CREACION Y DESTRUCCION DE ENTROPIA EN LOS SISTEMAS DE LA NATURALEZA

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FORMULACIONES DE LA SEGUNDA LEY DE LA TERMODINAMICA

1. CLAUSIUS

$$dS \geq \frac{\delta Q}{T} + m_S S_S - m_e S_e$$

2. PRIGOGINE

$$dS = \frac{\delta Q}{T} + dS_g + m_S S_S - m_e S_e$$

$$dS_g \geq 0$$

3. BOLTZMANN

$$S = K \ln \Omega$$

4. CARATHEODORY

“ En las cercanías del estado inicial de un sistema existen estados vecinos que son accesibles mediante trayectorias adiabáticas”

$$PV^{\gamma} = K$$

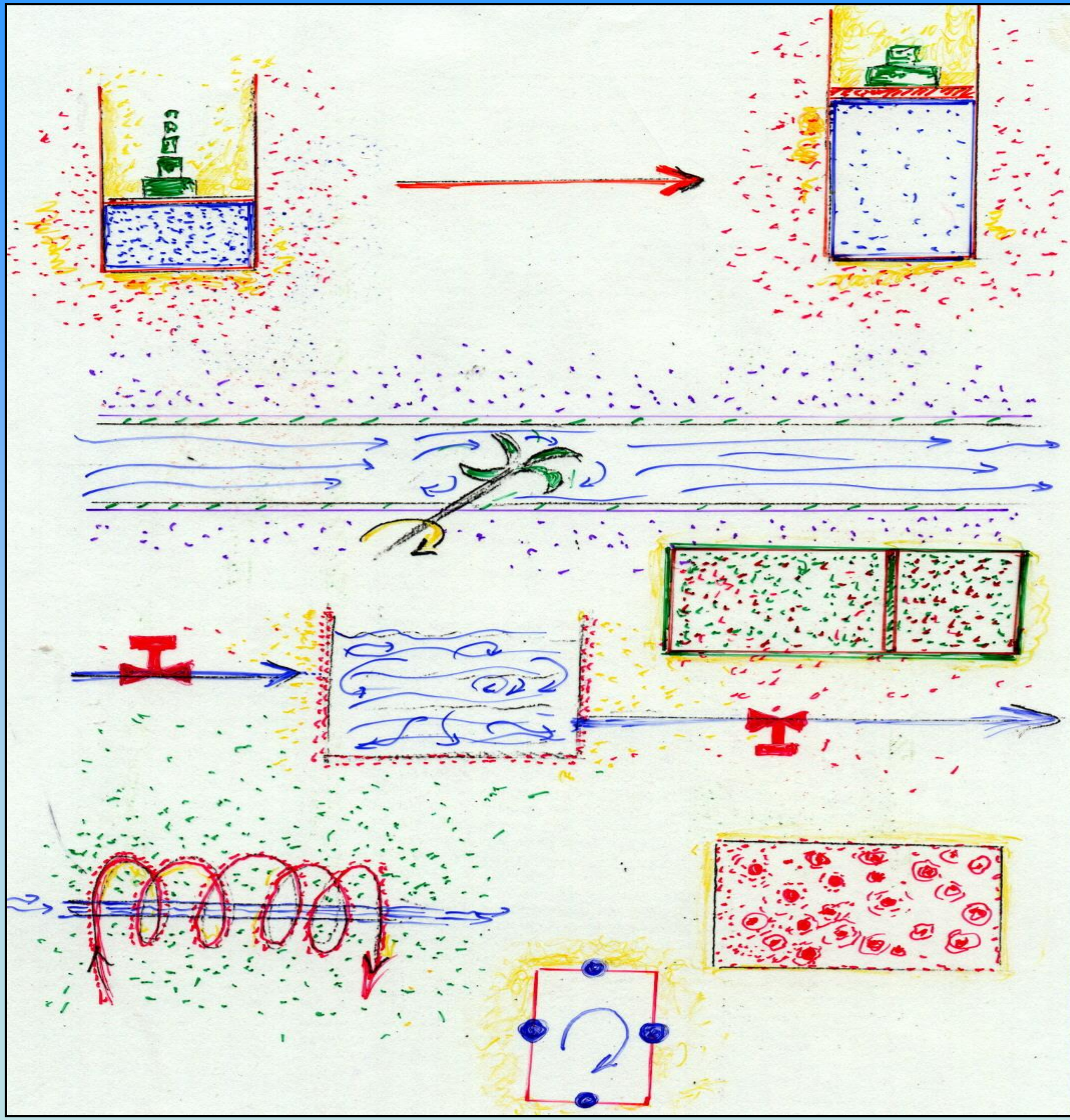
5. La eficiencia termodinámica de una etapa irreversible es menor que la eficiencia de un proceso reversible operando entre los mismos estados inicial y final

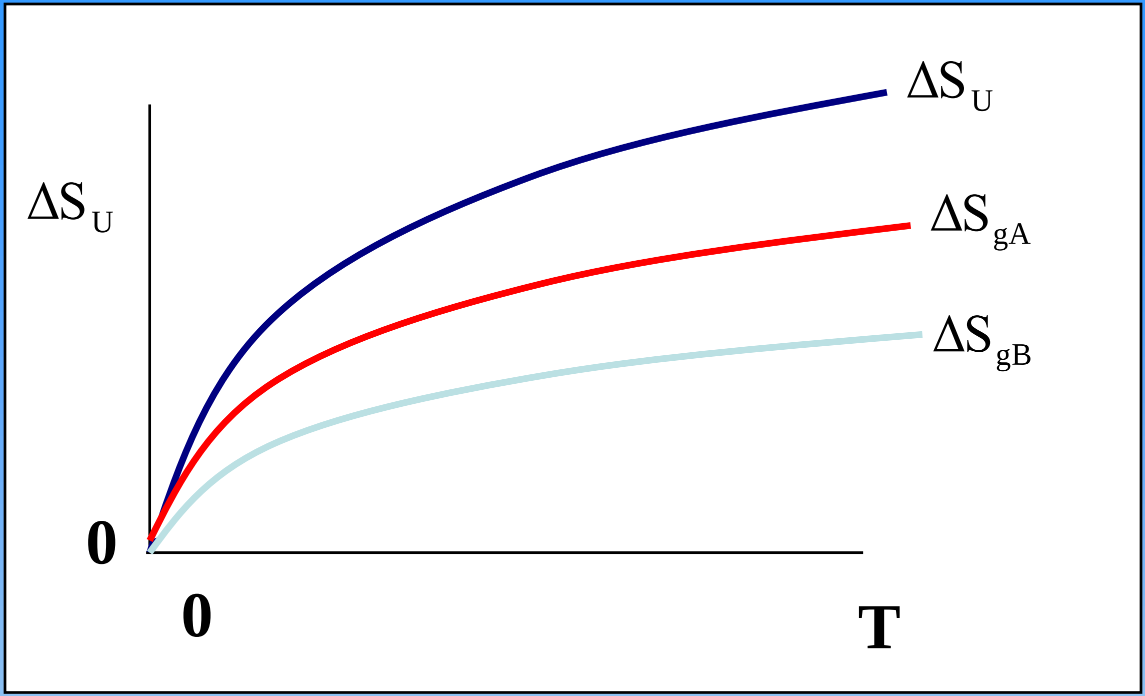
6. La eficiencia de cualquier máquina cíclica es menor que la eficiencia de una serie infinita de ciclos de Carnot operando con las mismas fuentes térmicas.

7. El estado de equilibrio alcanzado por un sistema es único y allí

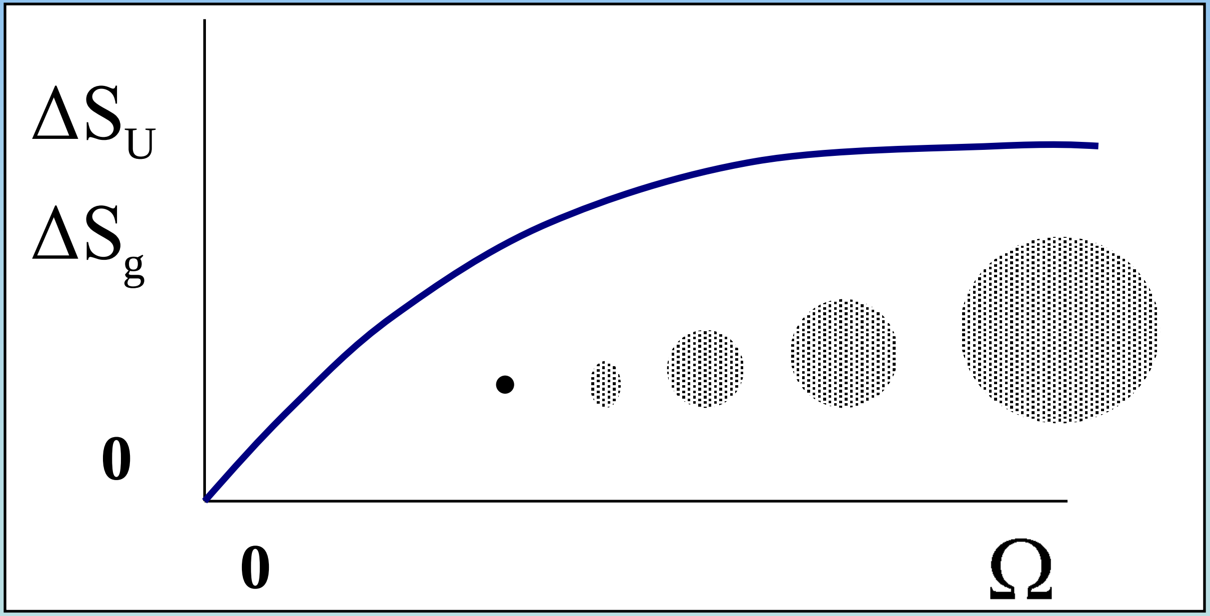
$$\Delta S_{UNIVERSO} = 0 \qquad \Delta S_{g} = 0$$

8. $$\Delta S_{UNIVERSO} = \Delta S_{SISTEMA} + \Delta S_{ALREDEDORES} \geq 0$$

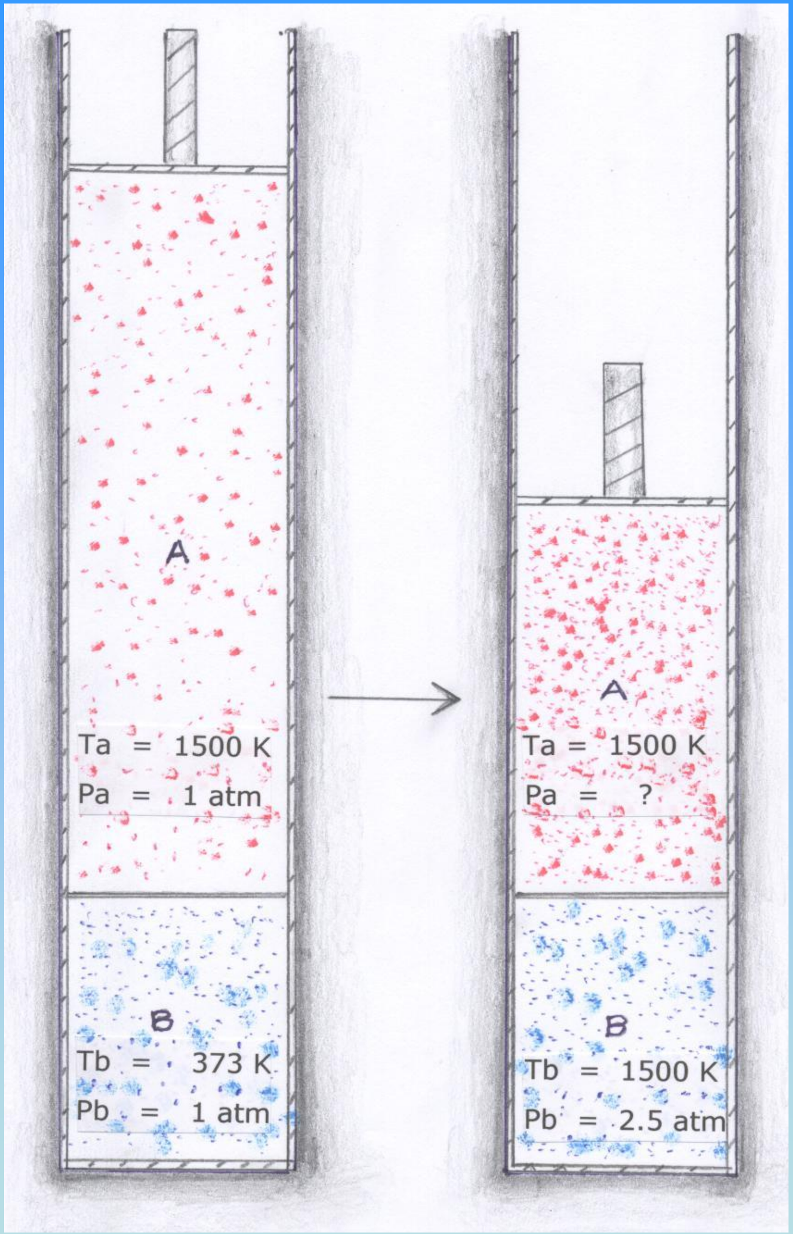




ΔS U
ΔS gA
ΔS gB
0
0
T



ΔS U
ΔS g
0
0
Ω


A
Ta = 1500 K
Pa = 1 atm
B
Tb = 373 K
Pb = 1 atm
A
Ta = 1500 K
Pa = ?
B
Tb = 1500 K
Pb = 2.5 atm

