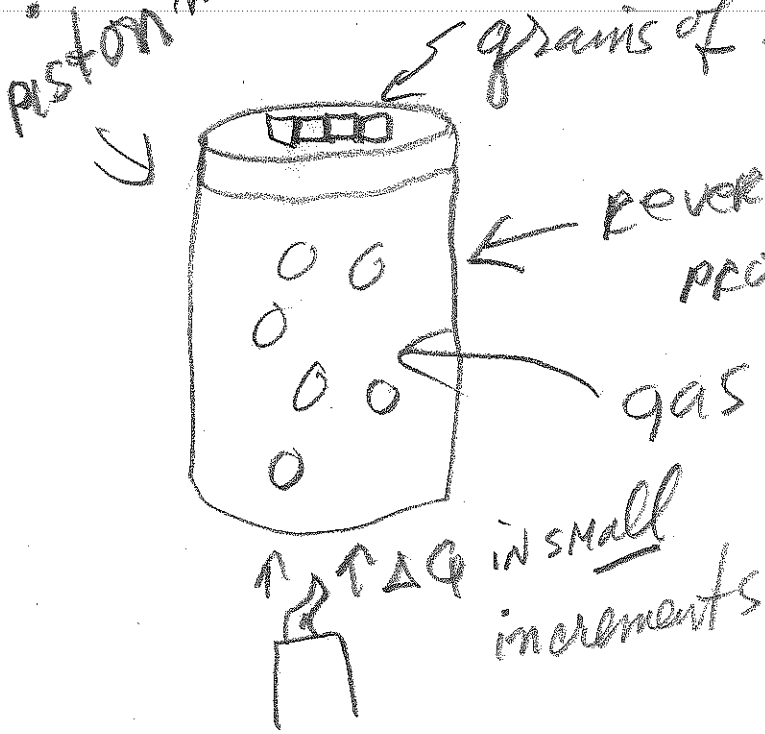
PZA 12-4-13

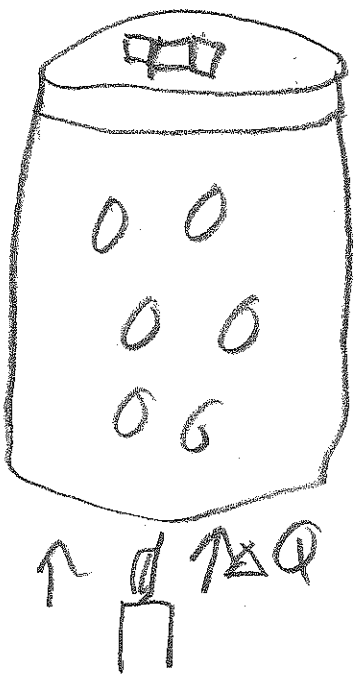
- CH16
- Lab 2 (I and S.H.M) ← spring lab ← RETURNED
  ← rotation lab

CH16 Thermodynamics and 2nd Laws = Thermo

Reversible PROCESS:
slow; no friction, no TURBULENCE.



Lift one grain of sand and ADD a little increment of heat ΔQ



ADD grain Back.

small compression
reversible step.

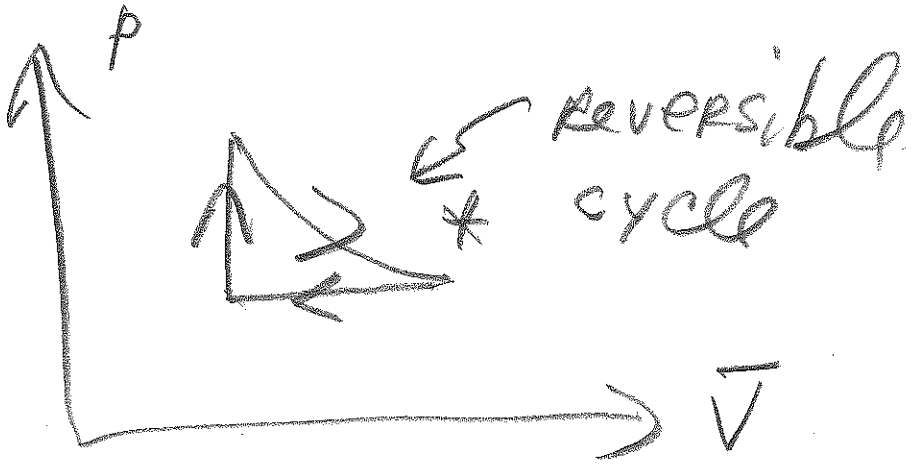
return to the SAME initial state
(initial volume, temperature, and pressure)
along SAME path.

