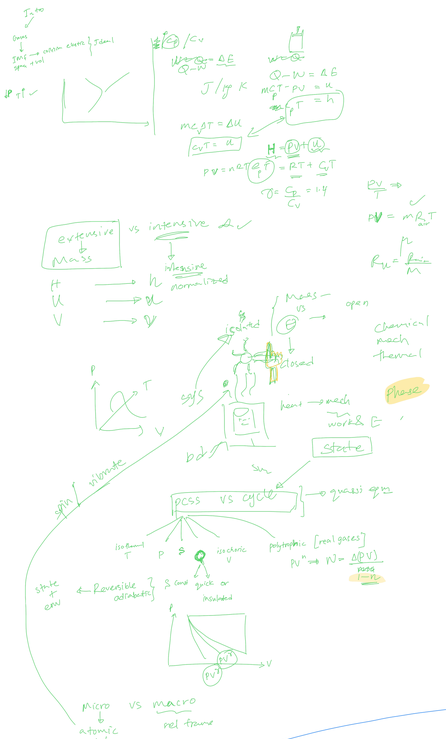

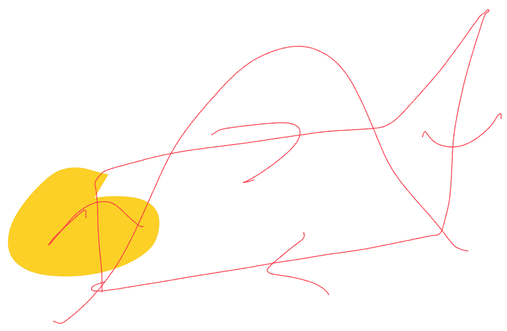

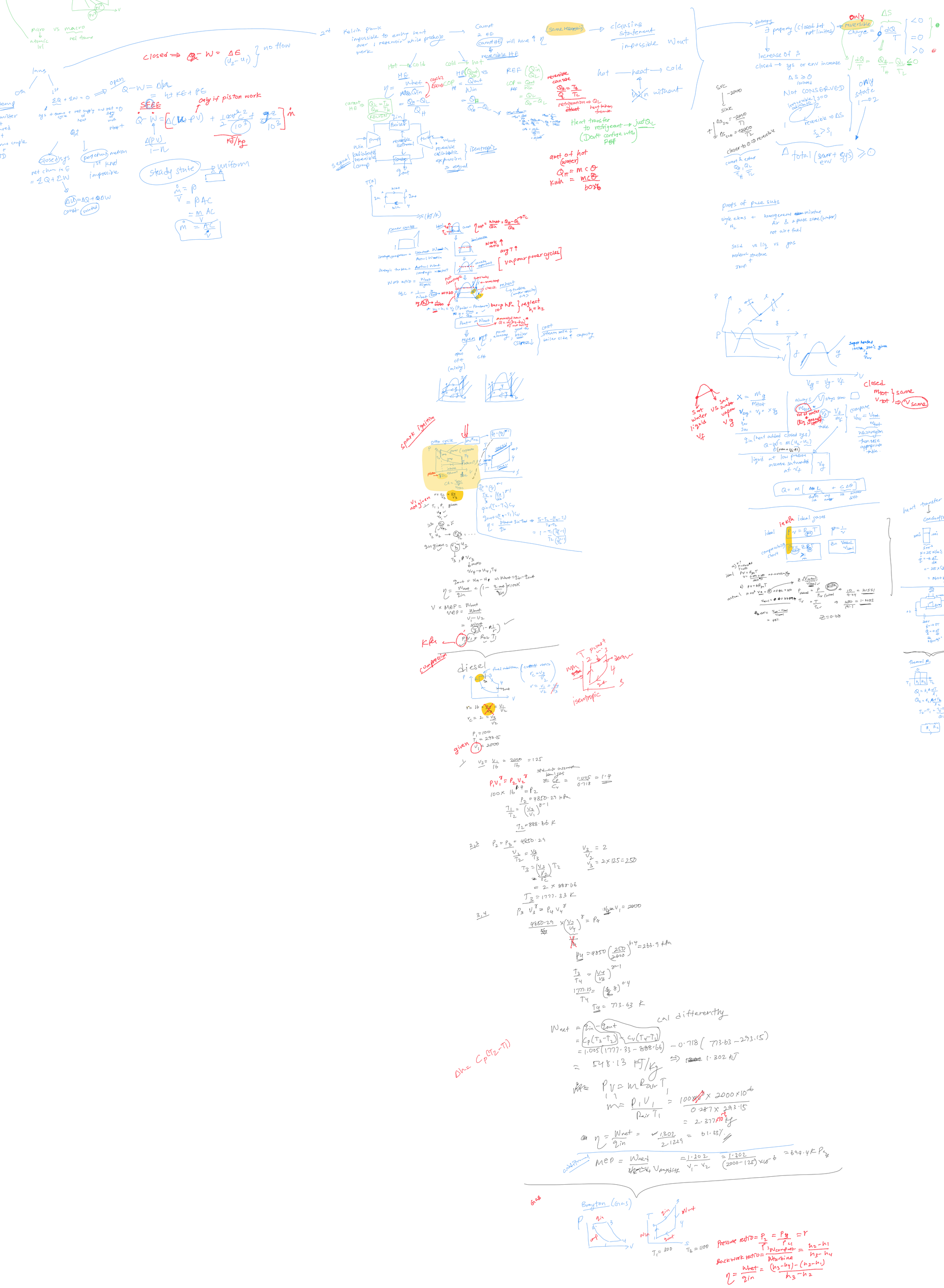
closed ⇒ Q − W = ΔE
no flow
2nd
Kelvin Planck
impossible to entirely heat over 1 reservoir while producing work
Carnot
2 HE
Carnot HE will have η
reversible HE
same reservoir
clausius statement
impossible Wout
hot → cold
cold → hot
HE
Wnet
cyclic
ΔU=0
cannot HE
KELVIN
Rankine
pump
boiler
turbine
condenser
isentropic
REF
COP
reversible carnot
refrigeration
heat pump
hot → heat → cold
without
Heat transfer to refrigerant → just QL
(Don't confuse with REF)
amt of hot (water)
Entropy
∃ property (closed but not limited)
only reversible
Change = ∮ dQ/T
ΔS
< 0
= 0
> 0
increase of S
closed → sys or env increase
ΔS ≥ 0 isolated
Not CONSERVED
reversible ⇒ ΔS
only state