$$\Delta\ Ua = Qa - Wa = 0$$

$$\Delta\ Ub = Qb - Wb = n\ Cv\ (T2 - T1)$$

$$Qa = -Qb = Wa$$

$$\Delta\ SgA = n\,R\ \ln(P1 / P2) - Qa / Ta$$

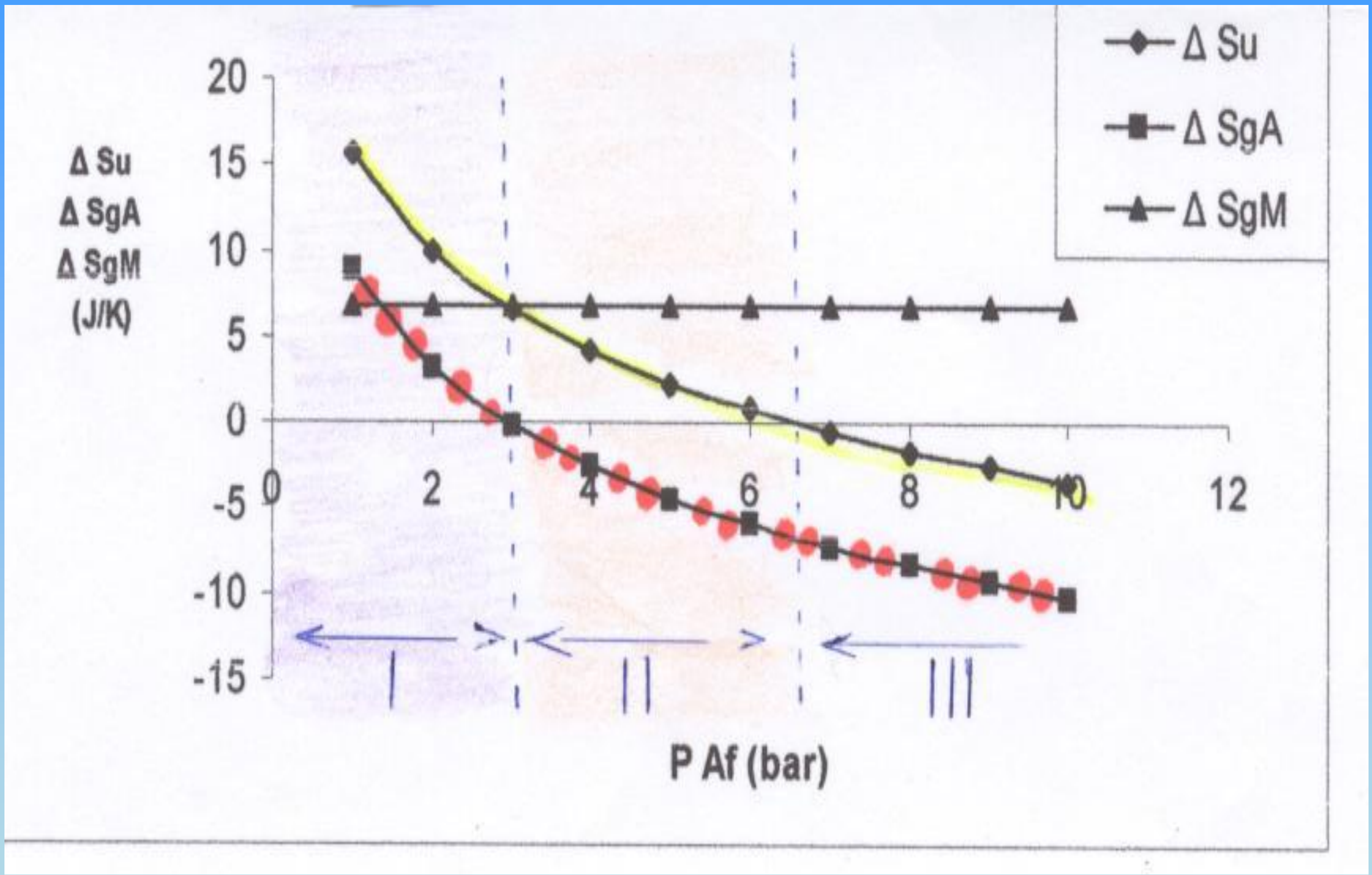
$$\Delta\ SgB = 0$$

$$\Delta\ SgM = Qa / Ta + n\ Cv\ \ln(T2 / T1)$$

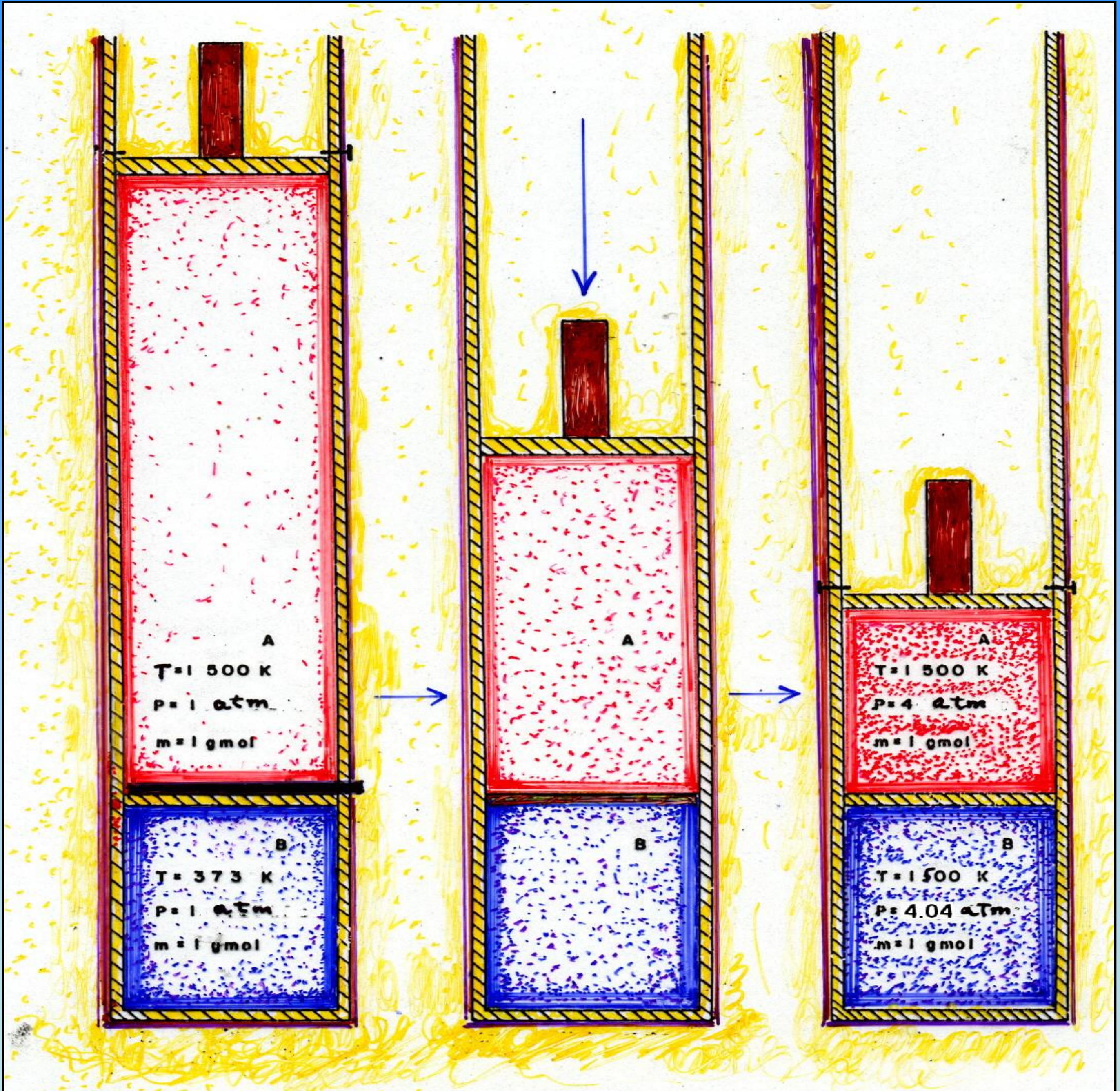
$$\Delta\ Su = \Delta\ Sa + \Delta\ Sb + \Delta\ Sm + \Delta\ Sr$$

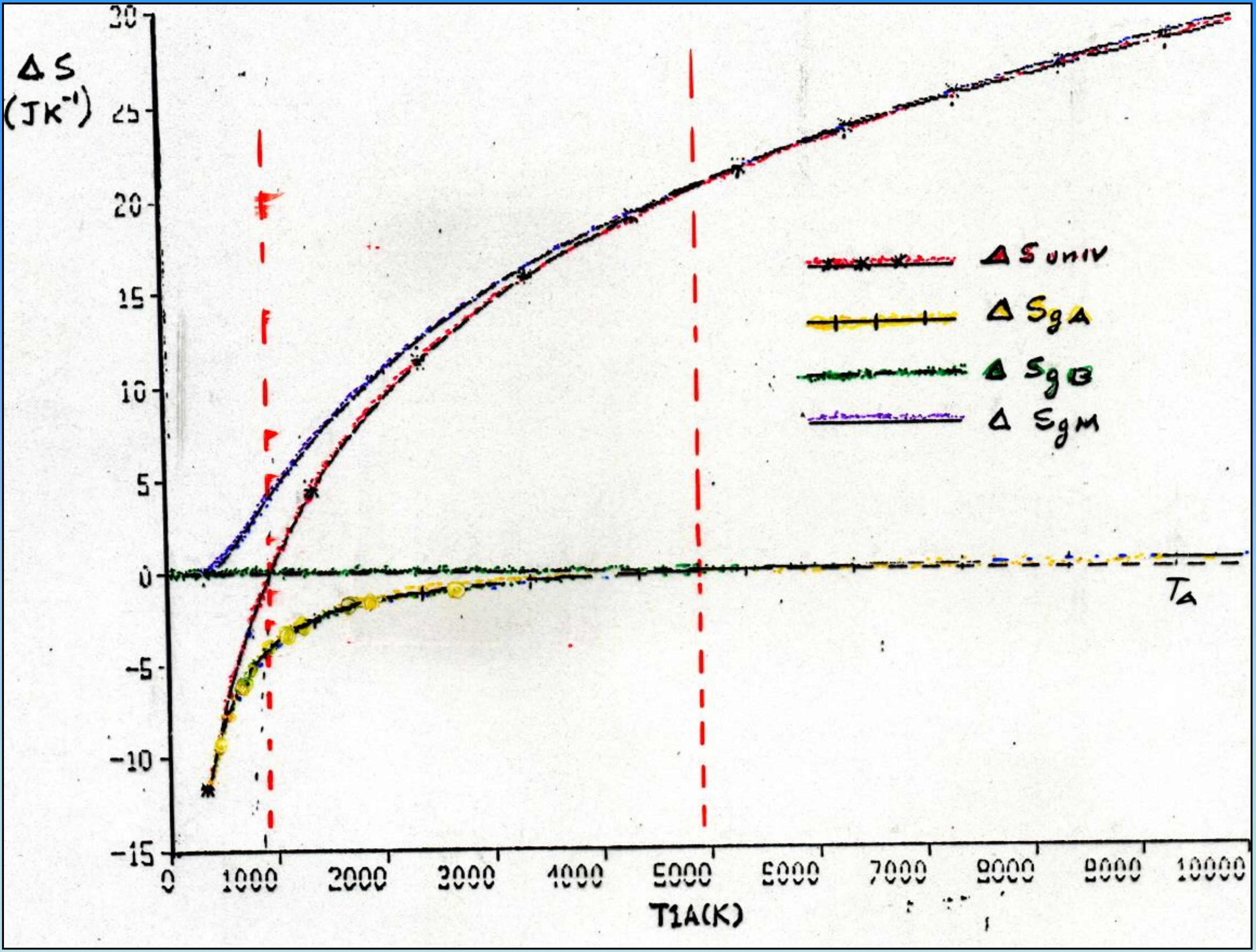
$$\Delta\ Su = n\,R\ \ln(P1 / P2) + n\ Cv\ \ln(T2 / T1)$$

$$\Delta\ Su = \Delta\ SgA + \Delta\ SgM$$

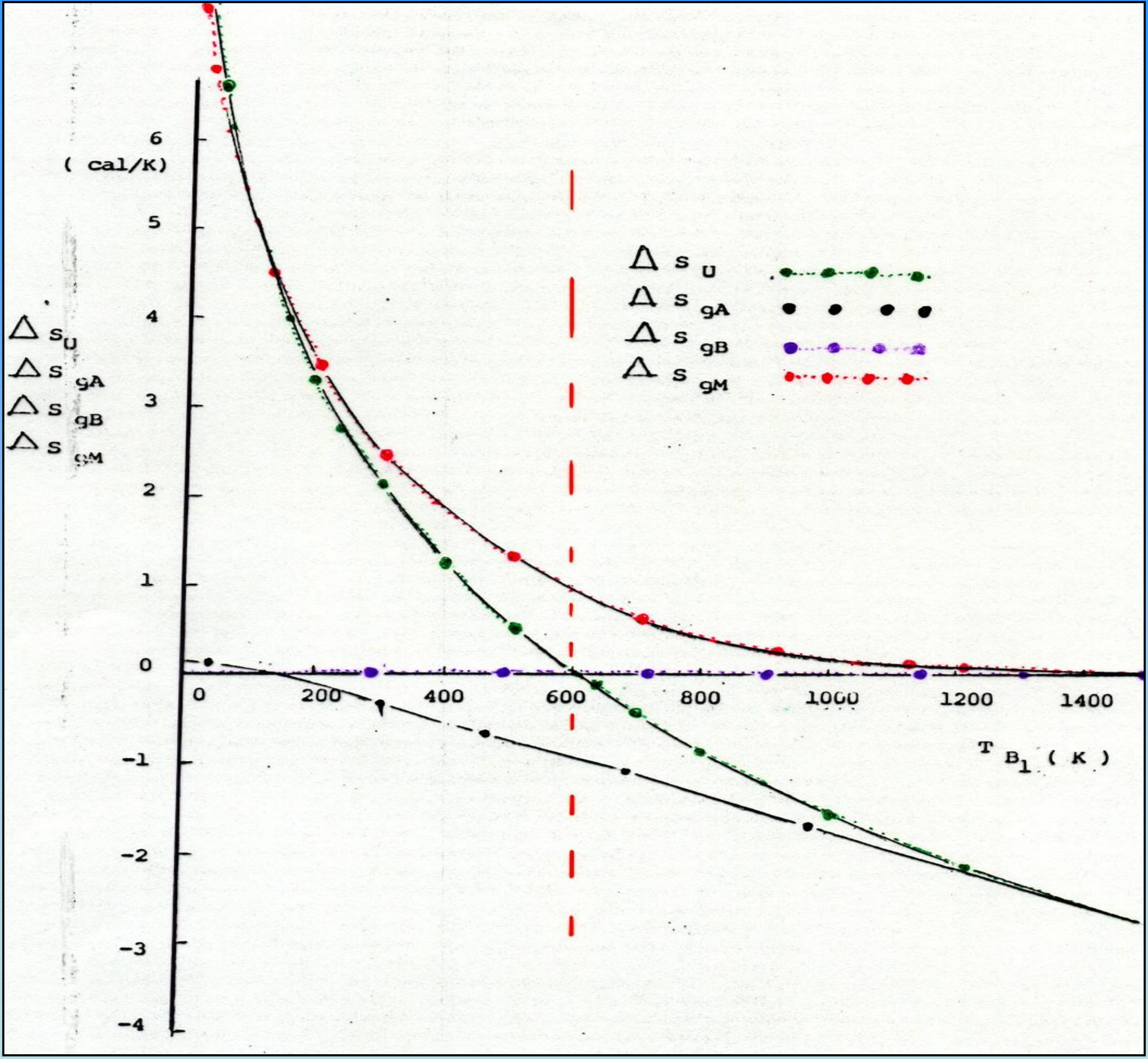


Δ Su
Δ SgA
Δ SgM
(J/K)
20
15
10
5
0
-5
-10
-15
0
2
4
6
8
10
12
I
II
III
P Af (bar)


A
T=1 500 K
P=1 atm
m=1 gmol
B
T=373 K
P=1 atm
m=1 gmol
A
B
A
T=1 500 K
P=4 atm
m=1 gmol
B
T=1500 K
P=4.04 atm
m=1 gmol



ΔS (JK⁻¹)
30
25
20
15
10
5
0
-5
-10
-15
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
T1A(K)
ΔS univ
ΔSgA
ΔSgB
ΔSgM
T_A



(cal/K)
6
5
4
3
2
1
0
-1
-2
-3
-4
0
200
400
600
800
1000
1200
1400
T B1 (K)
Δ S U
Δ S gA
Δ S gB
Δ S gM
Δ S U
Δ S gA
Δ S gB
Δ S gM

$$W = \int PdV - \int T \; d \; Sg$$

$$W_{acoplamiento\ entrópico} = -14053.69 J$$

$$W_{reversible} = -17288.48 \quad J$$

$$\partial W_{perdido} = T dS_g$$

$$\partial W_{ganado} = T dS_g \text{ (Analogía)}$$

$$W_{ganado} = -3234.74 \quad J$$

CARACTERISTICAS DEL ESTADO ESTACIONARIO

$$\Delta S_{UNIV} = 0$$

$T_1 = 1500 \;\; K$ $\quad$ $P_2 = 3.09 \;\; atm$

$P_1 = 1 \;\; atm$ $\quad$ $T_2 = 1500 \;\; K$

$T_1 = 1500 \;\; K$ $\quad$ $P_2 = 8.06 \;\; atm$

$P_1 = 1 \;\; atm$ $\quad$ $T_2 = 1500 \;\; K$

$$\Delta S_{gA} = \Delta S_{gB} = \Delta S_{gm} = 0 \;\; J / mol\,K$$

$$W_{rev} = -17288.48 \;\; J$$

$$\Delta S_{gA} = -7.98 \;\; J / mol\,K$$

$$\Delta S_{gB} = 0$$

$$\Delta S_{gm} = -7.98 \;\; J / mol\,K$$

$$W = -14053.69 \;\; J$$

$$W_{rev} = -26044.68 \;\; J$$

An Exceptional Theoretical Process with Internal Entropy Coupling

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The laws of thermodynamics regulate the existence of processes in the real world and for any process to be possible it must fit the requirements of these laws (*1, 2*).

