

Evaluating Statement Correctness Analysis

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Response: Let's analyze each statement to evaluate its correctness:

- **Statement (1):** In a closed-rigid container (constant volume), adding an inert gas increases the total number of moles of gas, thereby increasing the total pressure. Since temperature remains constant, the equilibrium constant (K) remains unchanged. **(Correct)**
- **Statement (2):** The equilibrium constant K is dependent only on temperature for a given system. Since the temperature is kept constant, K remains unchanged when an inert gas is added, regardless of volume changes. **(Correct)**
- **Statement (3):** For the system $2\text{HgO}(s) \rightleftharpoons 2\text{Hg}(l) + \text{O}_2(g)$, the gaseous product is on the right side ($\Delta n_g = +1$). According to Le Chatelier's principle, increasing the pressure shifts the equilibrium in the direction with fewer moles of gas—which is to the **left** (backward reaction), not the right. **(Incorrect)**
- **Statement (4):** For $2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$, decreasing the volume increases the overall pressure, shifting the equilibrium toward the side with fewer gas moles (the right side, forming more SO_3). **(Correct)**
- **Statement (5):** Increasing total pressure by reducing volume increases the partial pressure (and concentration) of the gaseous reactant, $\text{H}_2(g)$. Since $R_{\text{forward}} = k_f [\text{H}_2]^n$, an increase in reactant concentration increases the rate of the forward reaction. **(Correct)**

The incorrect statement is **(3)**.
