

19.11. Model: Process A is isochoric, process B is isothermal, process C is adiabatic, and process D is isobaric.

Visualize: Please refer to Figure Ex19.11.

Solve: Process A is isochoric, so the increase in pressure increases the temperature and hence the thermal energy. Because $\Delta E_{\text{th}} = Q - W_s$ and $W_s = 0$ J, Q increases for process A. Process B is isothermal, so T is constant and hence $\Delta E_{\text{th}} = 0$ J. The work done W_s is positive because the gas expands. Because $Q = W_s + \Delta E_{\text{th}}$, Q is positive for process B. Process C is adiabatic, so $Q = 0$ J. W_s is positive because of the increase in volume. Since $Q = 0$ J = $W_s + \Delta E_{\text{th}}$, ΔE_{th} is negative for process C. Process D is isobaric, so the decrease in volume leads to a decrease in temperature and hence a decrease in the thermal energy. Due to the decrease in volume, W_s is negative. Because $Q = W_s + \Delta E_{\text{th}}$, Q also decreases for process D.

	ΔE_{th}	W_s	Q
A	+	0	+
B	0	+	+
C	-	+	0
D	-	-	-