The second law of thermodynamics postulates that in all permitted processes the total entropy change of the universe is equal to or greater than zero (*1–4*). If the processes are reversible such variation is zero and when the processes are irreversible the total change of entropy of the universe is greater than zero. This happens because in all irreversible transformations there is a creation of entropy while in a reversible process the creation of entropy is null (*3–6*). The second law also implies that the created entropy accumulates in the universe and never can be destroyed in any part of a one-component closed system (*5*). However, in open systems entropy can be created in some regions and destroyed in other regions and the process occurs by means of an entropy coupling as seen in some biological processes or in thermo diffusion (*5*). A similar situation may occur in multicomponent systems with coupled chemical reactions (*5*).

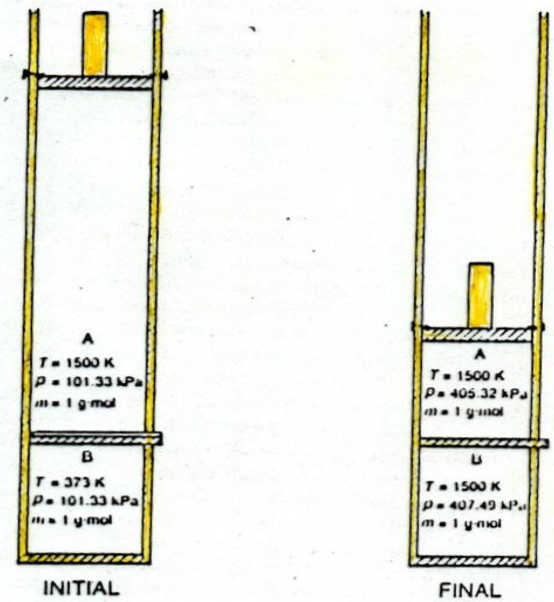
In this article there is proposed a closed theoretical process, permitted by thermodynamic laws, in which there is a set of conditions where internal entropy is created and destroyed during the operation. In this region the process is more efficient than a reversible process carried out between the same change of state, and it may be suggested that the process takes place by means of an entropy coupling between the systems involved.

The Process

The equipment shown in the figure consists of two adiabatic tanks, A and B, separated by a partition composed of a good heat-conducting metal covered with an adiabatic film. The adiabatic film of the partition can be removed or put back in place during process operation if desired. Tank A is fitted with a piston and tank B is a rigid box. In both tanks there is 1 g-mol of a monoatomic ideal gas.

Initially the metal partition is covered with the adiabatic film. Then, the ideal gas in A is set at 1500 K and 101.33 kPa and the ideal gas in B is set at 373 K and 101.33 kPa. When these conditions are reached in both tanks the adiabatic film is removed and the following process starts. In tank A the gas is compressed isothermally in a nonreversible way at 1500 K from 101.33 kPa to 405.32 kPa, and work is done on the ideal gas, and heat is transferred through the metal partition to the ideal gas in tank B. The gas temperature of B increases; when the compression is stopped the temperature in B is 1500 K. Then, the process is finished and the adiabatic film of the partition is put back in place again. Since tank B is rigid and there is no piston, then no work is involved in the process ocurring in this tank.

During the process heat is transferred only between gases and there are no heat losses to the surroundings because the boundaries of the tanks in contact with the surroundings are adiabatic.



The theoretical process discussed in this paper.

Application of the First and Second Law of Thermodynamics

For a process to be possible it must meet the requirements of the first and second laws of thermodynamics, which can be expressed in the following way for the process under discussion.

The universe of the process can be assumed to be formed by system A, system B, system M, and the surroundings S. System A is a closed system formed by tank A, the gas inside, and the piston enclosed in this tank. System B is also closed and consists of tank B and the gas inside this tank. System M is the dividing metal partition located between the tanks, which is also a closed system.

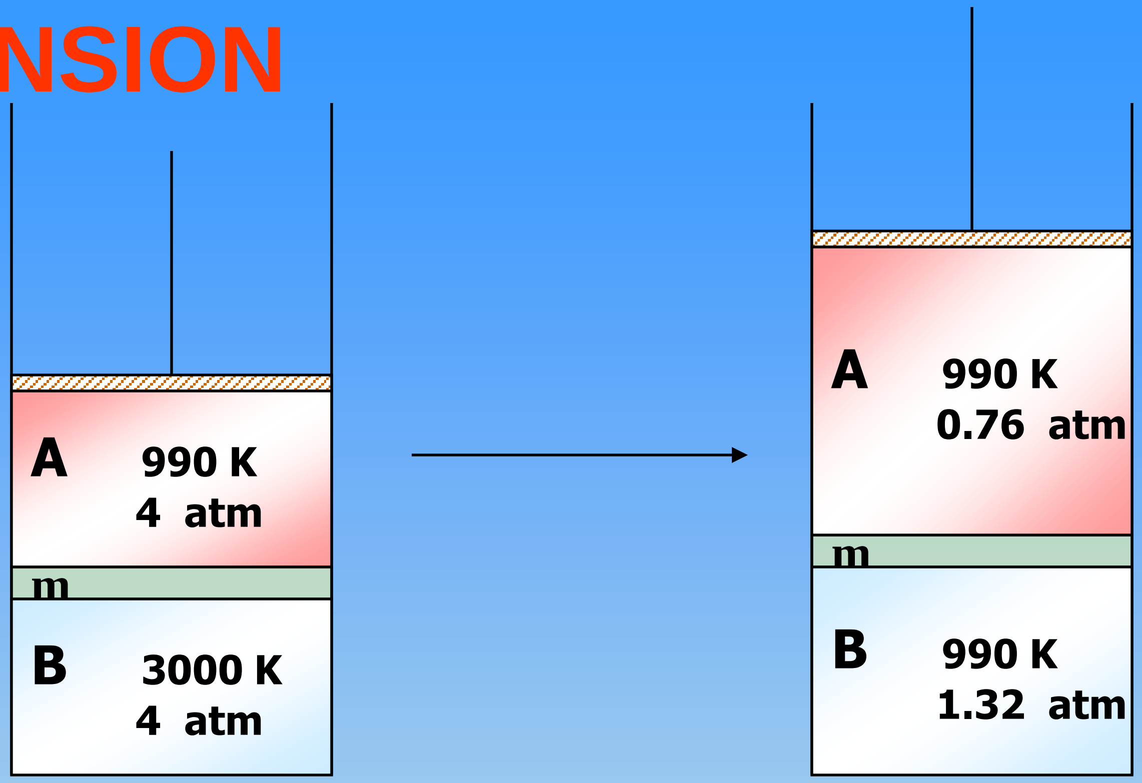
First Law of Thermodynamics

Neglecting the changes of kinetic and potential energy the first law can be expressed in the following way for each of the above closed systems. In these equations heat transferred to the system is considered positive and work done on the system is negative.

System A

$$Q_A - W_A = \Delta U_A \tag{1}$$

EXPANSION



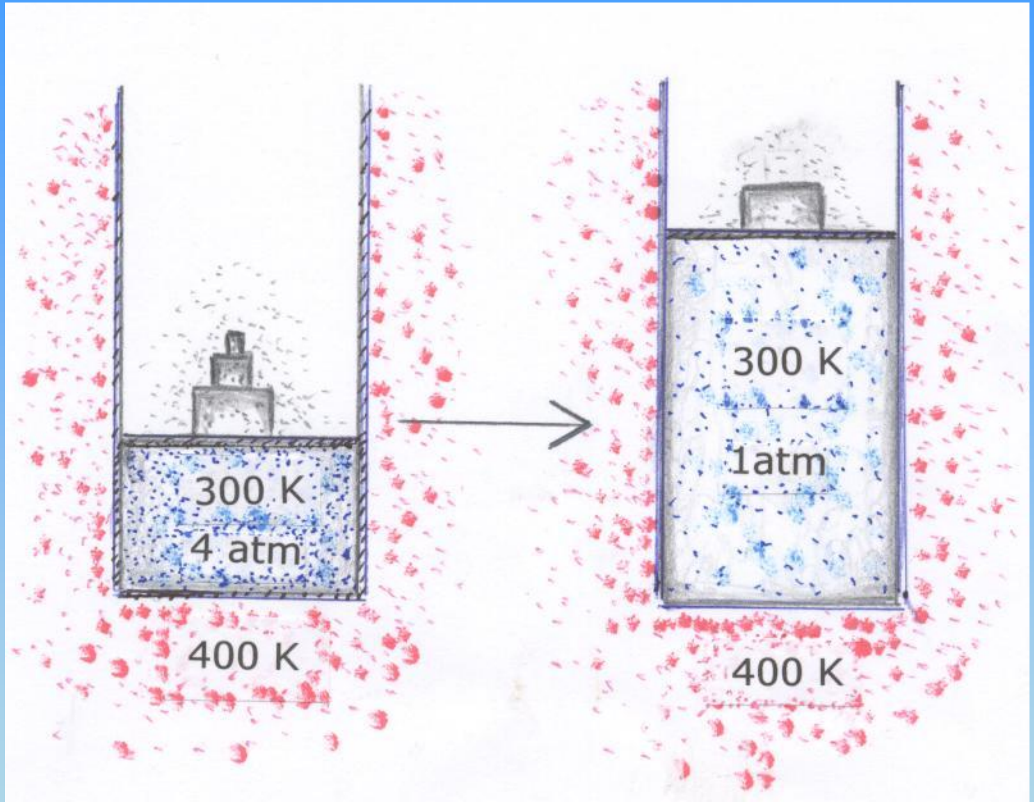
$$\Delta S_{UNIV} = 0 \qquad \Delta S_{gA} = \Delta S_{gB} = \Delta S_{gm} = 0 \qquad W_{rev} = 13481.8 \quad J$$

