Aula de Exercícios

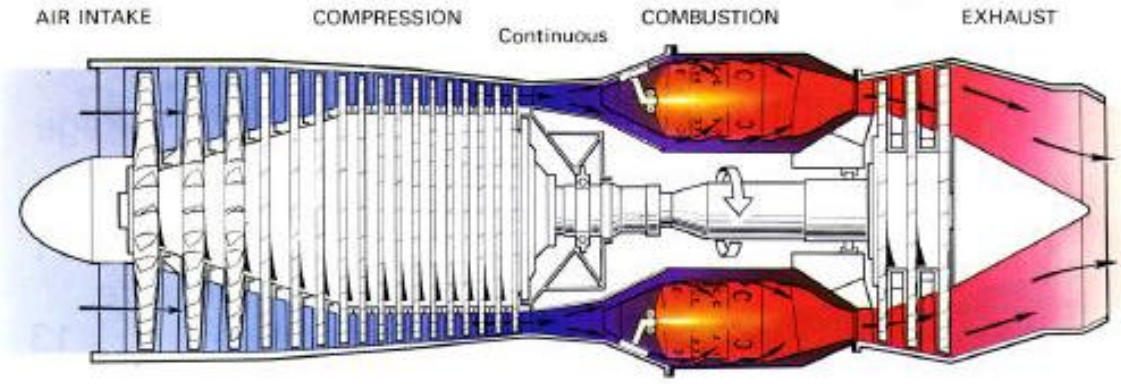
Capítulo 4

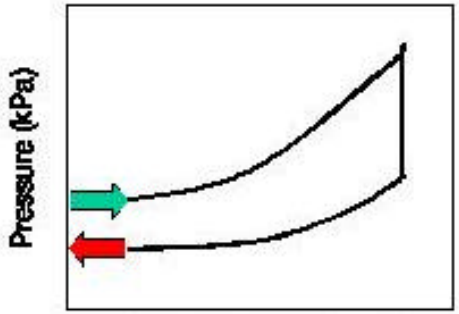
1ª e 2ª Leis

QUESTÕES CONCEITUAIS

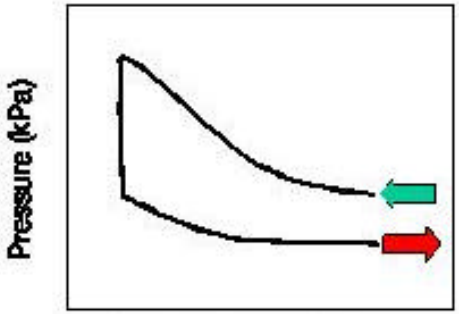
Chapter 2 Question #6

Which thermodynamic diagram best represents the processes that the gas undergoes as it passes through a gas turbine engine?

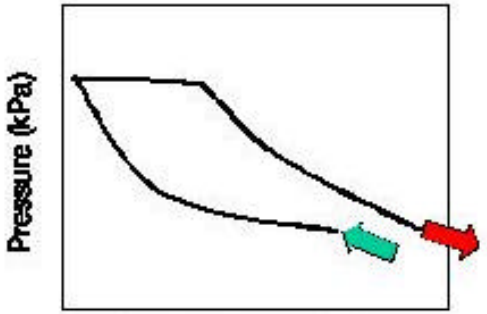




1)



2)



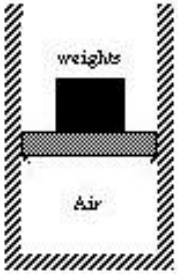
3)

