Entropy and work

(a) Isothermal expansion of an ideal gas:

$$W = \int_{V_i}^{V_f} p\, dV = \int_{V_i}^{V_f} \frac{NRT}{V}\, dV = NRT \ln\left(\frac{V_f}{V_i}\right).$$

In our case $W = (4.00\text{ mol})(8.31\text{ J/mol·K})(400\text{ K})\ln(2.00) = 9\,220\text{ J}$.

(b) For an ideal gas, E_{int} is a function of temperature alone and thus doesn't change in an isothermal process. Thus $Q = W$ and $\Delta S = Q/T = 23.0\text{ J/K}$.

(c) For any reversible adiabatic change, $\Delta S = 0$.