$$\Delta S_{UNIV} = 0 \qquad \Delta S_{gA} = -11.52 \quad J/mol\ K$$

$$W = 25084.8 \quad J$$

$$\Delta S_{gm} = 11.52 \quad J/mol\ K$$

$$\Delta S_{gB} = 0$$


300 K
4 atm
400 K
300 K
1atm
400 K

$$W = nRT_r \ln(P2/P1) - T_r(\Delta SgA + \Delta SgM)$$

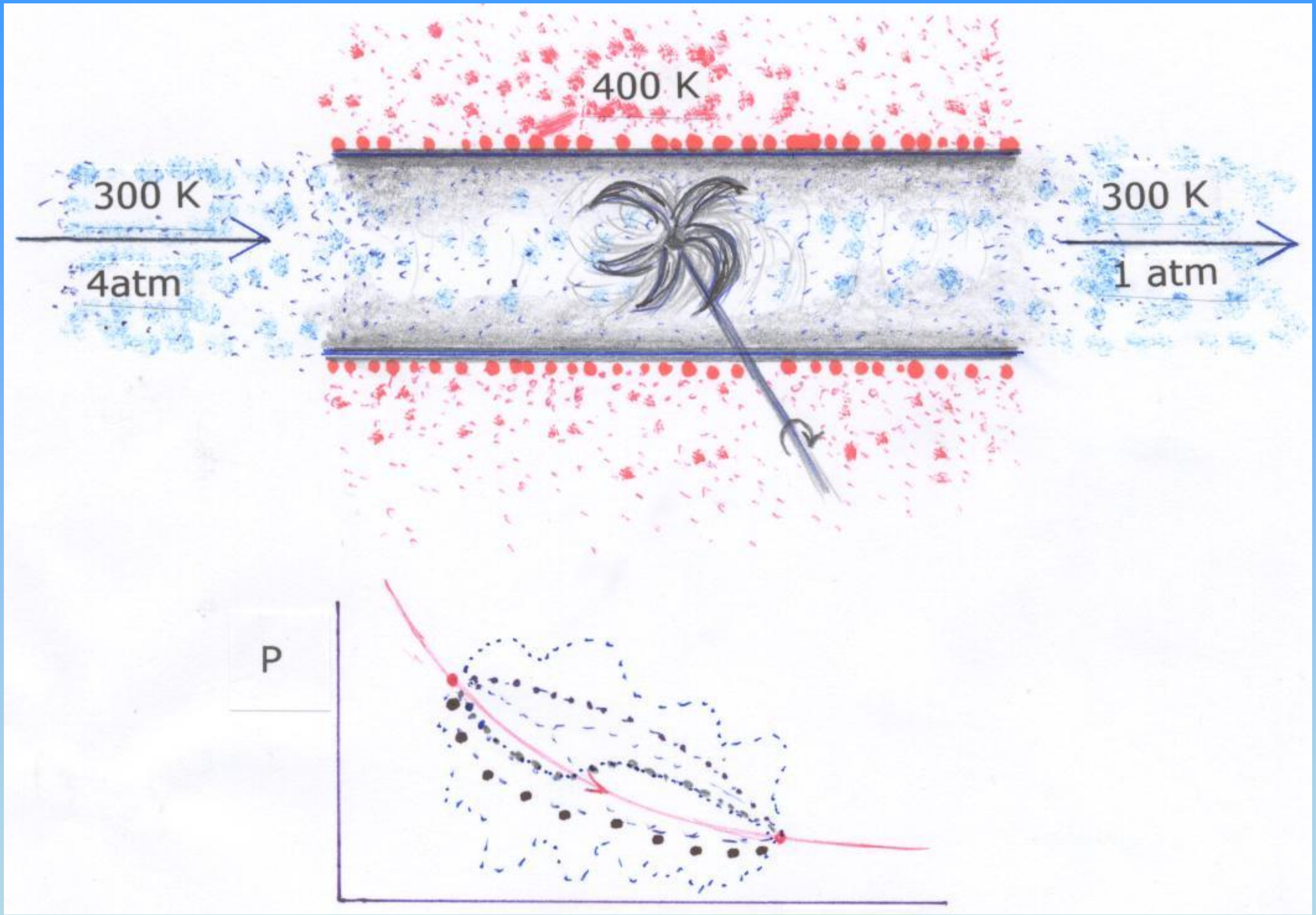
$$\Delta SgA = nR \ln(P2/P1) - Q/T_a$$

$$\Delta SgM = Q(1/T_a - 1/T_r)$$

$$\Delta Su = \Delta SgA + \Delta SgM$$

$$W_r = 3458 \text{ J}$$

$$W = 4610 \text{ J}$$



400 K
300 K
4atm
300 K
1 atm
P

$$W = nRT_r \ln(P_e / P_s) - T_r(\Delta S_{gA} + \Delta S_{gM})$$

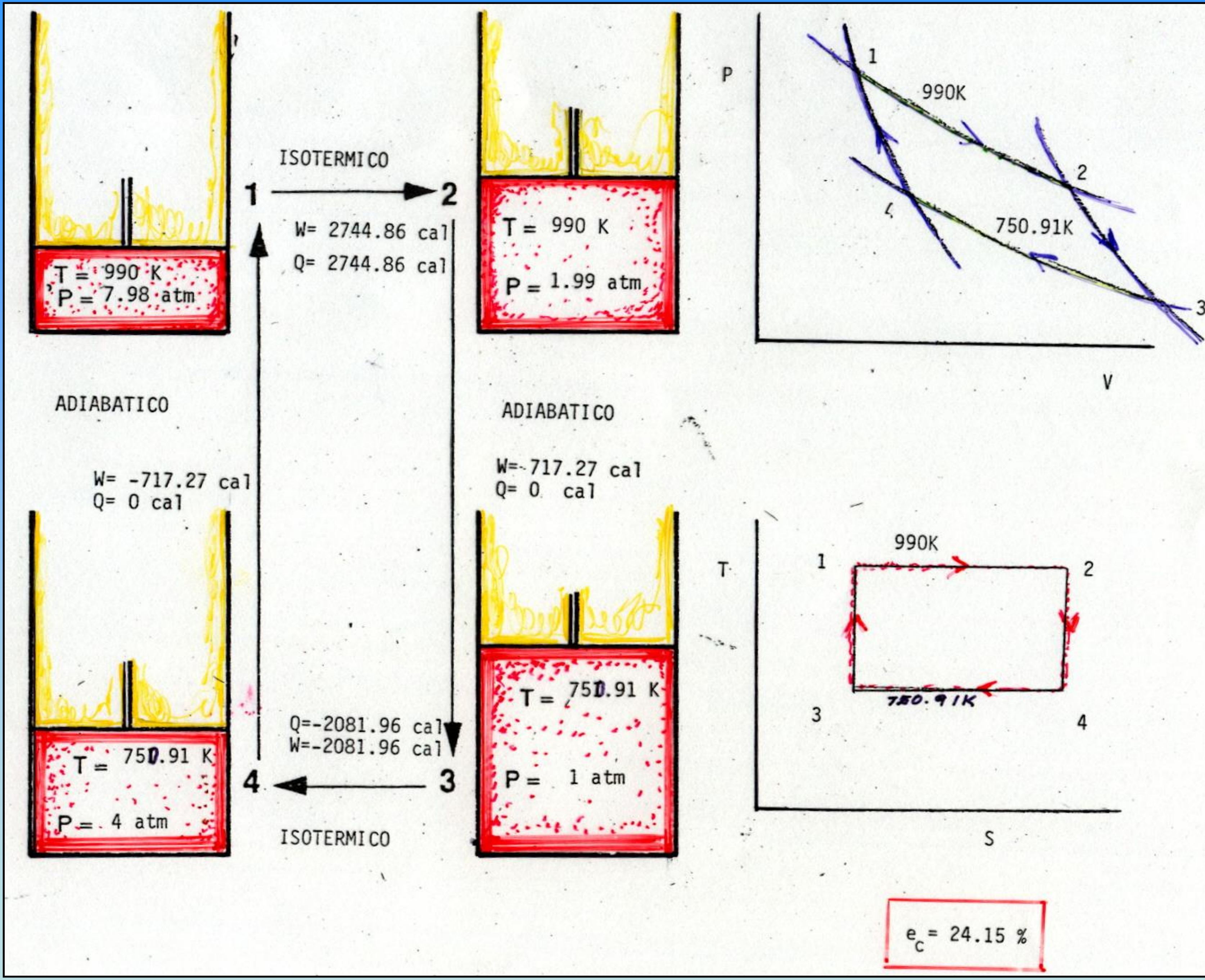
$$\Delta S_{gA} = nR \ln(P_e / P_s) - Q / T_a$$

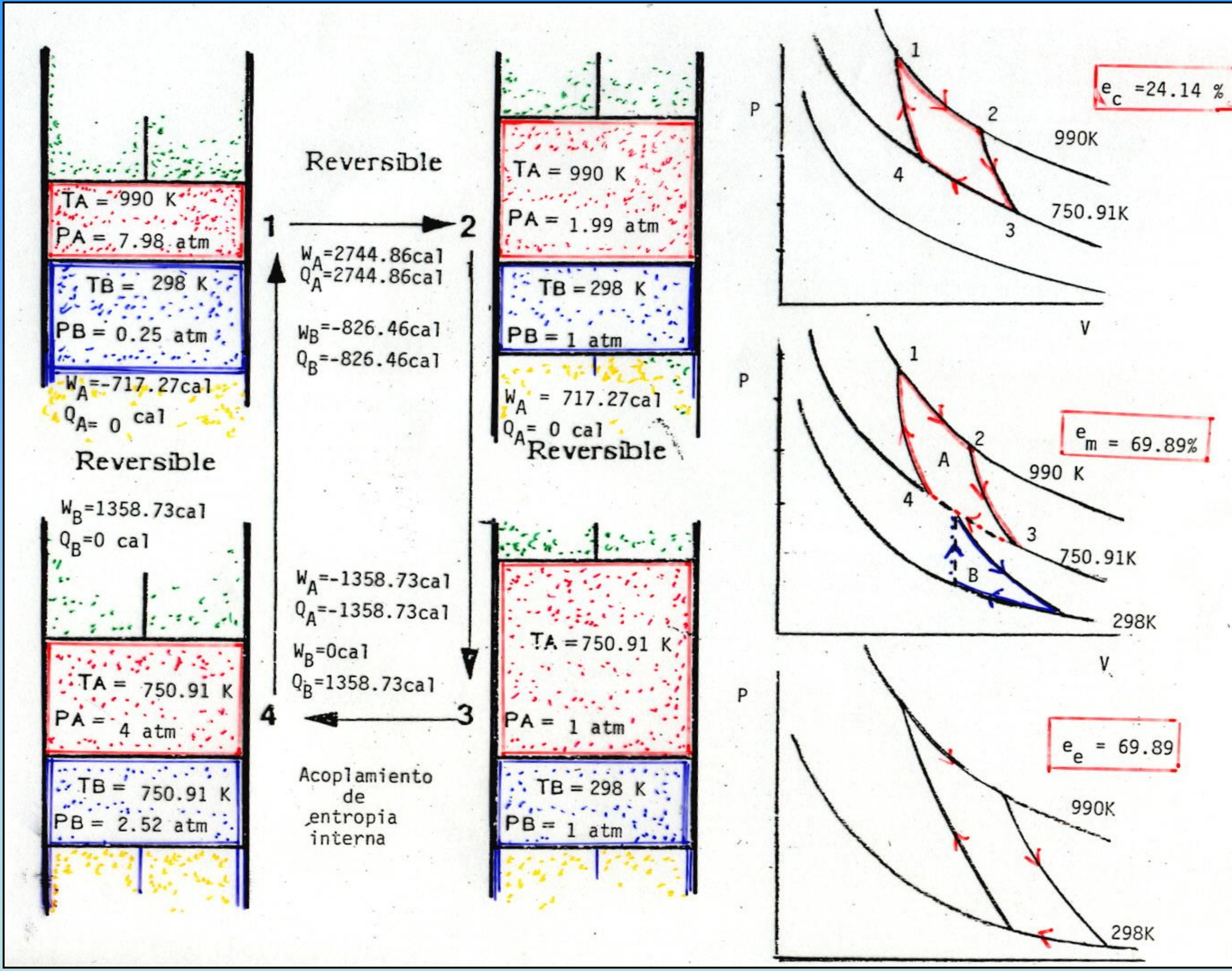
$$\Delta S_{gM} = Q(1/T_a - 1/T_r)$$

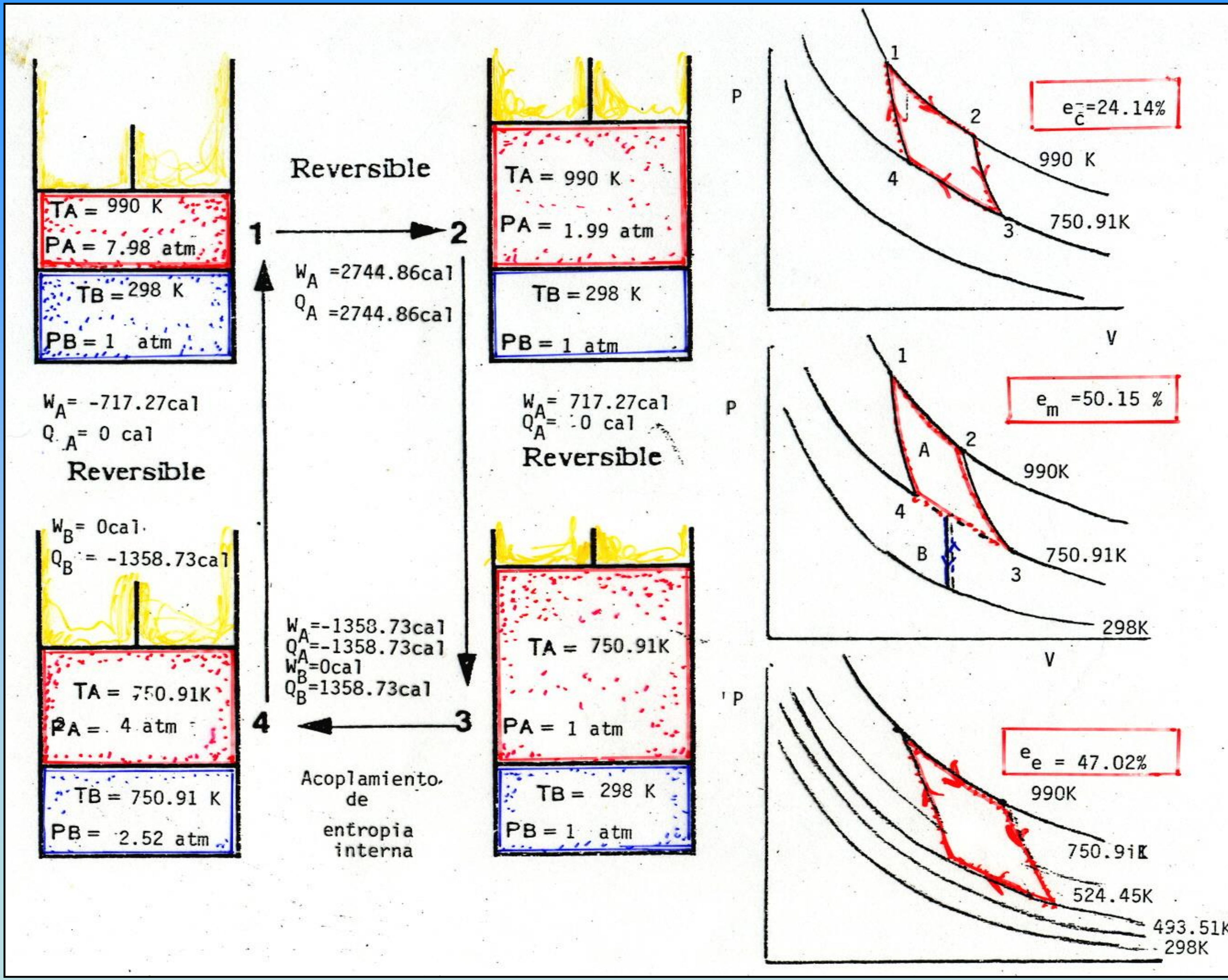
$$\Delta S_u = \Delta S_{gA} + \Delta S_{gM}$$

$$W_r = 3458 \text{ J}$$

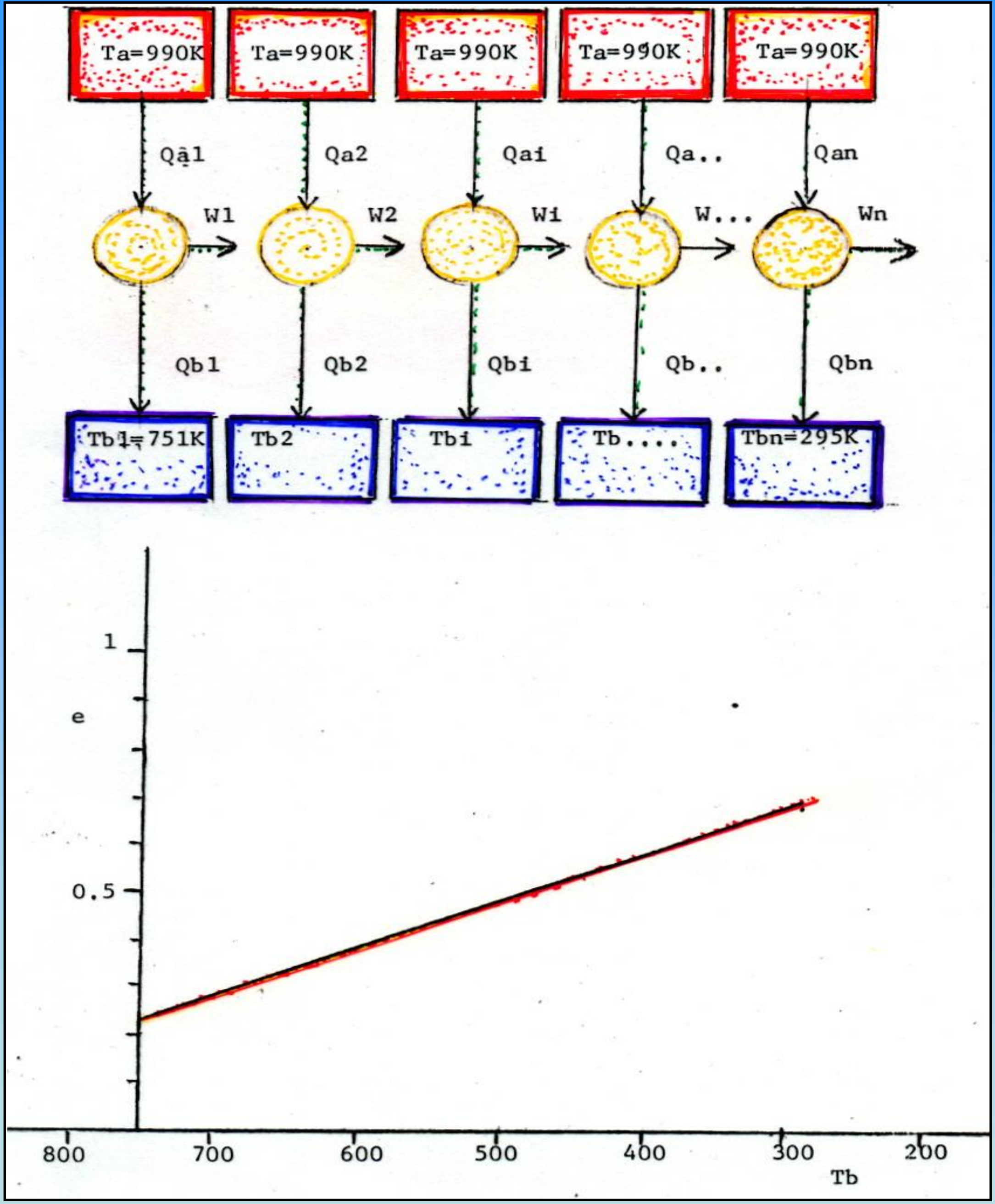
$$W = 4610 \text{ J}$$


T = 990 K
P = 7.98 atm
ISOTERMICO
1
2
W= 2744.86 cal
Q= 2744.86 cal
T = 990 K
P = 1.99 atm
P
1
990K
2
4
750.91K
3
V
ADIABATICO
ADIABATICO
W= -717.27 cal
Q= 0 cal
W= 717.27 cal
Q= 0 cal
T
990K
1
2
750.91K
3
4
S
T = 750.91 K
P = 4 atm
Q=-2081.96 cal
W=-2081.96 cal
4
3
T = 750.91 K
P = 1 atm
ISOTERMICO
e_c = 24.15 %