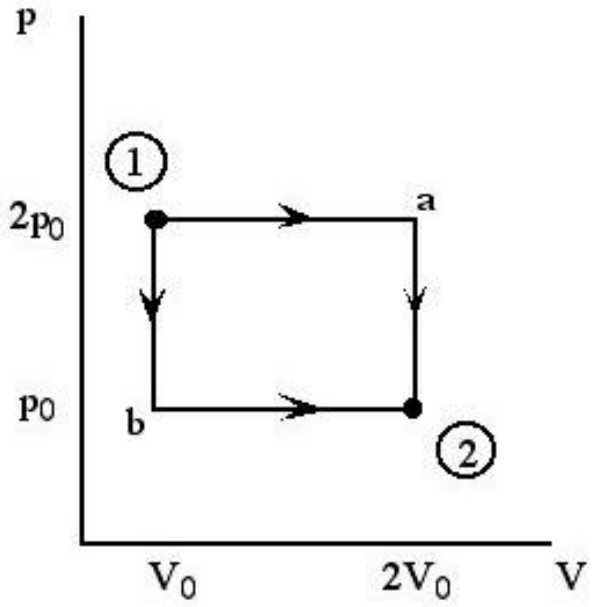
LO#5

Chapter 3 Question #3

Along Path a: $W = 2p_0(2V_0 - V_0) = 2p_0V_0$

Along Path b: $W = p_0(2V_0 - V_0) = p_0V_0$





Question: Given a piston filled with air, ice, a bunsen burner, and a stack of small weights, describe how you would use these to move along either path a or path b above. When you move along either path how do you physically know the work is different?

LO#5

Chapter 4 Question #4

When a thermodynamic system has undergone a cyclic process,

1) the net change in internal energy of the system is always zero.

2) the net work done must be zero.

3) the system and the surroundings must have returned to their initial state.

4) None of the above.

5) All of the above

LO#4

Chapter 4 Question #14

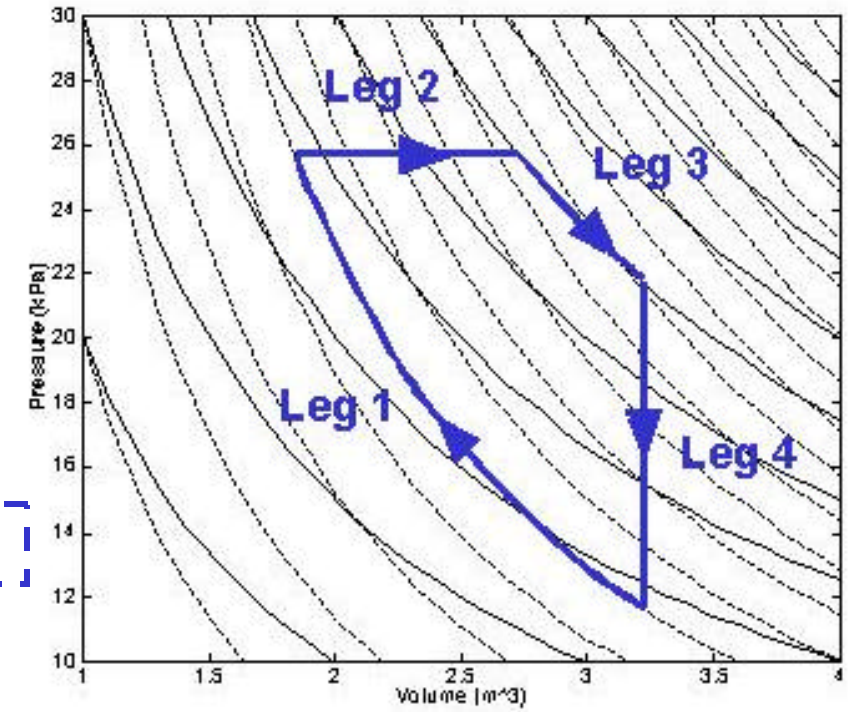
Typically for gases:

1) $C_v > C_p$
2) $C_v \approx C_p$
3) $C_v < C_p$
4) It depends on the gas, these are empirically determined quantities

Chapter 5 Question #3

For the following cycle which statement is correct?

