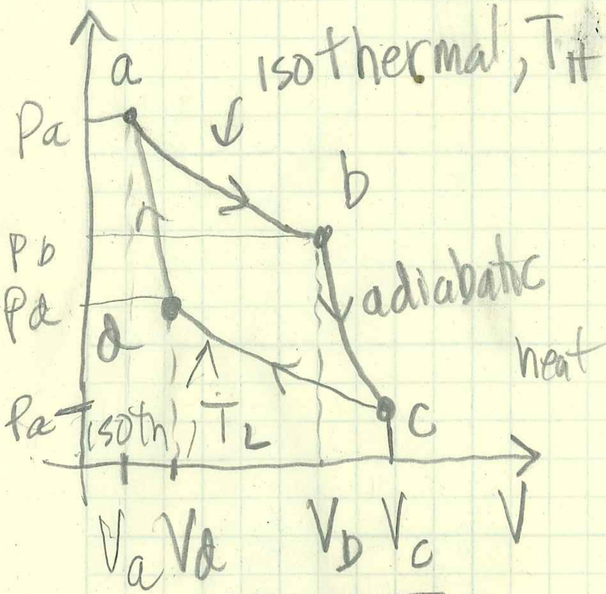
Carnot Cycle

$T_H = 520^\circ C = 793\,K$ $p_a = 1\,atm$

$T_L = 100^\circ C = 373\,K$ $V_a = .01\,m^3$

$V_b = .02\,m^3$



$n_{Dof} = 3$

Leg	Q	W
$a \to b$ heat intake	$Q = -W = nRT_H \ln\left(\frac{V_b}{V_a}\right)$ 702 J	$W = -\int \frac{nRT_H}{V}dV = -nRT_H \ln(V_b/V_a)$ $= -702$ J
$b \to c$	0	$W = \frac{1}{\gamma-1}(p_cV_c - p_bV_b) = \frac{-nR}{\gamma-1}(T_H - T_L)$ $= -805$ J
$c \to d$ heat exhaust	$Q = -W = nRT_L \ln\left(\frac{V_d}{V_c}\right)$ -330 J	$W = -nRT_L \ln(V_d/V_c)$ $= +330$ J
$d \to a$	0	$W = \frac{1}{\gamma-1}(p_aV_a - p_dV_d) = \frac{nR}{\gamma-1}(T_H - T_L)$ $= +805$ J
Total	$nR(T_H - T_L)\ln(V_b/V_a)$ $= 371.9$ J	$-nR(T_H - T_L)\ln(V_b/V_a)$ $= -371.9$ J
Q_{intake}	$nRT_H \ln(V_b/V_a)$ $= 702$ J	

but: $\frac{V_b}{V_a} = \frac{V_c}{V_d}$

proof:

$p_bV_b^\gamma = p_cV_c^\gamma$

$(p_bV_b)V_b^{\gamma-1} = (p_cV_c)V_c^{\gamma-1}$

$T_H V_b^{\gamma-1} = T_L V_c^{\gamma-1}$

also

$T_H V_a^{\gamma-1} = T_L V_d^{\gamma-1}$

take ratio

$\frac{V_b}{V_a} = \frac{V_c}{V_d}$

$$\varepsilon_c = \frac{-W}{Q_{intake}} = \frac{+371.9}{702\,J} = 52.9\% = 1 - \frac{T_L}{T_H}$$