Problem 7.

Same principle as problem 6, we have a cyclic process, i.e., $\Delta E = 0$ and $R = -Q$. The two isochoric processes do no work, but the two isothermal processes contribute according to $R = -\int P\,dV$ where $P = \frac{NT}{V}$. Adding the work done from those

$$R = -NT_2 \log \frac{V_2}{V_1} + NT_1 \log \frac{V_3}{V_1}$$

$$= N(T_2 - T_1) \log \frac{V_1}{V_2}$$

The heat is $Q = -R = N(T_2 - T_1) \log \frac{V_2}{V_1}$