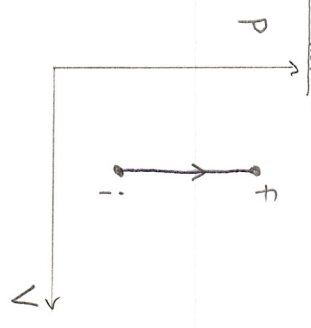


TYPES OF PROCESSES

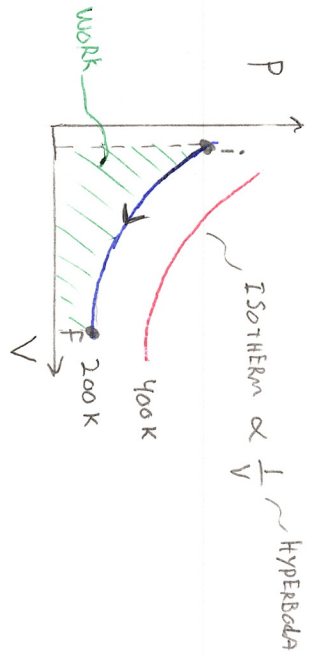
1) ISOCHEMIC - CONSTANT VOLUME



- $V_i = V_f$ thus $\frac{P}{T} = \text{constant}$
- AREA = 0 thus NO WORK ($W=0$)
- with $\Delta E_{th} = Q + W$
- $\Delta E_{th} = Q$

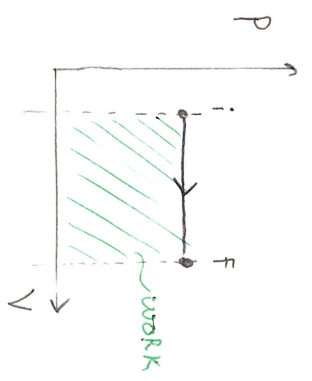
IDEAL GAS CYCLES

3) ISOTHERMAL - CONSTANT TEMPERATURE



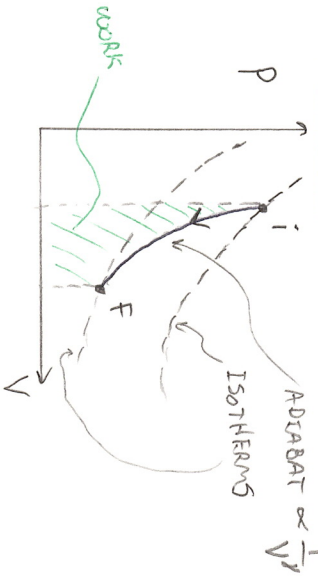
- $T_i = T_f$ thus $PV = \text{constant}$
- $W = -Nk_B T \ln\left(\frac{V_f}{V_i}\right)$
- with $\Delta E_{th} = Q + W$
- $Q = -W$

2) ISOBARIC - CONSTANT PRESSURE



- $P_i = P_f$ thus $\frac{Nk_B T}{V} = \text{constant}$
- $W = -P \Delta V$
- $\Delta E_{th} = Q + W$

4) ADIABATIC - NO HEAT TRANSFER



- SPEEDIER THAN ISOTHERMS $\rightarrow PV^\gamma = \text{constant}$
- $\gamma = \frac{5}{3}$ FOR MONOATOMIC GAS
- with $\Delta E_{th} = Q + W$
- $\Delta E_{th} = W$

PROCESSES SUMMARY

MONOTONIC	ISOCHEMIC	ISOBARIC	ISOTHERMAL	ADIABATIC
ΔE_{th}	$\frac{3}{2} Nk_B \Delta T$	$\frac{3}{2} Nk_B \Delta T$	0	$\frac{3}{2} Nk_B \Delta T$
Q	$\frac{3}{2} Nk_B \Delta T$	$\frac{3}{2} Nk_B \Delta T + P \Delta V$	$Nk_B T \ln\left(\frac{V_f}{V_i}\right)$	0
W	0	$-P \Delta V$	$-Nk_B T \ln\left(\frac{V_f}{V_i}\right)$	$\frac{3}{2} Nk_B \Delta T$

THERMO CYCLE EFFICIENCY

$$\epsilon = \frac{Q_{out}}{Q_{in}} = \frac{|-W|}{|Q_{in}|}$$

← Sum only + HEAT

← Sum both + AND - WORK

RECALL: STATE OF THERMODYNAMIC SYSTEM IS

CHARACTERIZED BY A SET OF MACROSCOPIC VARIABLES (STATE VARIABLES) SUCH AS:

$$P, V, T, N$$

THUS THE STATE OF A SYSTEM IN EQUILIBRIUM IS REPRESENTED BY A POINT ON A P-V DIAGRAM.

• A THERMODYNAMIC SYSTEM CAN CHANGE ITS STATE (INITIAL \rightarrow FINAL) THROUGH A PROCESS WHICH IS REPRESENTED BY A CURVE/PATH IN A P-V DIAGRAM.

• STATES CAN ONLY BE SPECIFIED IF THE SYSTEM IS IN EQUILIBRIUM

• QUASISTATIC PROCESSES - EACH INSTANT IN A PROCESS IS VERY CLOSE TO EQUILIBRIUM (i.e. "Slow")