

Solutions

2.1 A $1 - 300/400 = 0.25$.

Compare the rejected options: 0.75; 1.33. Use the stated model and conditions.

2.2 B The negative exponential decreases with energy.

Compare the rejected options: greater; always identical. Use the stated model and conditions.

2.3 60. $\Delta U = Q - W = 100 - 40$.

2.4 False. That violates the second law.

3.1 Free expansion has $Q = 0$ by insulation and $W = 0$ because external pressure is zero. Thus $\Delta U = 0$ and ideal-gas temperature is unchanged. Entropy is a state function: $\Delta S = nR \ln 2 > 0$, evaluated on an imagined reversible isothermal path. The actual process is irreversible; $Q_{\text{actual}}/T = 0$ is not its entropy change. Reversible expansion has $Q = W = nRT \ln 2$ and the same gas entropy increase, with a matching reservoir entropy decrease. Award the four quantities and comparison.