Dashed = adiabats, Solid = isotherms



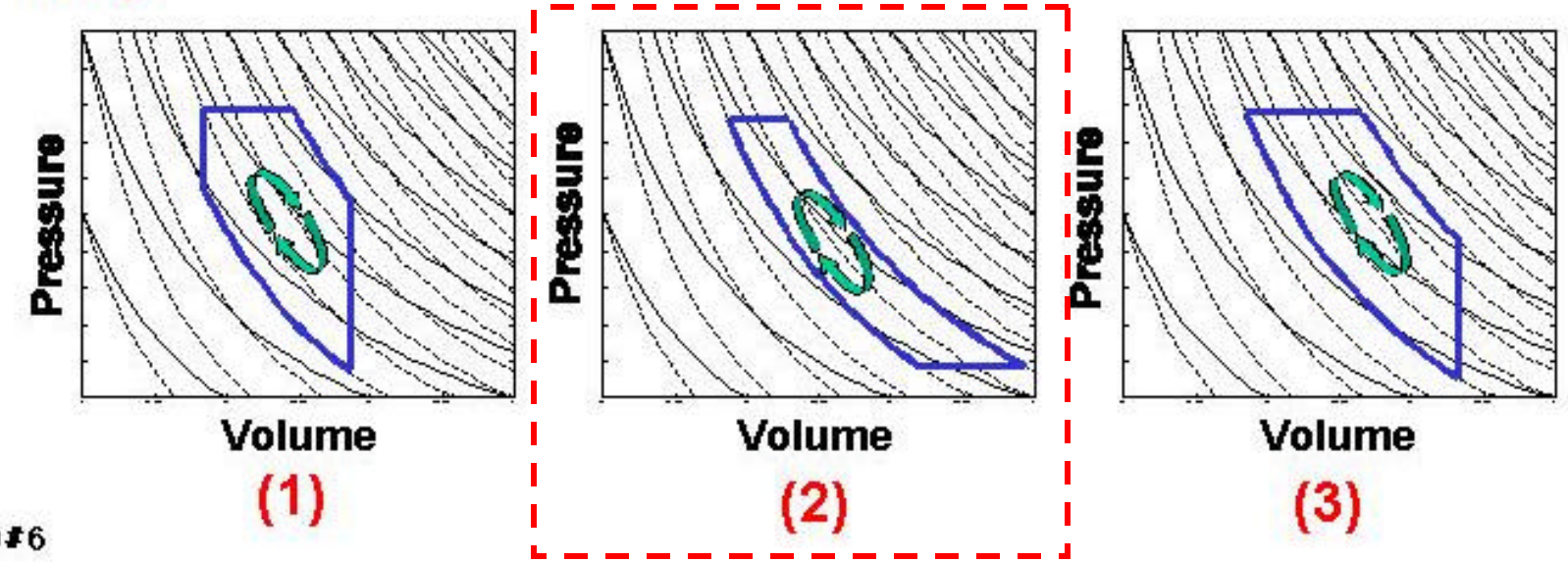
1) Leg 1: Q < 0, W <0
2) Leg 2: Q > 0, W = 0
3) Leg 3: Q > 0, W < 0
4) Leg 4: Q < 0, W > 0
5) None of the above

LO#6

Chapter 5 Question #4

An Otto cycle is a model for the thermo-mechanical energy conversion processes in spark ignition internal combustion engines. Diesel engines operate in a similar manner except the combustion process happens more slowly so that constant pressure heat addition is a better approximation than constant volume heat addition. The assumptions for the processes along the other legs of the cycle are the same for the Diesel and the Otto cycle.

Which of the following diagrams best represents a Diesel cycle, (4 = none of them)?



LO#6

Dashed = adiabatic line; Continuous = isothermal line

- Consider the container with a liquid-vapor mixture that is held at constant temperature through contact with heat reservoir. The volume is increased by movement of the piston. What happens?

1) p constant, U constant, less liquid

2) p decreases, U constant, same composition

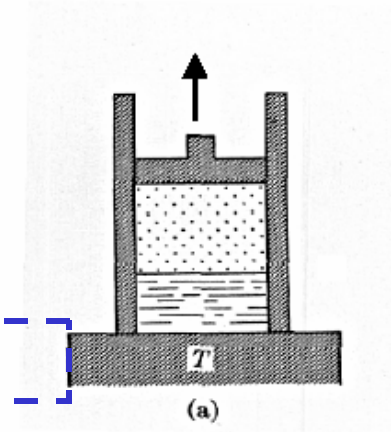
3) p constant, U constant, more vapor

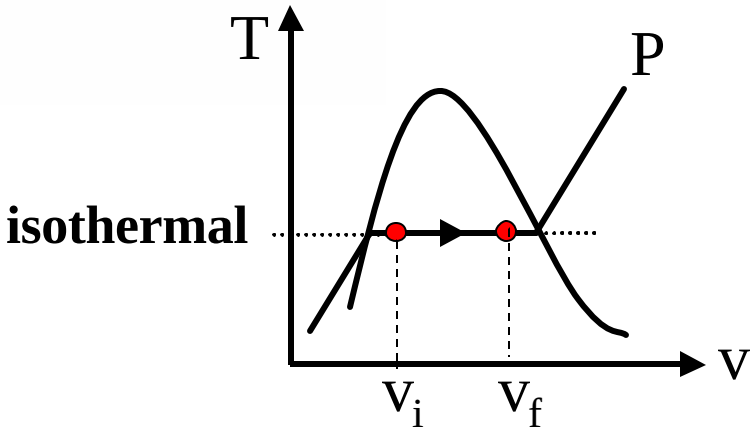
4) p decreases, U increases, less liquid