ΔQ (small)

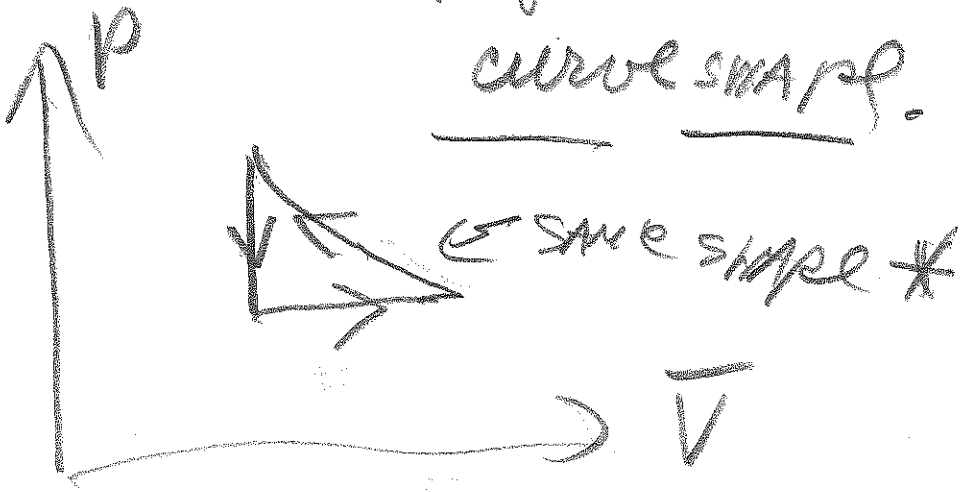
ice

any mathematical curve is reversible

i.e. see problem 9.



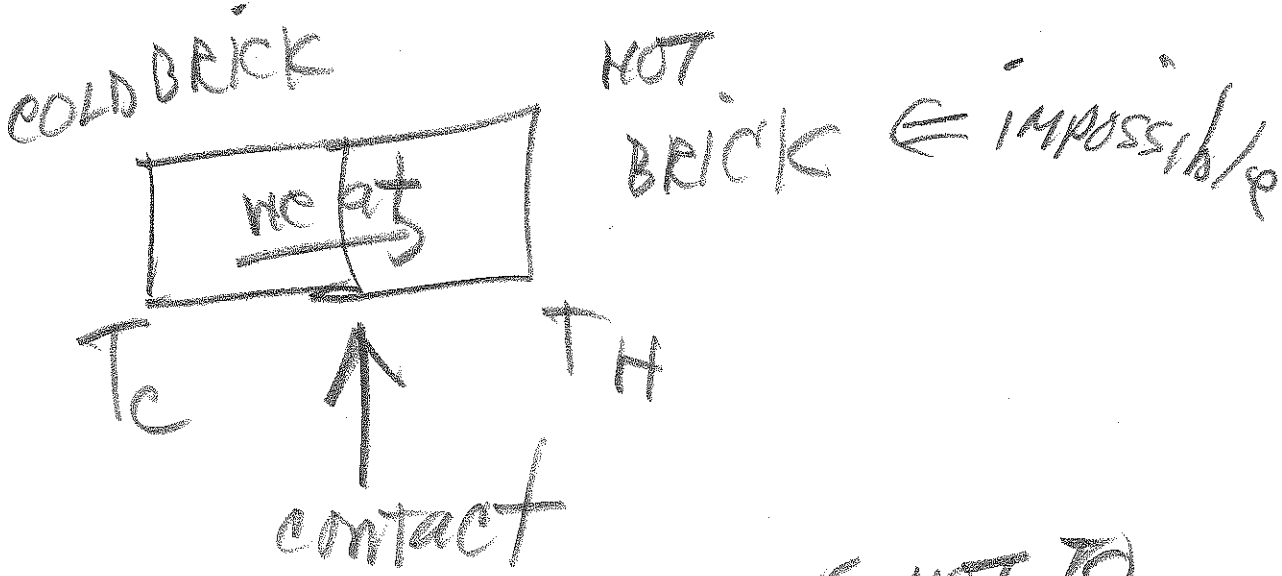
I can reverse direction and get same curve shape.



