

a) $Q_{AB} = +3000 \text{ J}$
 $Q_{CD} = -2000 \text{ J}$

Q_{BC} and $Q_{DA} = 0$ (adiabatic)

$$Q_{\text{net}} = Q_{AB} + Q_{BC} + Q_{CD} + Q_{DA}$$
$$= (+3000 \text{ J}) + 0 + (-2000 \text{ J}) + 0$$

$$Q_{\text{net}} = 1000 \text{ J}$$

b) $\Delta U = 0 \text{ J}$ (for a cycle)

$$Q_{\text{net}} = +1000 \text{ J}$$

$$\Delta U = W + Q$$

$$0 = W_{\text{net}} + (1000 \text{ J})$$

$$W_{\text{net}} = -1000 \text{ J}$$