5) p constant, U increases, more vapor

6) none of the above

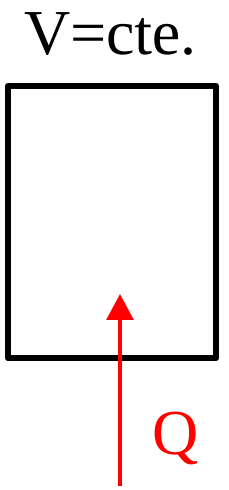
7) I don't know



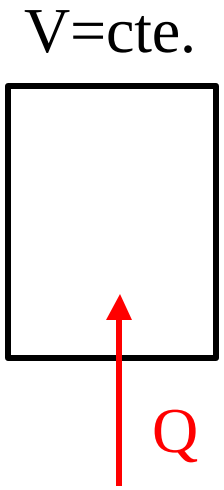


Exercício 4.24

- Calor é adicionado de uma chama de gás para o AR *(gás ideal)* contido em um tanque rígido. Como variam as propriedades:
- Pressão
- Energia interna
- Entalpia
- Entropia
- Como varia a entropia líquida do sistema + meio?



Ex4.24)



Adição de calor a volume constante

1ºLei: Q-W=DU onde: [W=0]

$\Delta U = C_V \Delta T = Q$

Energia Interna aumenta (Q>0)

Temperatura aumenta (DU>0)

Pressão aumenta (PV=MRT)[T -]

Entalpia aumenta (H=U+PV)

Entropia:

$$? S = c_V \ln\left(\frac{T_2}{T_1}\right) + k \ln\left(\frac{V_2}{V_1}\right)$$