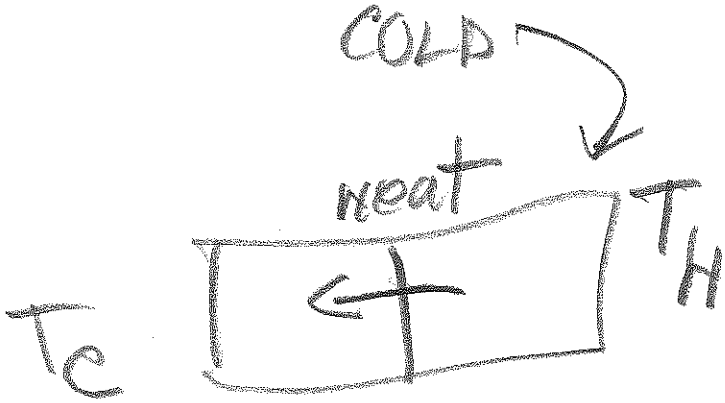
2ND LAW heat never

flows from cold

to HOT.

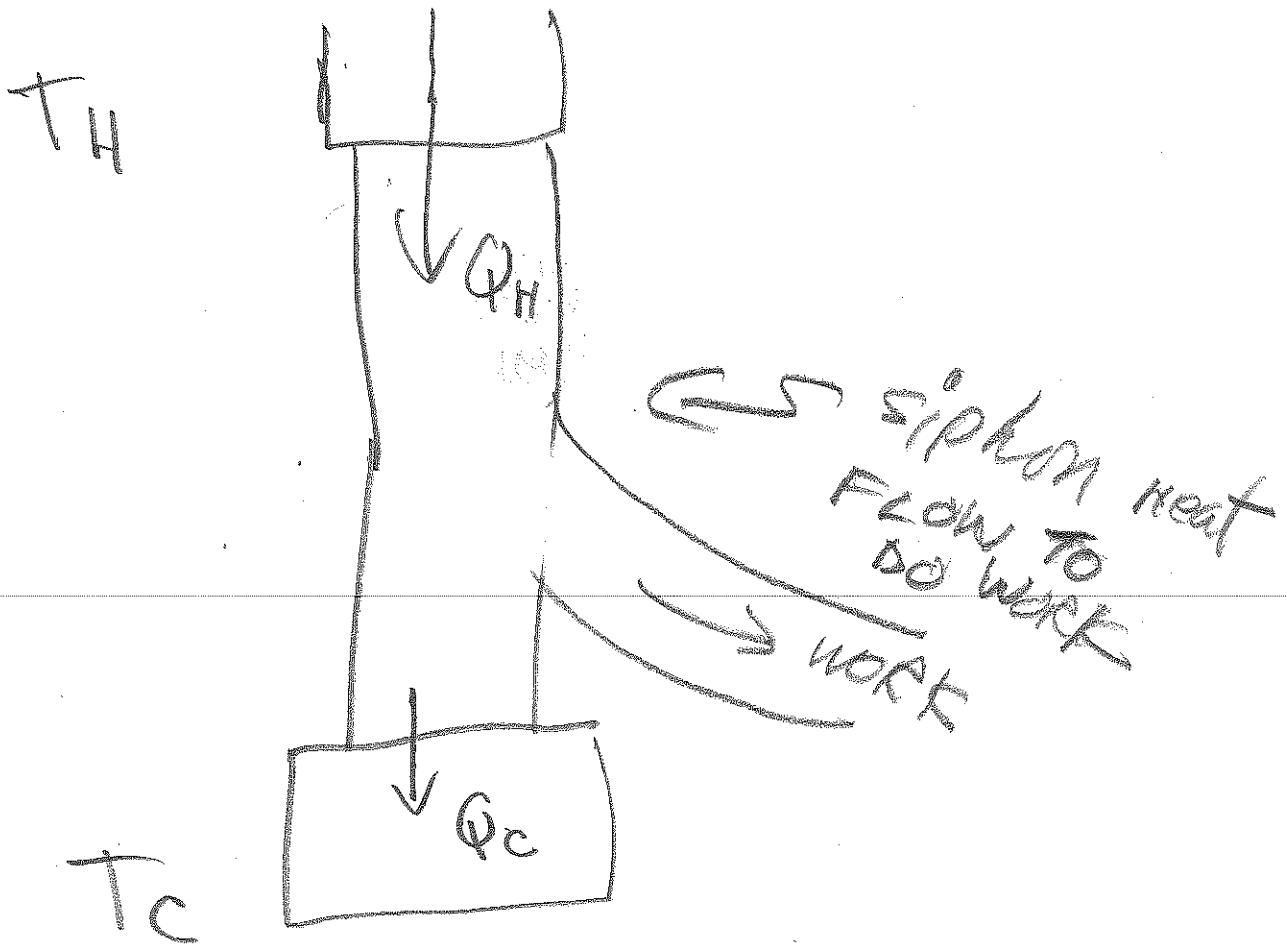


HEAT ALWAYS FLOWS HOT TO



P2A 12-CO-13

Engines use 2ND Law to create WORK: Eq. 16.1



Efficiency: $\varepsilon = \dfrac{W}{Q_H}$ (CAR engine $\varepsilon < 50\%$)

use $Q_H = -|Q_H|$ $= 1 - \dfrac{|Q_C|}{|Q_H|}$; $Q_H > 0$, $Q_C < 0$

steam engine; Reciprocating
otto cycle
carnot cycle.

CH 16 SUMMARY

PS 33 to End:

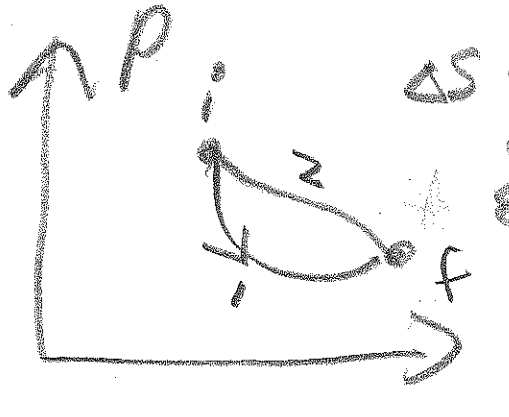
ALL NATURAL PROCESSES ARE IRREVERSIBLE due to friction, TURBULENCE, HEAT LOSS ETC.

S is a "state" VARIABLE like U = internal energy used in $\Delta Q = \Delta U + W$ (1ST LAW CH 15)

Thus: ΔS is path independent

ΔS = SAME OVER EACH PATH

$\Delta S_{path1} = \Delta S_{path2} = S_f - S_i$



THUS: we can compute ΔS for real natural irreversible paths using a reversible path.

irreversible path: can't use.

use this in calculations

$$\Delta S_{\text{Rev. Path}} = \Delta S_{\text{irrev. Path}}$$