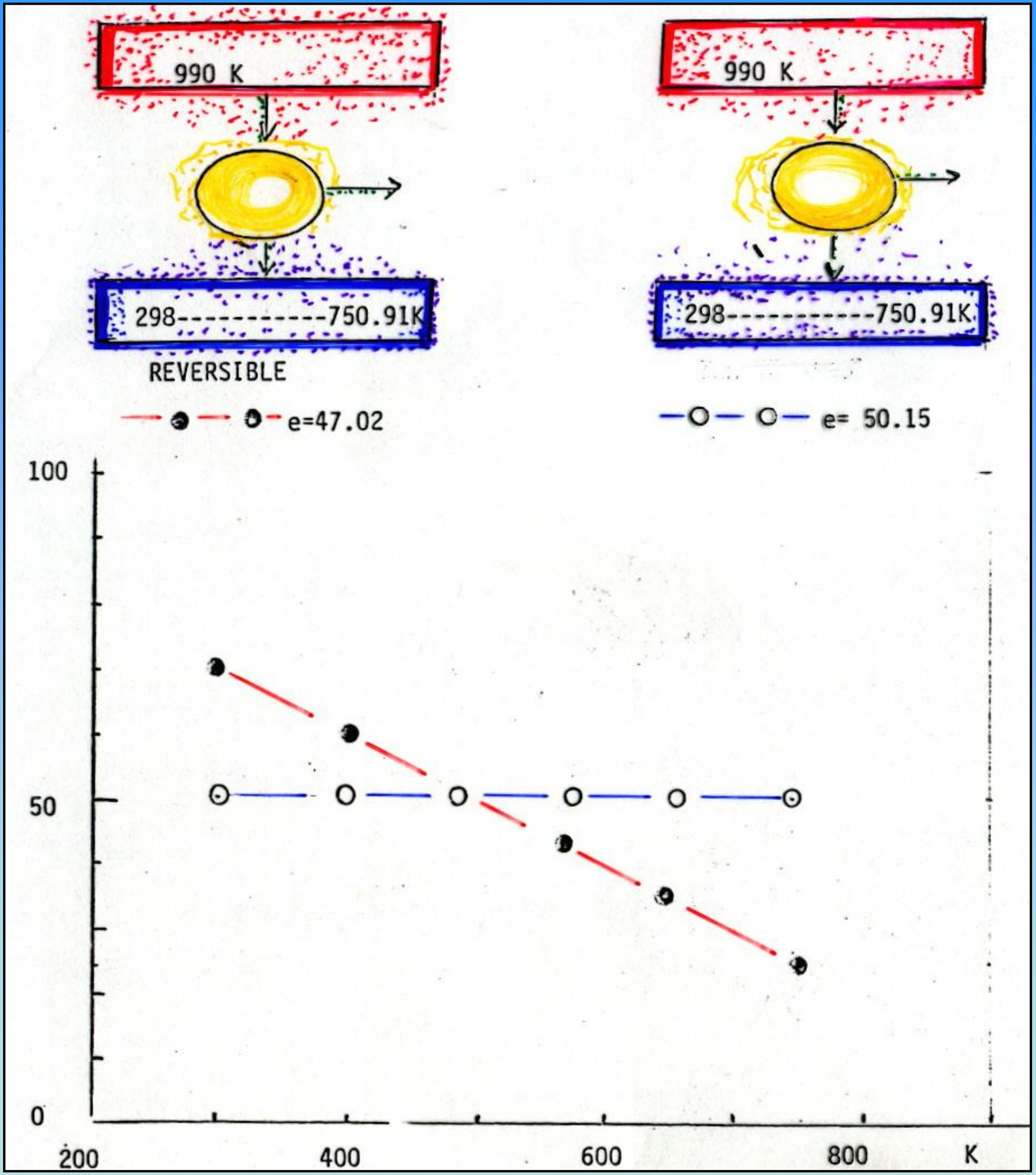

TA = 990 K
PA = 7.98 atm
TB = 298 K
PB = 0.25 atm
WA=-717.27cal
QA= 0 cal
Reversible
1
2
WA=2744.86cal
QA=2744.86cal
WB=-826.46cal
QB=-826.46cal
TA = 990 K
PA = 1.99 atm
TB = 298 K
PB = 1 atm
WA = 717.27cal
QA= 0 cal
Reversible
Reversible
WB=1358.73cal
QB=0 cal
TA = 750.91 K
PA = 4 atm
TB = 750.91 K
PB = 2.52 atm
4
3
WA=-1358.73cal
QA=-1358.73cal
WB=0cal
QB=1358.73cal
Acoplamiento de entropia interna
TA = 750.91 K
PA = 1 atm
TB = 298 K
PB = 1 atm
P
V
1
2
3
4
990K
750.91K
ec = 24.14 %
P
V
1
2
3
4
A
B
990 K
750.91K
298K
em = 69.89%
P
990K
298K
ee = 69.89



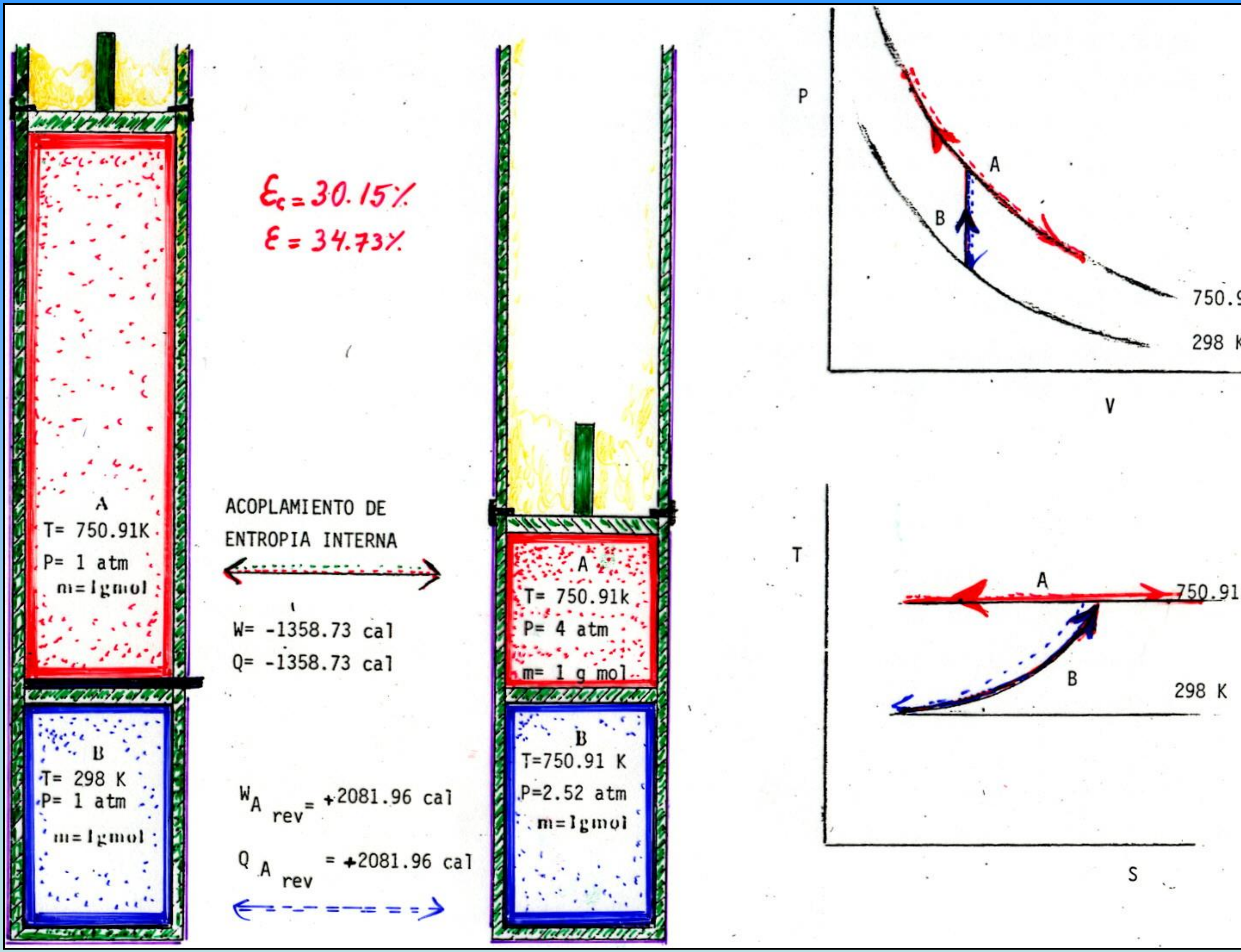
TA = 990 K
PA = 7.98 atm
TB = 298 K
PB = 1 atm
Reversible
1
2
WA =2744.86cal
QA =2744.86cal
TA = 990 K
PA = 1.99 atm
TB = 298 K
PB = 1 atm
WA= -717.27cal
QA= 0 cal
Reversible
WA= 717.27cal
QA= 0 cal
Reversible
WB= 0cal
QB = -1358.73cal
TA = 750.91K
PA = 4 atm
TB = 750.91 K
PB = 2.52 atm
4
3
WA=-1358.73cal
QA=-1358.73cal
WB=0cal
QB=1358.73cal
Acoplamiento de entropia interna
TA = 750.91K
PA = 1 atm
TB = 298 K
PB = 1 atm
P
V
ec=24.14%
990 K
750.91K
em =50.15 %
A
B
990K
750.91K
298K
ee = 47.02%
990K
524.45K
493.51K
298K



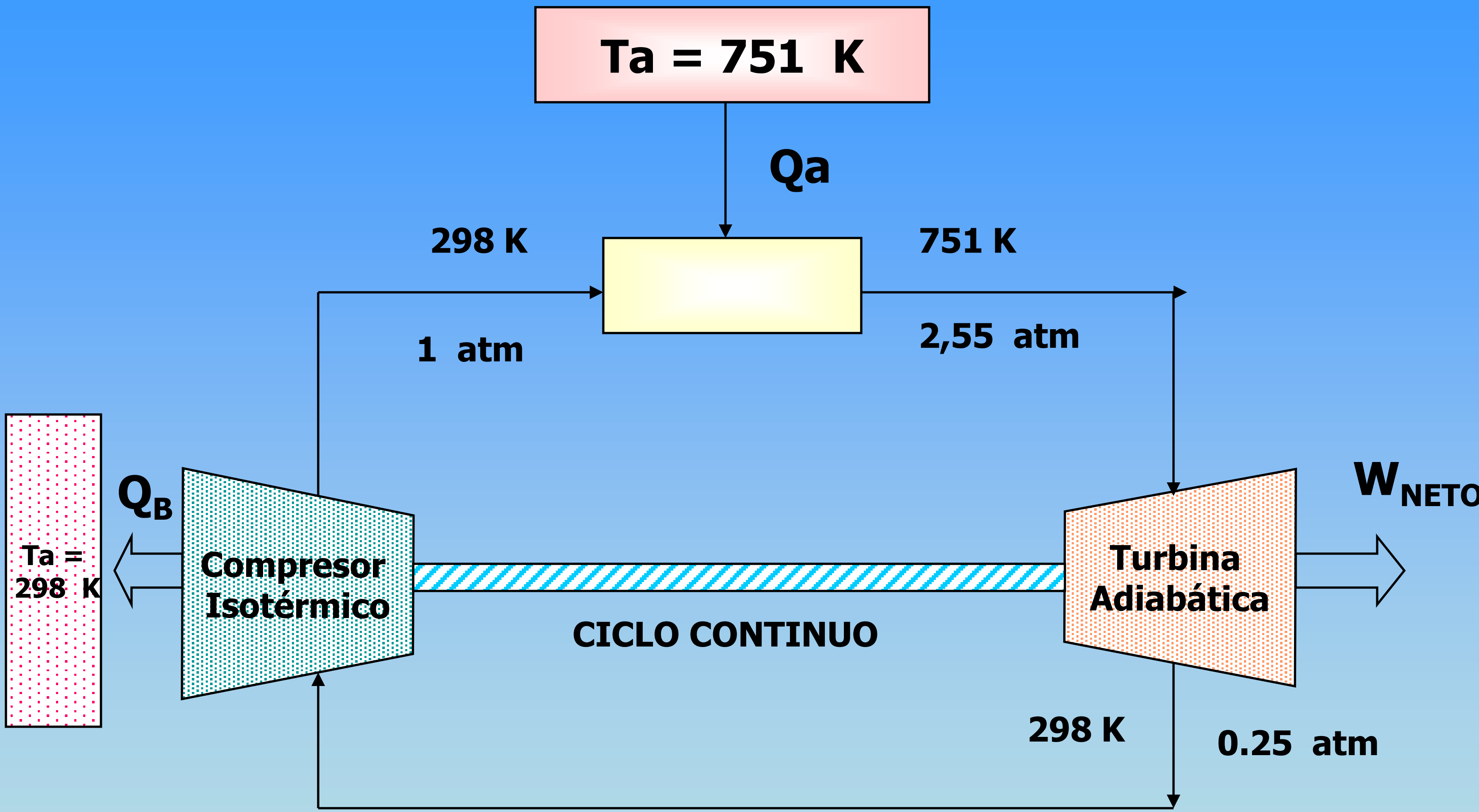
Ta=990K
Ta=990K
Ta=990K
Ta=990K
Ta=990K
Qa1
Qa2
Qai
Qa..
Qan
W1
W2
Wi
W...
Wn
Qb1
Qb2
Qbi
Qb..
Qbn
Tb1=751K
Tb2
Tbi
Tb....
Tbn=295K
1
e
0.5
800
700
600
500
400
300
200
Tb



990 K
990 K
298-----------750.91K
298-----------750.91K
REVERSIBLE
e=47.02
e= 50.15
100
50
0
200
400
600
800
K



A
T= 750.91K
P= 1 atm
m=1gmol
B
T= 298 K
P= 1 atm
m=1gmol
$\varepsilon_c = 30.15\%$
$\varepsilon = 34.73\%$
ACOPLAMIENTO DE
ENTROPIA INTERNA
W= -1358.73 cal
Q= -1358.73 cal
$W_{A\ rev}$ = +2081.96 cal
$Q_{A\ rev}$ = +2081.96 cal
A
T= 750.91k
P= 4 atm
m= 1 g mol
B
T=750.91 K
P=2.52 atm
m=1gmol
P
A
B
750.9
298 K
V
T
A
750.91K
B
298 K
S