$$? S > 0 \rightarrow T_2 > T_1$$

Troca de calor com diferença de temperatura

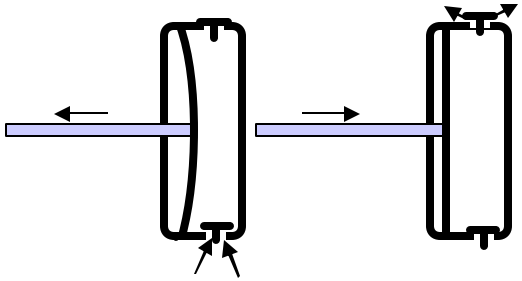
® Processo Irreversível

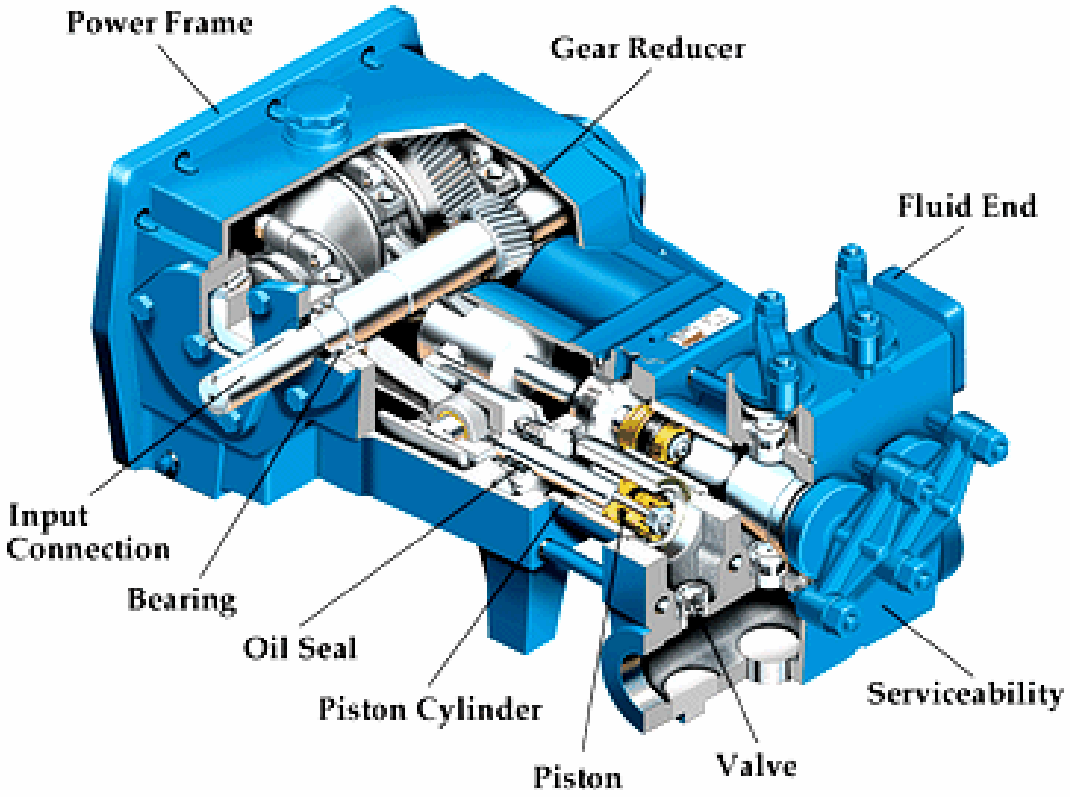
$\Delta S_{sist+viz} > 0$

BOMBAS ALTERNATIVAS OU DE DESLOCAMENTO POSITIVO

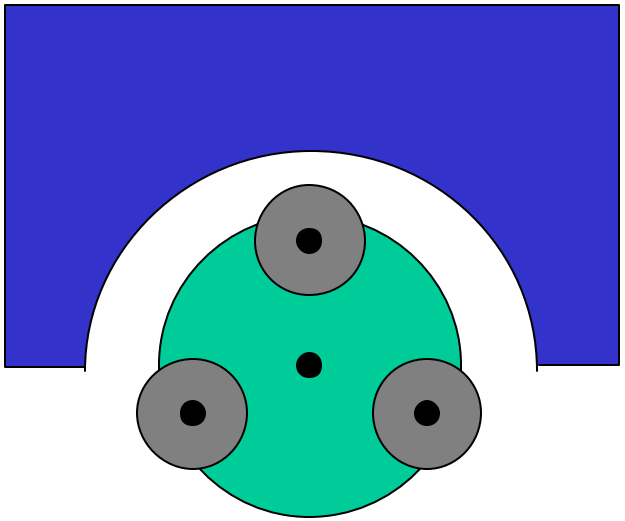
- Piston pump
  - can produce very high pressures
  - hydraulic fluid pump
  - high pressure water washers

