(b)

Process A:

$pV = C = p_1V_1 = (10\times10^5\ Pa)(0.1\ m^3) = 1\times10^5\ Pa\cdot m^3$

$p = \frac{C}{V}$

$W_A = \int_1^2 P\,dV = \int_{V_1}^{V_2} \frac{C}{V}\,dV = C\ln\frac{V_2}{V_1} = (1\times10^5\ Pa\cdot m^3)\ln\left(\frac{1.0\ m^3}{0.1\ m^3}\right)$

$\approx 2.302\times10^5\ J = 230.2\ kJ$

$W_A = 230\ kJ$

process B:

$1 \to 3$ isovolumetric so no work

$3 \to 2$ $P(V) = qV + \beta$ ... ①

$q = \frac{(2\times10^5 - 1\times10^5)\ Pa}{(0.1 - 1.0)\ m^3} \approx -1.11\times10^5\ \frac{Pa}{m^3}$

plug in P_2, V_2 into ①

$\beta = 1\times10^5 + \left(1.11\times10^5\ \frac{Pa}{m^3}\right)(1.0\ m^3) = 2.11\times10^5\ Pa$

$P(V) = qV + \beta$

$W_B = \int_3^2 P(V)\,dV = \int_{V_1}^{V_2} (qV+\beta)\,dV = \frac{q}{2}(V_2^2 - V_1^2) + \beta(V_2 - V_1)$

$= \frac{1}{2}\left(-1.11\times10^5\ \frac{Pa}{m^3}\right)(1.0^2 - 0.1^2)(m^6) + (2.11\times10^5\ Pa)(1.0 - 0.1)(m^3)$

$= 134955\ J = 134.955\ kJ$

$W_B = 135\ kJ$

(c)

$Q_A = \Delta U + W_A = (U_2 - U_1) + W_A$

$= (200\ kJ - 400\ kJ) + 230\ kJ$

$= -30.0\ kJ$

$Q_B = \Delta U + W_B = (U_2 - U_1) + W_B$

$= -200\ kJ + 135\ kJ$

$= -65.0\ kJ$

$Q_A = -30.0\ kJ$

$Q_B = -65.0\ kJ$