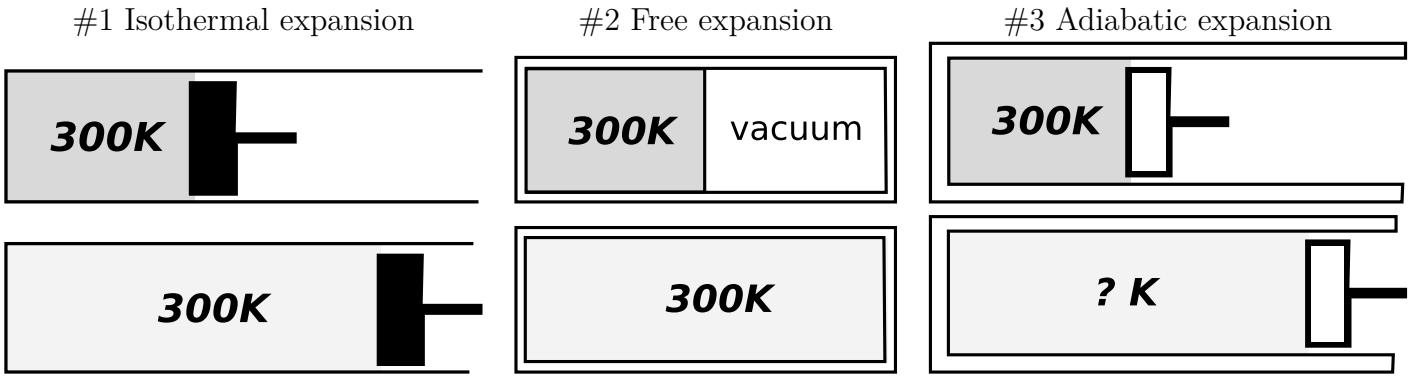
Consider the three processes described below.

Process #1 Five moles of an ideal gas are initially confined in a one-liter cylinder with a movable piston, at a temperature of 300 K. Slowly the gas expands against the movable piston, while the cylinder is in contact with a thermal reservoir at 300 K. The temperature of the gas remains constant at 300 K while the volume increases to two liters.

Process #2 A thin plastic sheet divides an insulated two-liter container in half. Five moles of the same ideal gas are confined to one half of the container, at a temperature of 300 K. The other half of the container is a vacuum. The plastic divider is suddenly removed and the gas expands to fill the container. No work is done on or by the gas. The final temperature of the gas is also 300 K.

Process #3 The same cylinder as in process #1 is thermally insulated and then allowed to slowly expand, starting at 300 K, to twice its original size (two liters).



1. Consider the change in the entropy of the gas for process 1, 2 and 3. We'll call these changes ΔS_1, ΔS_2 and ΔS_3. Are these changes positive, negative, or zero? Please explain your reasoning.

2. Is ΔS_1 greater than, less than, or equal to ΔS_2? How do each of these compare with ΔS_3? Please explain.

3. Consider the change in entropy of the surroundings for process 1, 2 and 3. We'll call these changes $\Delta S_{\text{surr-1}}$, $\Delta S_{\text{surr-2}}$ and $\Delta S_{\text{surr-3}}$. Are these changes positive, negative, or zero? Please explain.