diaphragm pump



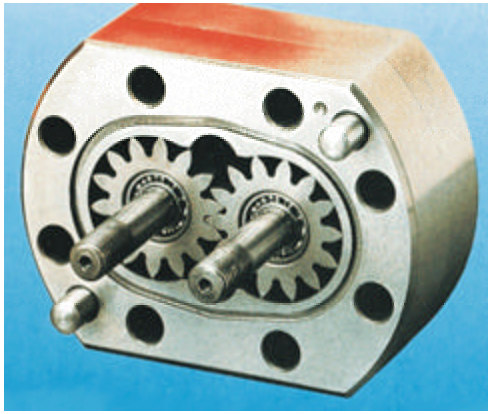


Peristaltic Pump

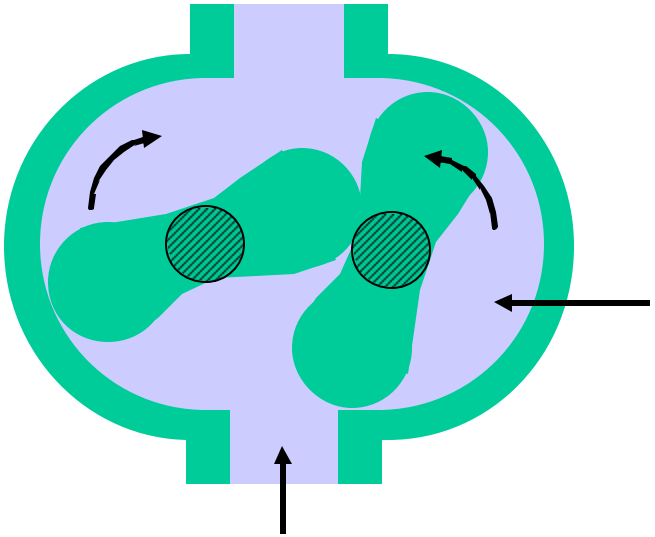


- Fluid only contacts tubing
- Tubing $\frac{ID}{velocity}$ and roller velocity with respect to the tubing determine flow rate
- Tubing eventually fails from fatigue and abrasion
- Fluid may leak past roller at high pressures
- Viscous fluids may be pumped more slowly

Rotary Pumps



- Gear Pump
  - fluid is trapped between gear teeth and the housing
- Two-lobe Rotary Pump
  - (gear pump with two “teeth” on each gear)
  - same principle as gear pump
  - fewer chambers - more extreme pulsation



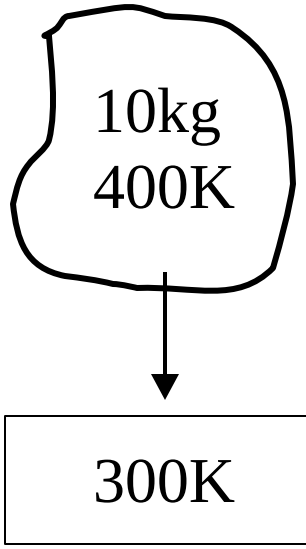
Exercício 4.25

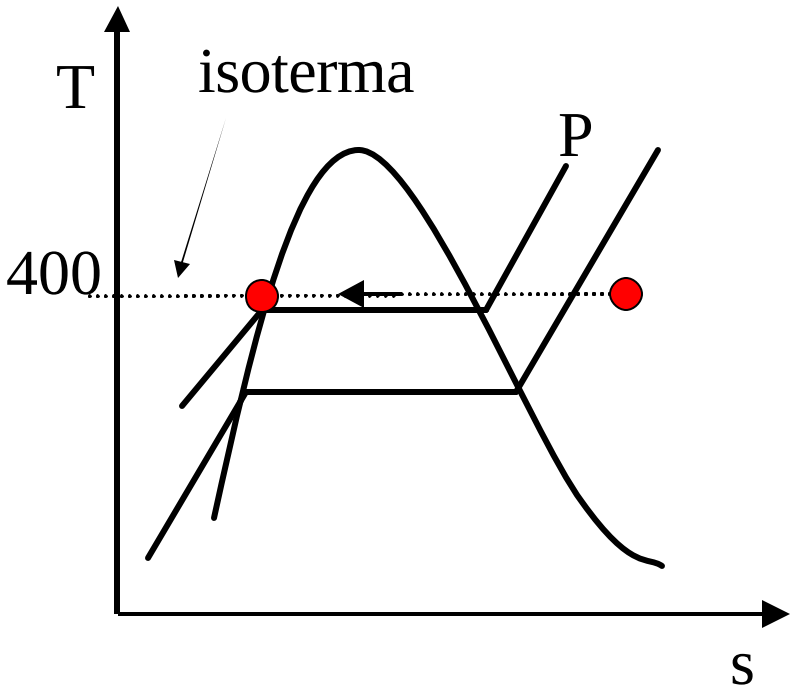
- Uma bomba alternativa bombeia água de um poço num processo irreversível. Quais equações são aplicáveis:

- PV^{γ}=constante — Falsa
- $\delta Q = dU + \delta W$ — Verdadeira
- $dW = PdV$ — Falsa
- $dQ = TdS$ — Falsa
- $dS > 0$ — Verdadeira

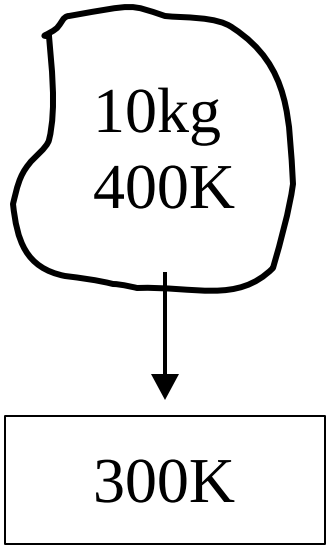
Exercício 4.27

- 100 kJ de calor é removido de um sistema que contém 10 kg de vapor enquanto este sistema sofre um processo isotérmico reversível a 400K. O calor é transferido para o ambiente que está a 300K.
- Qual é a variação de entropia específica do sistema?
- Qual é a variação de entropia do sistema?
- Qual é a variação de entropia do sistema+ meio ambiente?





