4] = K_{eq} \times \_\_\_\_\_$$

▶ Substitute the numbers given above and **use your calculator** to determine the value of $[CH_4]$.

$$[CH_4] = (8.1 \times 10^{8}) \times (1.00 \times 10^{-5})^2 = \_\_\_\_\_ M$$

Verify Your Answer

▶ **Verify your answer** by working the problem backward. Plug each concentration into the equilibrium expression. Does this value of K match the one given for the reaction?

$$K = \frac{[CH_4]}{[H_2]^2} = \frac{[\_\_\_\_\_]}{[\_\_\_\_\_]^2} = \_\_\_\_\_$$

For more practice with equilibrium problems, see Example Problems 18-1, 18-2, and 18-3 in your text.

Problems

For each of the following problems, write your solutions on a separate sheet of paper to be turned in with this worksheet. Write your answers in the spaces provided.

1. The value of the equilibrium constant for the reaction, $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$, is 8.2×10^{-2} at 627°C. If the equilibrium concentrations of CO and Cl_2 are each 0.50*M*, what is the equilibrium concentration of $COCl_2$?_____

2. The value of the equilibrium constant for the reaction, $CaSO_4(s) \rightleftharpoons Ca^{2+}(aq) + SO_4^{2-}(aq)$, is 2.4×10^{-5}. If the equilibrium concentration of the sulfate ion is 0.025*M*, what is the equilibrium concentration of the calcium ion? _____

Critical Thinking

Use the reaction, $2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$, to answer these questions on your solution sheets. The equilibrium constant is 1.0×10^{-14}.

3. A solution is said to be acidic if $[H_3O^+] > [OH^-]$ and is said to be basic if $[H_3O^+] < [OH^-]$. Calculate the concentration of H_3O^+ in a solution in which (A) the concentration of OH^- is 2.5×10^{-1}M and (B) the concentration of OH^- is 2.5×10^{-4}M. Are these solutions acidic or basic?

4. Using LeChâtelier's principle, explain why the H_3O^+ concentration in the last question was greater for Solution B than for Solution A.