S2 > S1
Δ total (sys + env) ≥ 0
src
sink
closer to 0 ⇒ reversible
carnot & extra
Open
Steady state
uniform
Ṁ = ρ
V̇ = ρAC
Ṁ = AC/v
temp
thermister
infrared
thermocouple
RTD
Q − W = ΔE
(u2 − u1)
ΔU = ΔQ + ΔW
const
sealed
perpetual motion
1st kind
impossible
net chan in E = Σ Q + Σ W
Q − W = ΔKE
= ΔH + ΔKE + ΔPE
SFEE
only if piston work
Q − W = [Δ(U + PV)] + ΔKE + ΔPE
ΔP(V)
1 − n
KJ/kg
ṁ
Δh = Cp(T2 − T1)
Δu = Cv(T2 − T1)
Δs = Cp ln(T2/T1) − R ln(P2/P1)
Δs = Cv ln(T2/T1) + R ln(v2/v1)
Δh = Δu + RΔT
Δh = Δu + ΔPV
Δs = Δh − ΔPV/T
Δs = Δu + PΔV/T
Δs = Δh − VΔP/T
Δs = Δu + VΔP/T
Δh = Δu + ΔPV
Δs = Δh − VΔP/T
Δs = Δu + PΔV/T
Δh = Δu + ΔPV
Δh = Δu + RΔT
Δh = Cp(T2 − T1)
Δu = Cv(T2 − T1)
Δs = Cp ln(T2/T1) − R ln(P2/P1)
Δs = Cv ln(T2/T1) + R ln(v2/v1)
Δs = Δh − VΔP/T
Δs = Δu + VΔP/T
Δs = Δu + PΔV/T