Ex4.27)



$$\int dS = \oint \frac{\partial Q}{T} + \int dI$$

$=0$ reversível

$$?S_{sist} = \frac{-100}{400} = -0{,}25 \frac{kJ}{^oK}$$

$$?S_{viz} = \frac{+100}{300} = +0{,}33 \frac{kJ}{^oK}$$

$$?S_{univ} = ?S_{sist} + ?S_{viz}$$

$$?S_{univ} = \left(\frac{1}{3} - \frac{1}{4} \right) = \frac{1}{12} = 83{,}33 \frac{J}{^oK}$$

Exercício 4.31

- Responda se os processos seguintes são reversíveis, irreversíveis, ou impossíveis, para água líquida (incompressível) que passa por um processo adiabático

- $U2 - U1 > 0$ **Irreversível, possível**
- $U2 - U1 = 0$ **reversível, possível**
- $U2 - U1 < 0$ **impossível**

What For Are the Reversible Process?

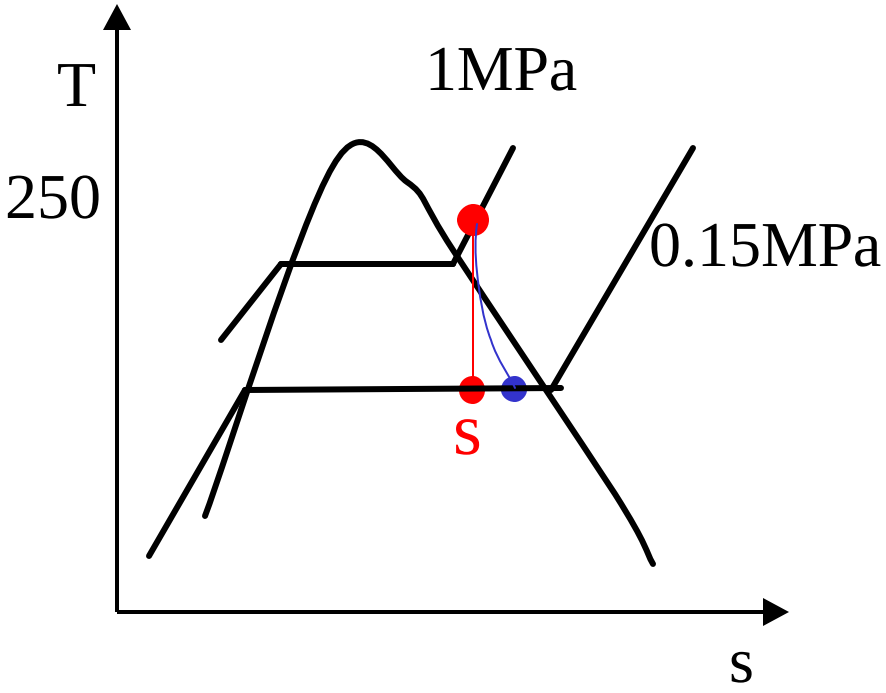
- They are useful for establishing references between actual and ‘ideal’ processess.
- The process efficiency defined as the ratio of the work delivered by an actual and an reversible process compares how close they are.

$$\eta = \frac{W_{actual}}{W_{reversible}}$$

- *It must not be confused the process efficiency with the thermal eff. of heat engines! The later operates in a cycle.*

Exercício 4.37

- Um sistema possui 0.1kg de vapor a 1MPa & 250ºC. Ele se expande ‘adiabaticamente’ para 0,15 MPa enquanto produz 26 KJ de trabalho.
- Esboce os processos real e ideal num diagrama Ts.
- Qual é o título no estado 2?
- Calcule a eficiência do processo