$e = 64\ \%$ $\qquad$ $e_C = 61\ \%$

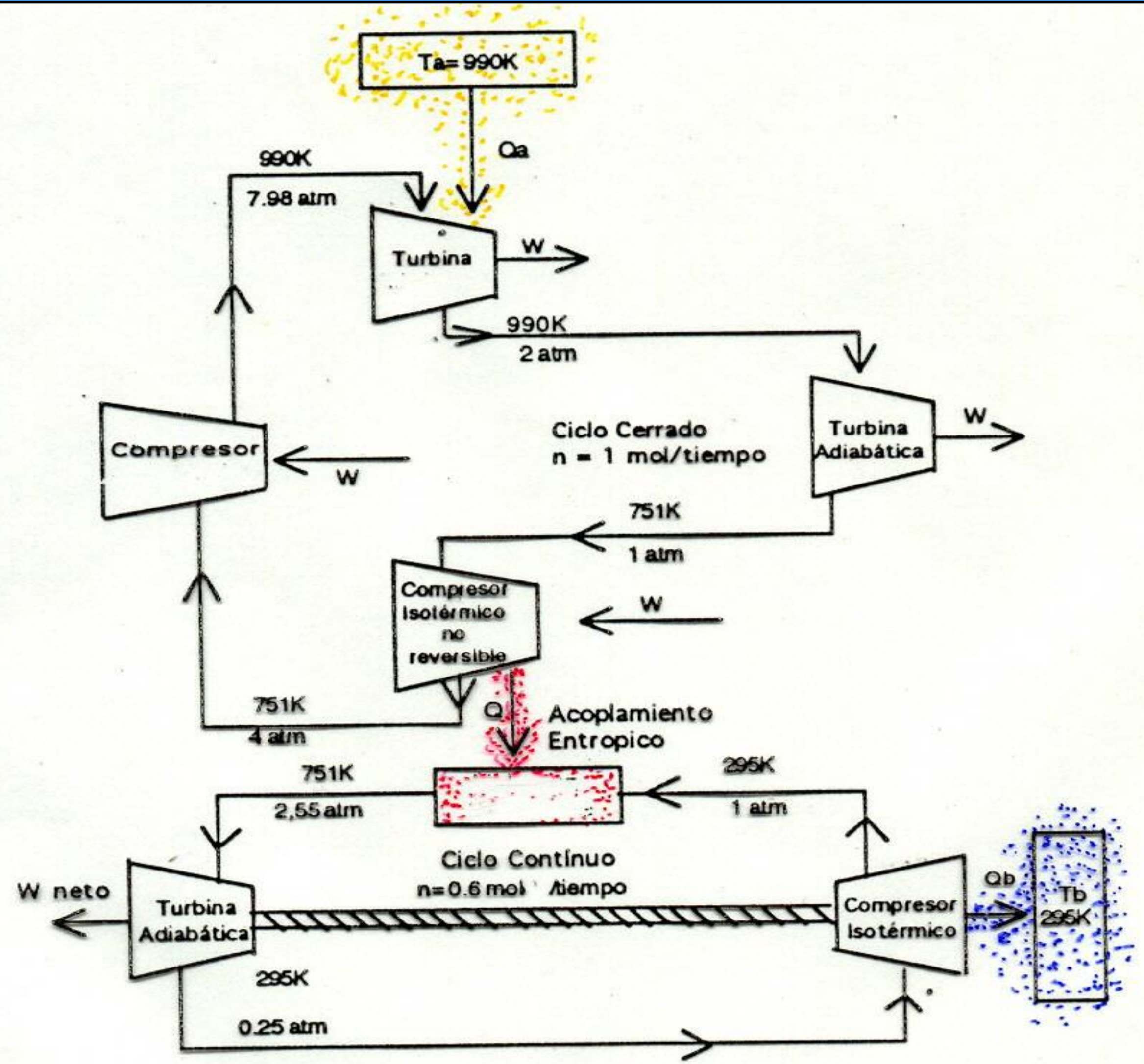
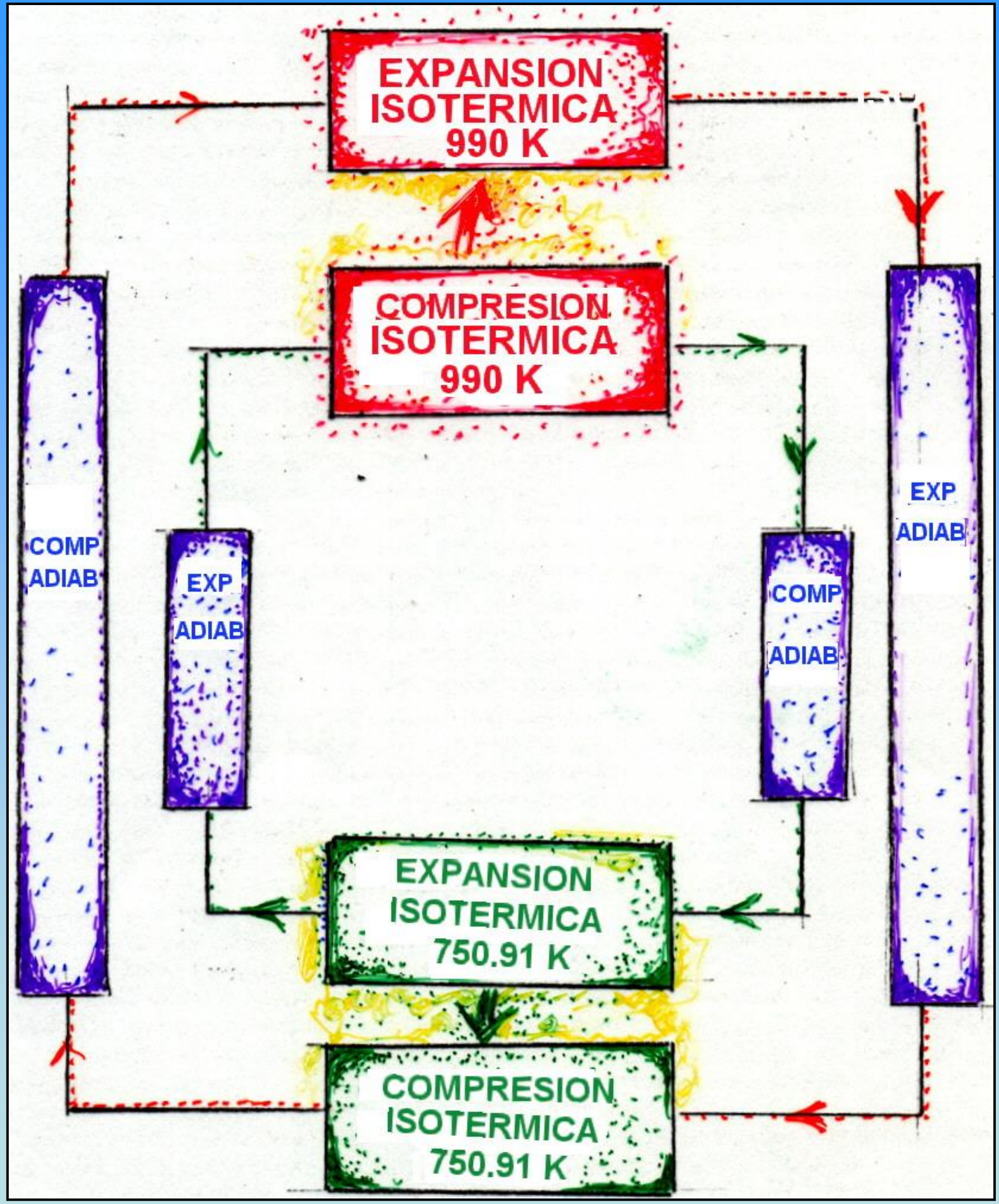
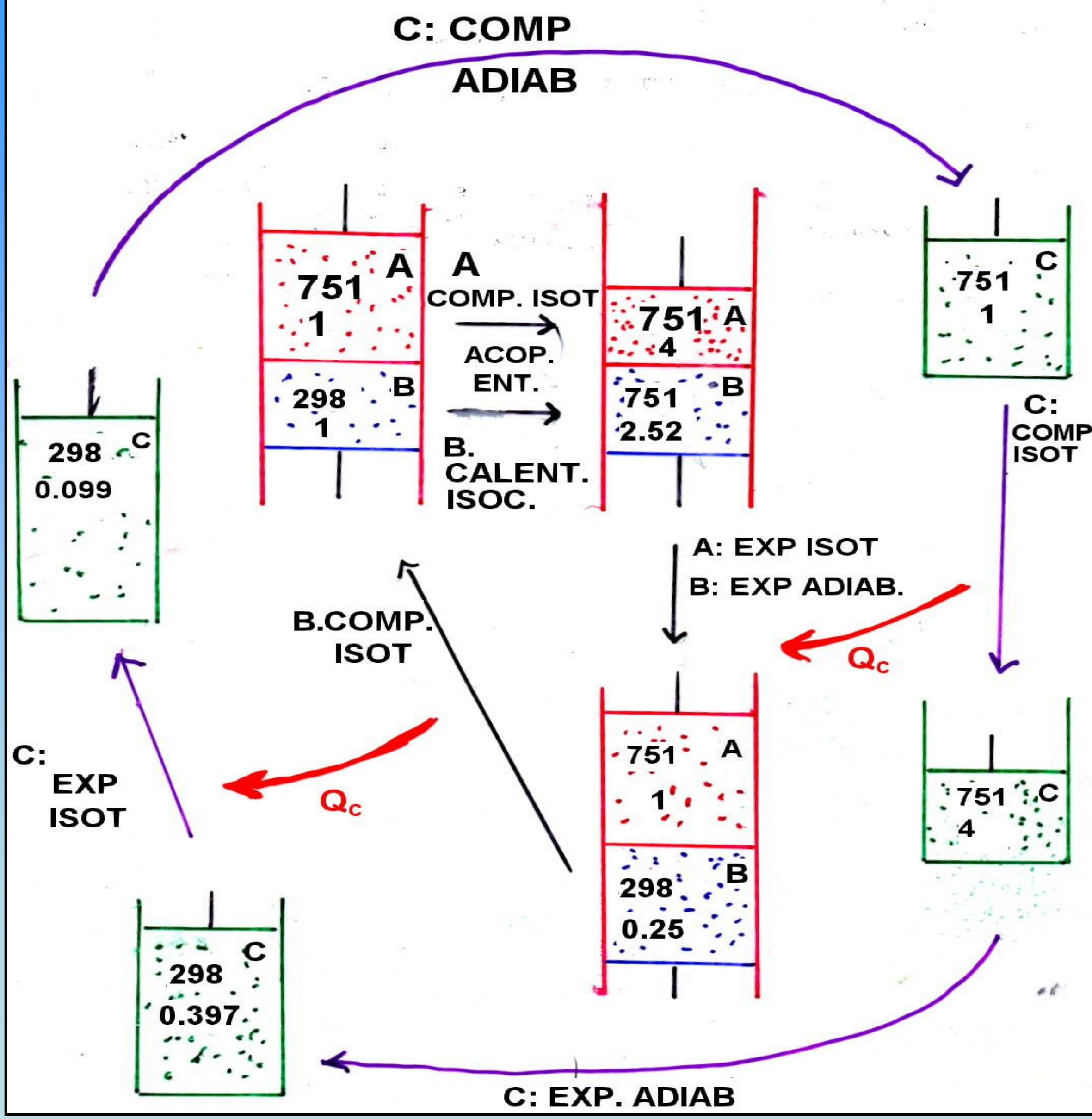


Fig. 11.4 $e = 82\ \%$ $e_c = 70\ \%$

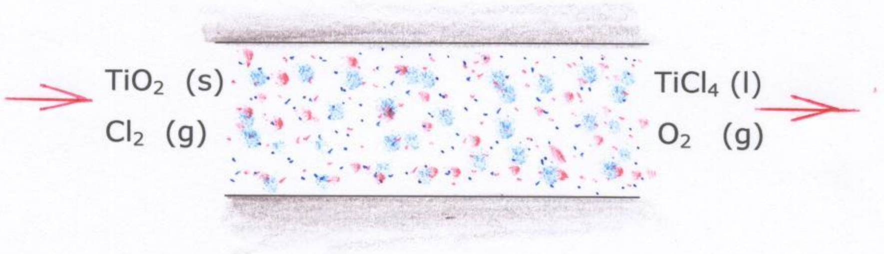

EXPANSION
ISOTERMICA
990 K
COMPRESION
ISOTERMICA
990 K
COMP
ADIAB
EXP
ADIAB
COMP
ADIAB
EXP
ADIAB
EXPANSION
ISOTERMICA
750.91 K
COMPRESION
ISOTERMICA
750.91 K

SISTEMA AISLADO COMPLEJO



$$TiO_2\,(s) + 2\,Cl_2\,(g) \longrightarrow TiCl_4\,(l) + O_2\,(g) \qquad (1)$$

$\Delta G_{R1} = 39.7$ Kcal/mol $\qquad \Delta S_{g1} = -\,0.133$ Kcal/mol K

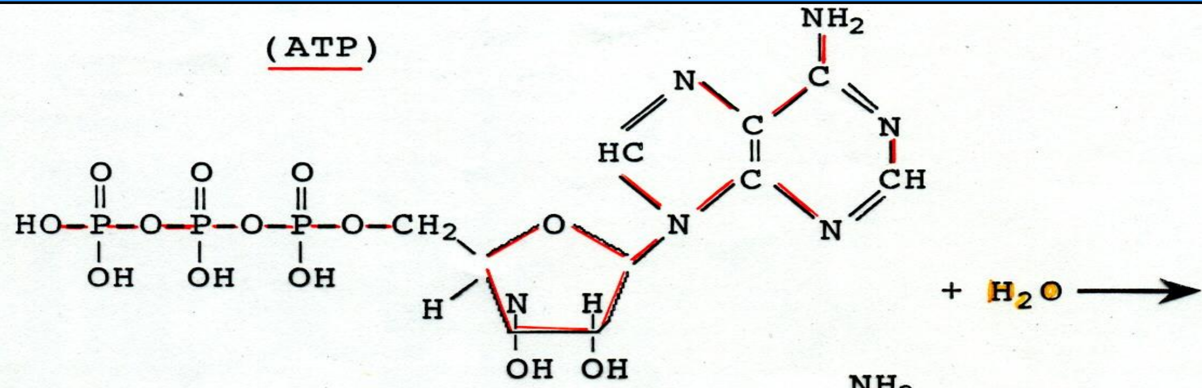


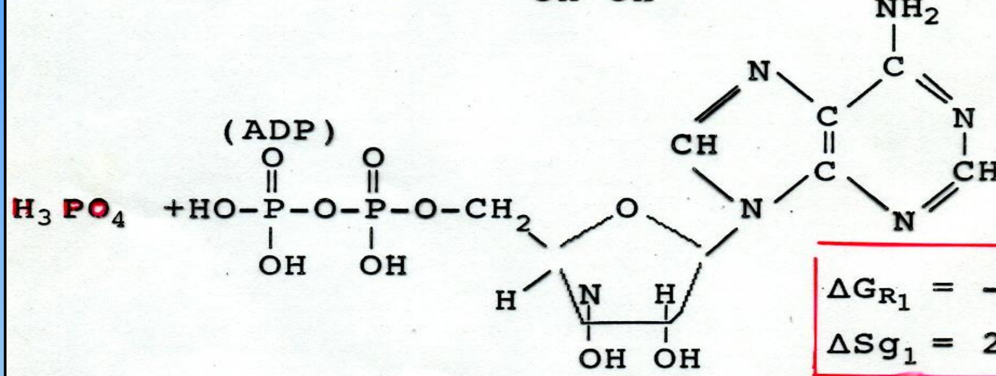
$$C\,(s) + O_2\,(g) \longrightarrow CO_2 \qquad (2)$$

