

$$dU = \underbrace{-pdV}_{dW_v} + dQ + dW_{diss}$$

$$U_2 - U_1 = \underbrace{W_{v12}}_{-\int_1^2 pdV} + Q_{12} + W_{diss12}$$

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$$W_{v12} = -\int_{V_1}^{V_2} pdV$$

$$W_v^A = -120 \text{ J}$$

$$W_v^C = -30 \text{ J}$$

$$W_v^D = -75 \text{ J}$$

$$Q_0 = 100 \text{ J}$$

$$U_2 - U_1 = W_v^D + Q^D + \underbrace{W_{diss}^D}_{\rightarrow 0} = 25 \text{ J}$$

$$U_2 - U_1 = W_v^A + Q^A + \overset{\rightarrow 0}{W_{diss}^A}$$

$$Q^A = U_2 - U_1 - W_v^A = 145 \text{ J}$$