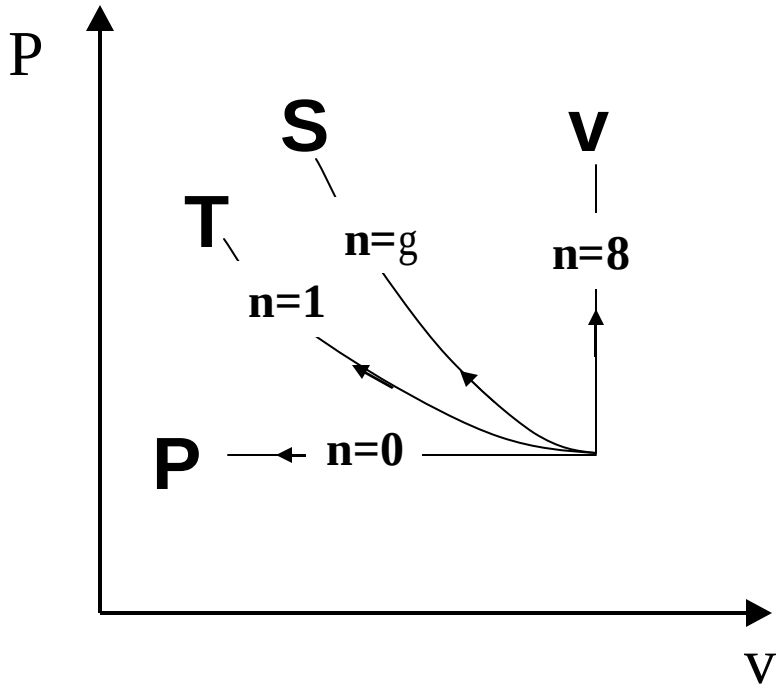


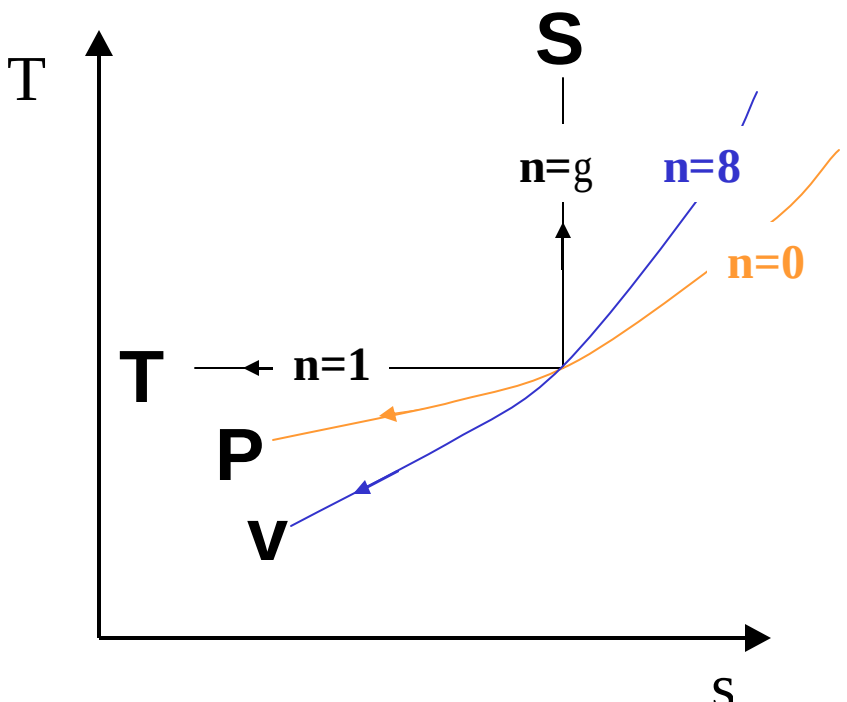
Exercício 4.38

- Esboce num diagrama Ts os caminhos para um gás ideal que passa por processos politrópicos reversíveis com n = 0, 1, γ e 8
- $Pv^0 = c$? isobárico
- $Pv^1 = c$? isotérmico
- $Pv^\gamma = c$? isoentrópico
- $Pv^8 = c$? isovolume

$$s_2 - s_1 = C_{v,av} \ln \frac{T_2}{T_1} + R \ln \frac{v_2}{v_1}$$

$$s_2 - s_1 = C_{p,av} \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1}$$





- Exercícios Recomendados

- 4.22; 4.23; 4.24; 4.27; 4.31; 4.32; 4.34; 4.37; 4.38