$\Delta G_{R2} = -\,94.3$ Kcal/mol $\qquad \Delta S_{g2} = 0.316$ Kcal/mol K

$$TiO_2\,(s) + C(s) + 2Cl_2(g) \longrightarrow TiCl_4\,(l) + CO_2(g)$$

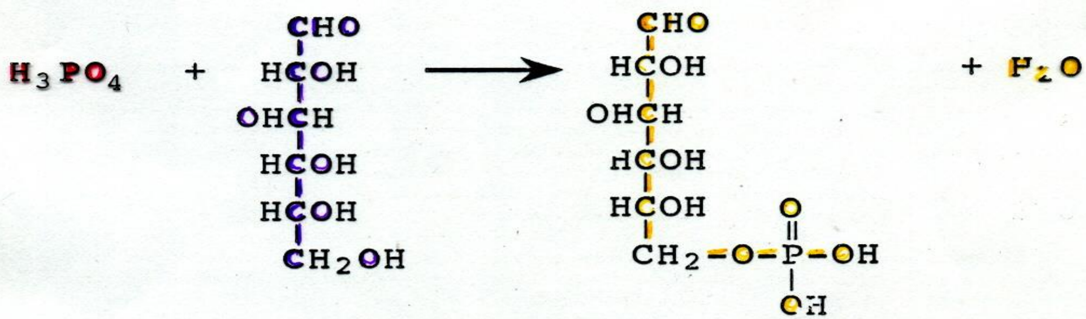
$\Delta G_R = -\,55.6$ kcal/mol $\qquad \Delta S_g = 0.187$ Kcal/mol K





$\Delta G_{R_1} = -\ 8100$ cal

$\Delta S_{g_1} = 27.18$ cal/K



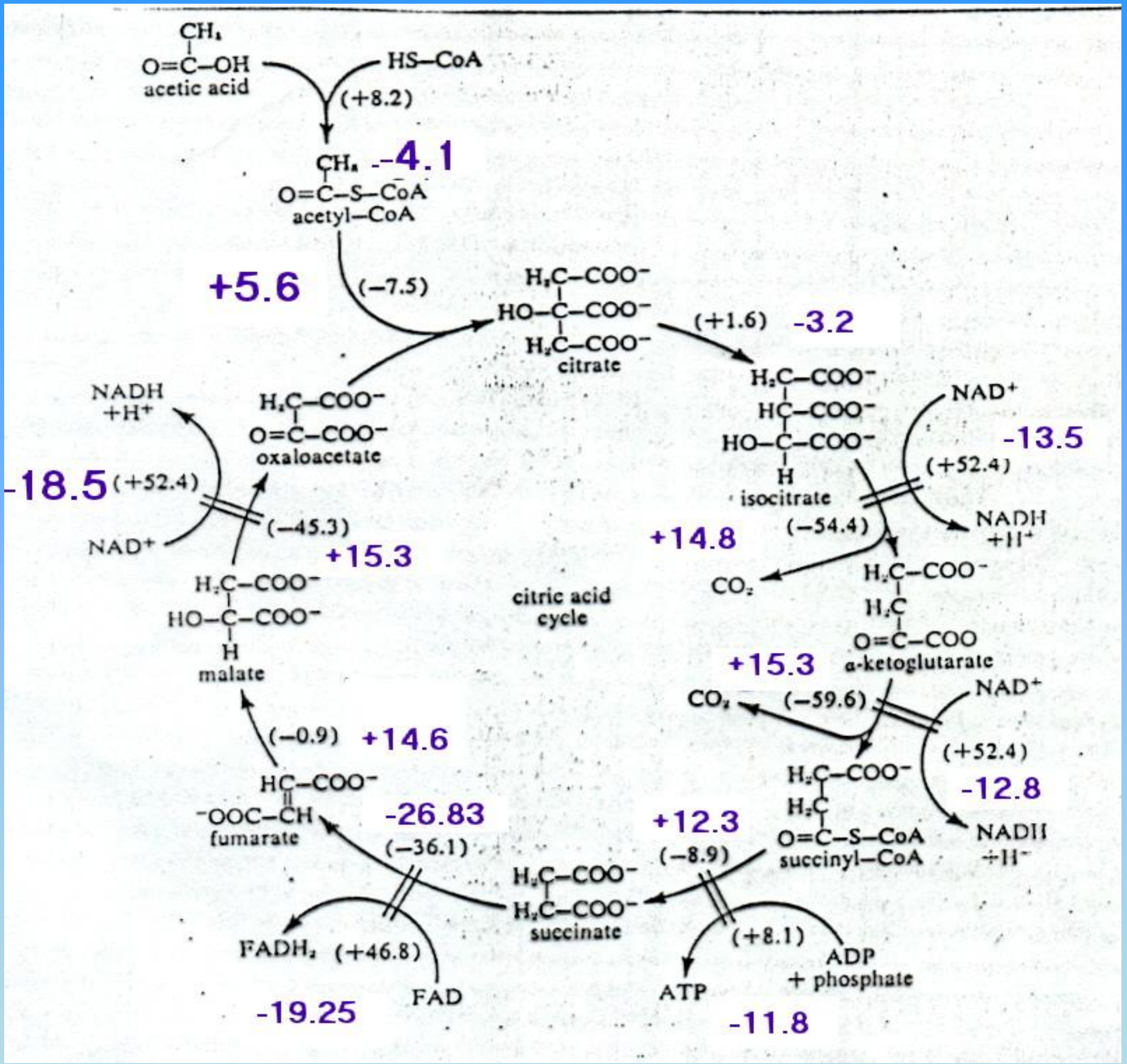
Glucosa

Glucosa-6-fosfato

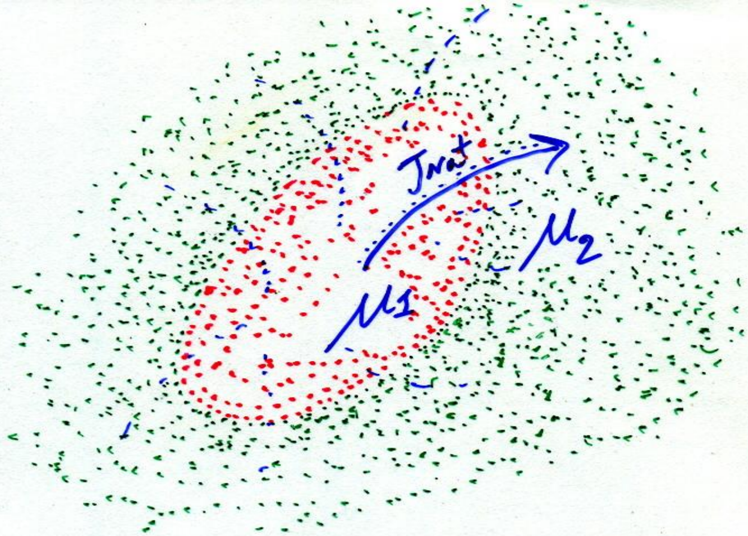
$\Delta G_{R_2} = 3000$ cal

$\Delta S_{g_2} = -\ 10$ cal/K

$\Delta S_g \cong \Delta S_{g_1} + \Delta S_{g_2} \cong 17$ cal $\quad T = 298$ K $\quad P = 1$ atm



$$\frac{\Delta S_g}{\Delta T} = 13.8\ \frac{cal}{K} = \frac{\Delta S_{g1}}{\Delta T} + \frac{\Delta S_{g2}}{\Delta T} + \cdots$$



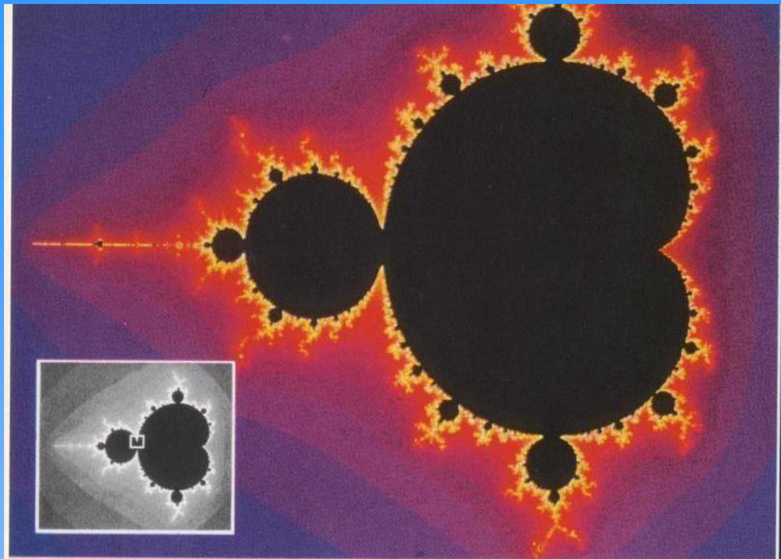
$$\mu_2 > \mu_1$$

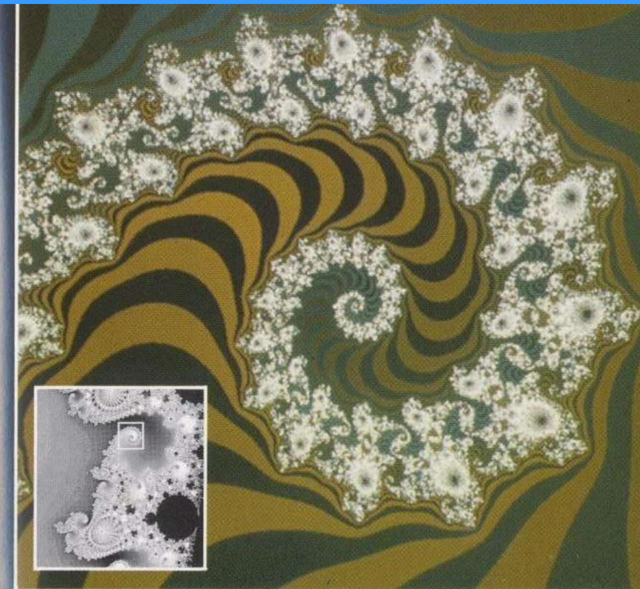
$$ATP + HOH \rightarrow ADP + H_3PO_4 \qquad \frac{dSg_1}{dt} = 17.11\ {}^{cal}\!/_{K}$$

$$J_{Na_1^+} \rightarrow J_{Na_2^+} \qquad \frac{dSg_2}{dt} = -14.6\ {}^{cal}\!/_{K}$$

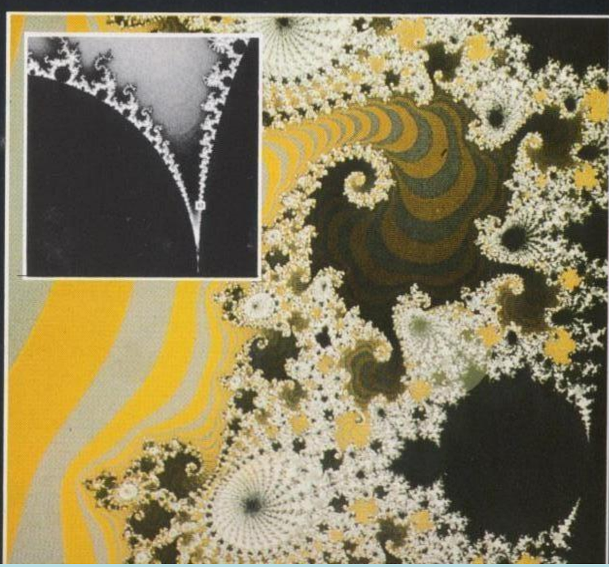
$$\frac{dSg}{dt} \cong \frac{dSg_2}{dt} + \frac{dSg_1}{dt} \cong 2.95\ {}^{cal}\!/_{K}$$

