Consider the following reaction.

\[ H_2(g) + N_2(g) + 2 \text{O}_2(g) \rightleftharpoons 2 \text{HNO}_2(g) \]

Answer the following questions based on the above chemical reaction.

1. Write an algebraic expression for the equilibrium constant, K.

\[ K = \frac{[\text{HNO}_2]^2}{[\text{H}_2][\text{N}_2][\text{O}_2]^2} \]

2. The \( \Delta G_f^\circ \) for \( \text{HNO}_2 \) is -46.0 kJ/mol at 25°C. Calculate K for the above reaction at 25°C.

\[
\Delta G_f^\circ \text{reaction} = \sum_{\text{prod}} \Delta G_f^\circ - \sum_{\text{reac}} \Delta G_f^\circ = (2\text{mol}) (-46.0 \text{kJ/mol})
\]

\[ \Delta G_f^\circ \text{reac} = -92.0 \text{ kJ} \]

\[ \Delta G_f^\circ = -RT \ln K \]

\[ \ln K = -\frac{-92.0 \text{ kJ}}{(8.31 \frac{\text{J}}{\text{mol} \cdot \text{K}})(298 \text{K})(\frac{1.00 \text{J}}{1000 \text{kJ}})} = 37.15 \]

\[ K = 1.36 \times 10^{16} \]

3. Based on your answer to part 2, what is K for the reaction in which 1 mole of \( \text{HNO}_2 \) is produced?

\[ K_{\text{new}} = K^{1/2} = \sqrt{1.36 \times 10^{16}} = 1.17 \times 10^8 \]