The Carnot Cycle

Carnot engine – The most efficient heat engine possible.

Step 1: Isothermal expansion

$\Delta T = \emptyset$ $\Delta U = \emptyset$ $\boxed{Q = W}$

$\Delta U = Q - U = \emptyset$

Energy is added but $\Delta T = \emptyset$ so all energy is work on the gas.

Step 2: Adiabatic expansion

System expands without heat exchange

$Q = \emptyset$ $\boxed{\Delta U = -W}$ Work done by the system

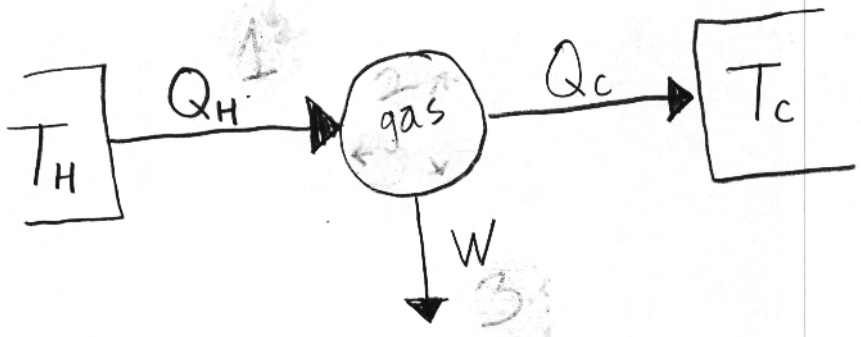
Step 3: Isothermal compression

Work is done on the gas and heat is removed. $\Delta U = \emptyset$

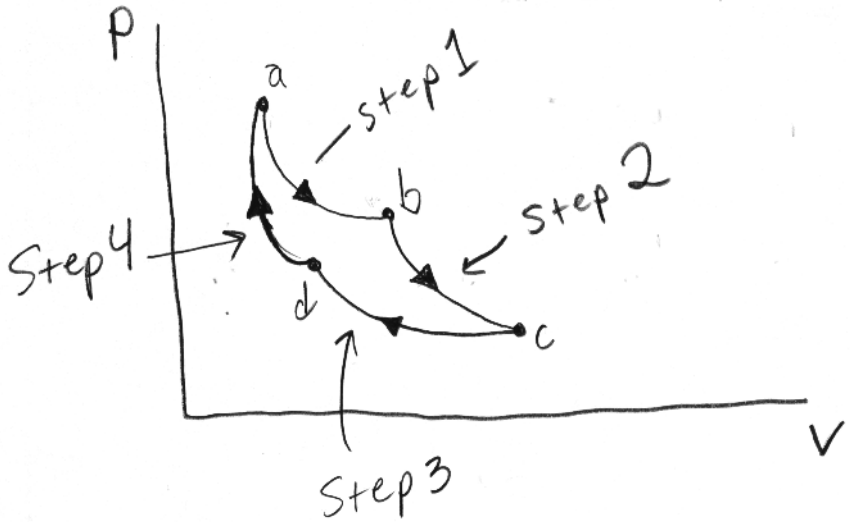
Step 4: Adiabatic compression

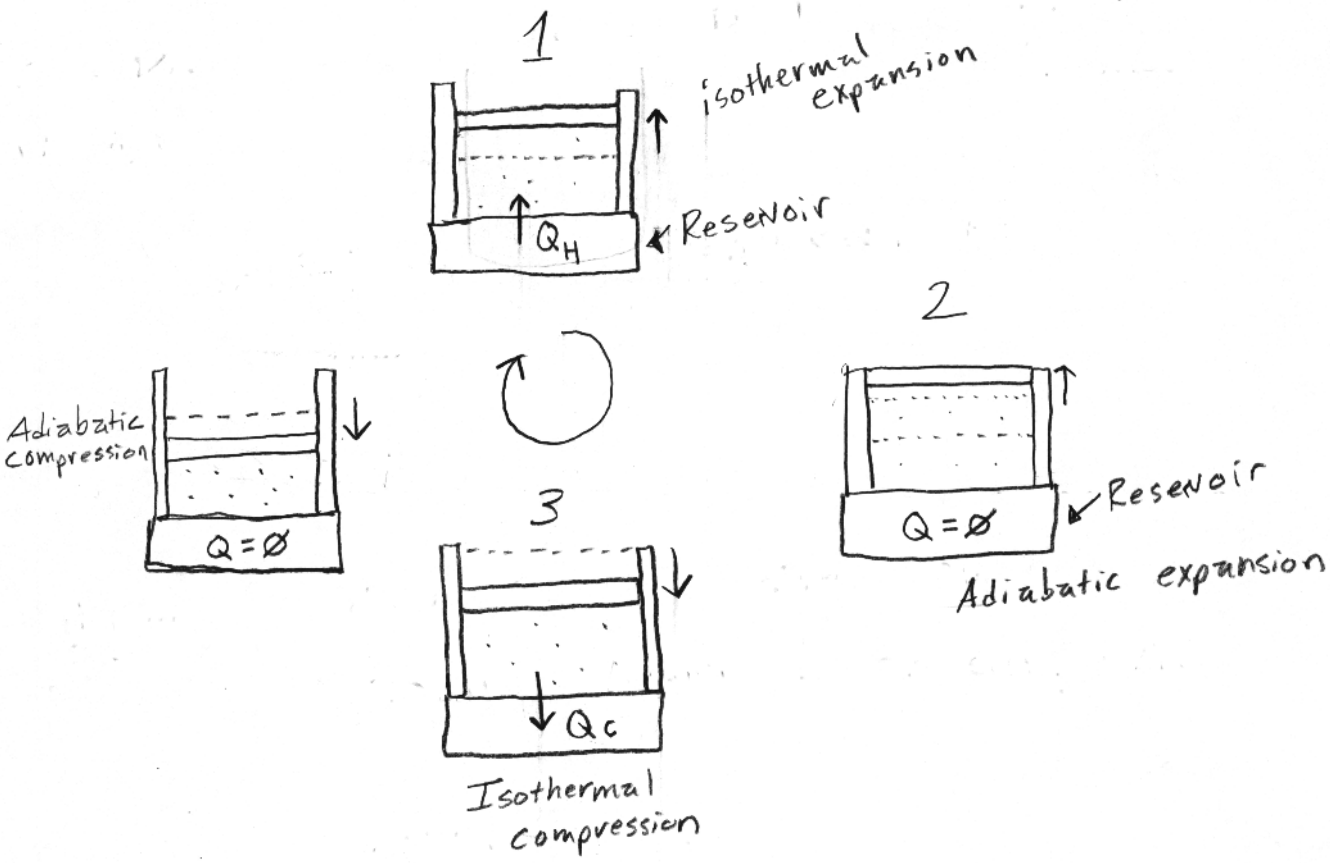
System compresses without heat exchange

$Q = \emptyset$ $\Delta U = -W$ Temperature increases



Carnot cycle





Efficiency of Carnot cycle

$$e_c = \frac{T_H - T_C}{T_H} = 1 - \frac{T_C}{T_H}$$

$T_C \neq 0$

Thermodynamic Processes

Isovolumetric / isochoric

- No work done
- $\Delta V = \emptyset$ so... $P\Delta V = \emptyset$ $W = \emptyset$

$$\boxed{\Delta U = Q}$$

Isothermal

- No change in Temperature or internal energy

$\Delta T = \emptyset$

$\Delta U = \emptyset$

$$\boxed{Q = -W}$$

Adiabatic

No energy transfer $Q = \emptyset$

$$\boxed{\Delta U = W}$$

Closed System

$Q = \emptyset$ $\Delta U = \emptyset$ $W = \emptyset$

$\Sigma Q = \emptyset$ $U_0 = U_f$ No change in system's internal energy