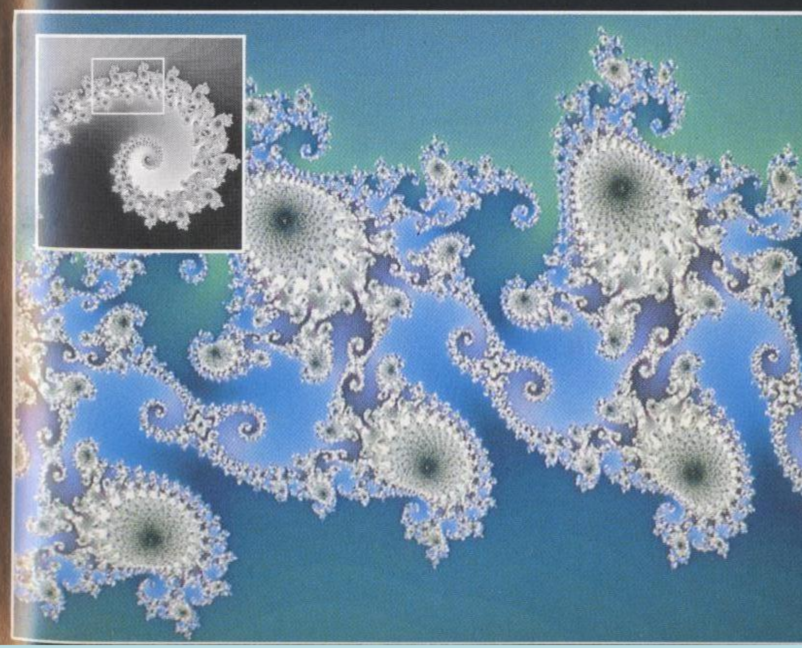
$$L_{12} \# 0$$

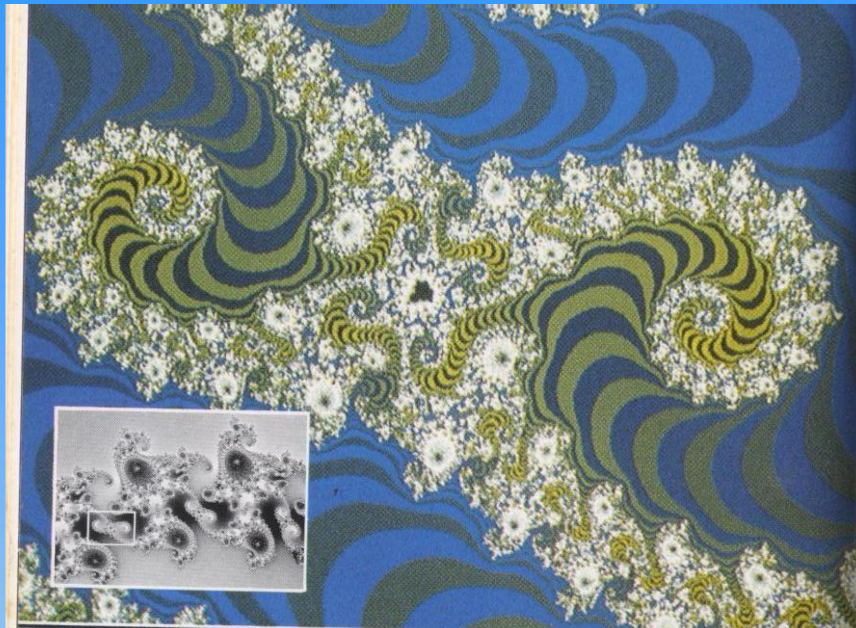
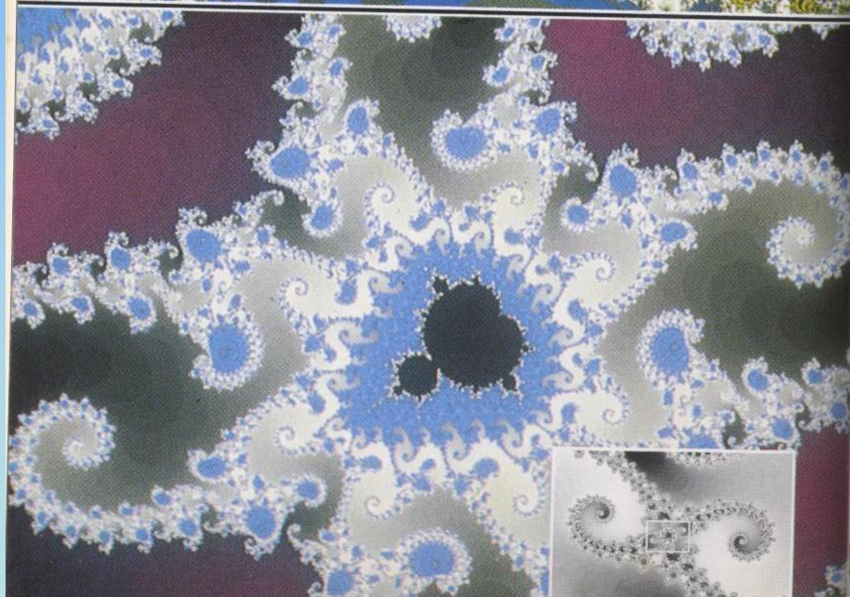
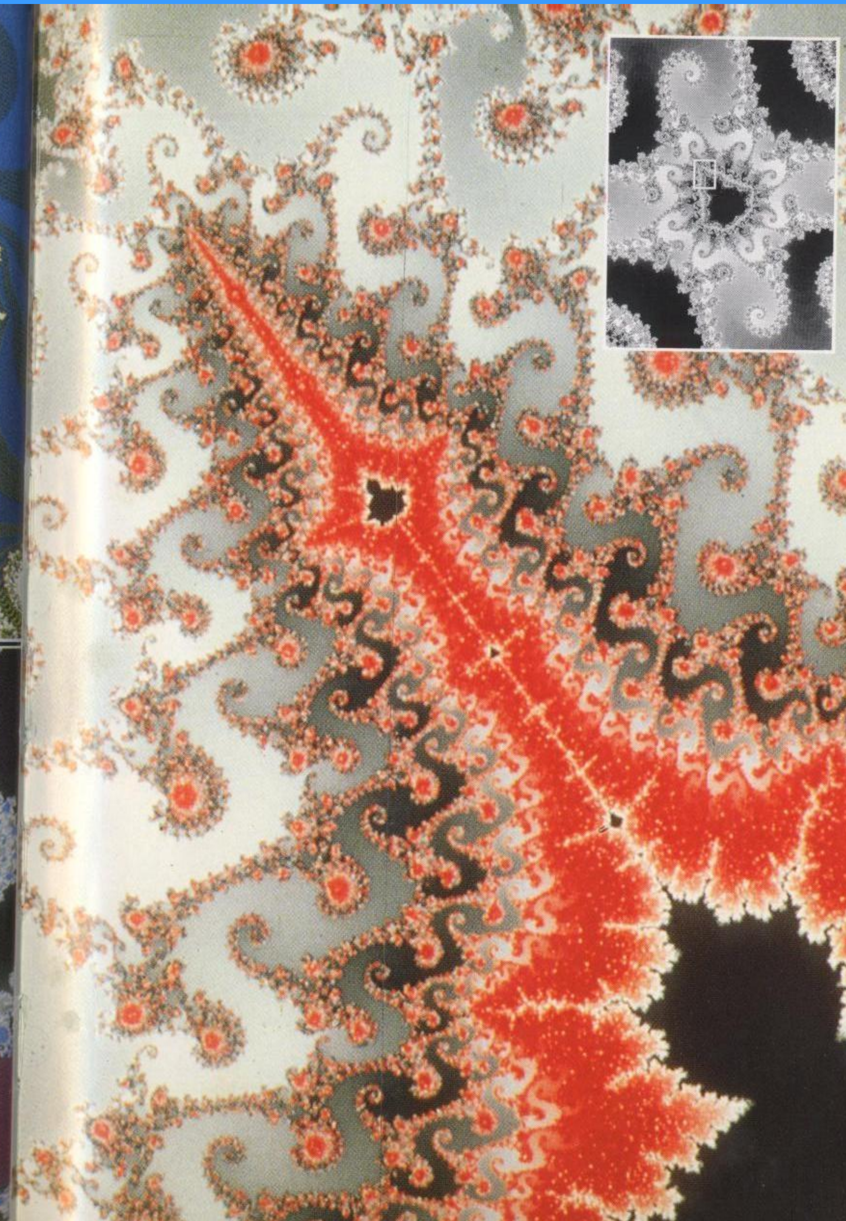


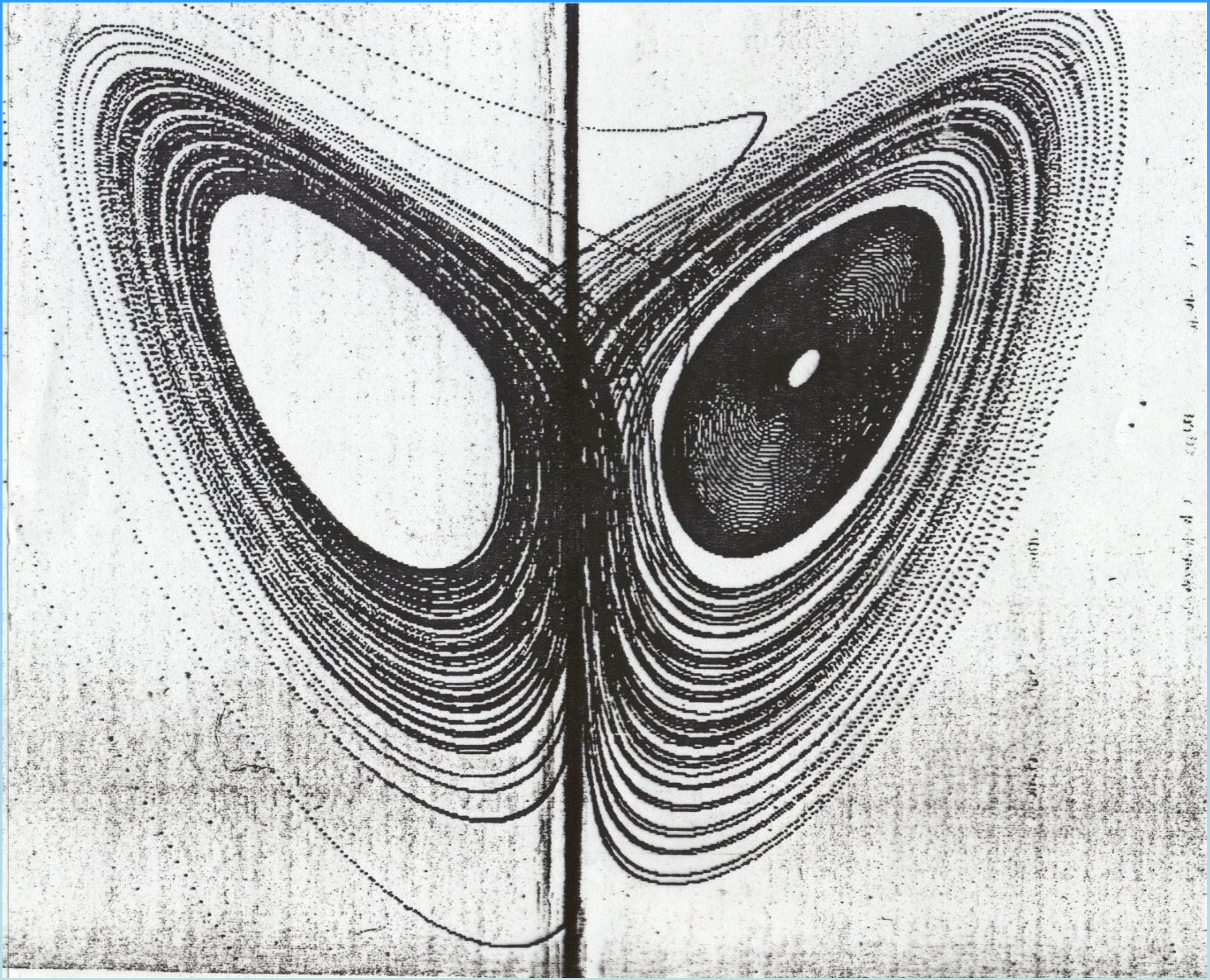


EL CONJUNTO DE MANDELBROT. Un viaje a través de escalas cada vez más pequeñas muestra la creciente complejidad del conjunto, con colas de caballo de mar y moléculas como islas, semejantes a la imagen total. En el último recuadro, el índice de ampliación es de un millón en cada dirección.







SEGÚN LAS TEORIAS DEL CAOS EL ORDEN Y EL DESORDEN COEXISTEN SIMULTANEAMENTE.

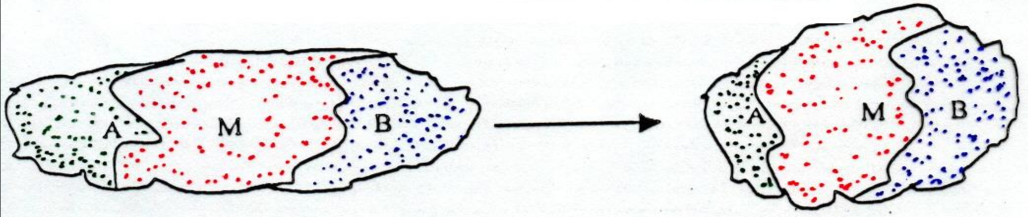
EL DESORDEN ES APARENTE Y DETRÁS DE ÈL SE ESCONDE UN ORDEN INTERNO.

LOS FRACTALES REVELAN EL ORDEN ESCONDIDO DETRÁS DEL CAOS.


Y
B
P
X
A
C
N
M

ACOPLAMIENTO ENTROPICO EN

SISTEMAS ADIABATICOS COMPLEJOS.



$$dS_{univ} = dS_A + dS_B + dS_M = d_eS_{univ} + d_iS_{univ}$$

$$= \frac{\delta_e Q_{univ}}{T_{univ}} + \frac{\delta_i Q_{univ}}{T_{univ}}$$

$$= \frac{\delta_i Q_{univ}}{T_{univ}}$$

$$= d_iS_{univ}$$

$$dS_A = \frac{\delta_e Q_A}{T_A} + \frac{\delta_i Q_A}{T_A} = \frac{\delta_e Q_A}{T_A} + d_i S_A$$

$$dS_B = \frac{\delta_e Q_B}{T_B} + \frac{\delta_i Q_B}{T_B} = \frac{\delta_e Q_B}{T_B} + d_i S_B$$

$$dS_M = \frac{\delta_e Q_M}{T_M} + \frac{\delta_i Q_M}{T_M} = \frac{\delta_e Q_M}{T_M} + d_i S_M$$

en muchos casos

$$\frac{\delta_e Q_M}{T_M} = -\left(\frac{\delta_e Q_A}{T_A} + \frac{\delta_e Q_B}{T_B}\right)$$

$$dS_{univ} = d_i S_{univ} = d_i S_A + d_i S_B + d_i S_M \geq 0$$

$$dS \overset{>}{\le} \frac{\delta Q}{T}$$

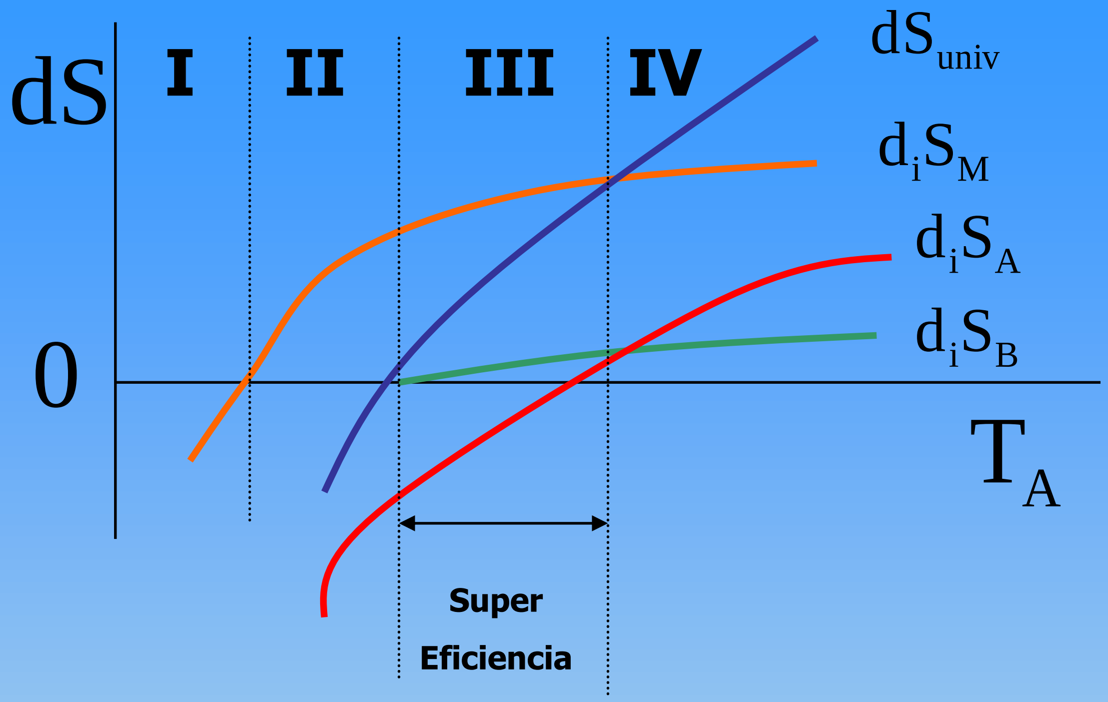
$$d_i S \overset{>}{\le} 0$$

$$dS_{univ} = d_i S_{univ} = \frac{\delta_e Q_1}{T_1} + \frac{\delta_e Q_2}{T_2} + \frac{\delta_e Q_3}{T_3} + + \frac{\delta_e Q_i}{T_i} +$$

$$+ d_i S_1 + d_i S_2 + + + d_i S_i \quad +$$

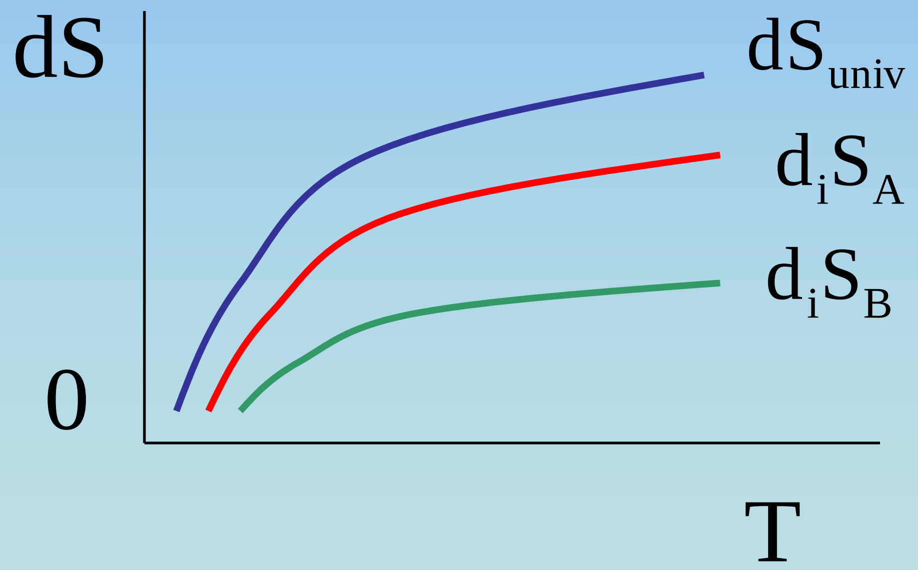
$$+ \sum_{i=1}^{i} \left(\sum_{e=1}^{n} m_e S_e - \sum_{S=1}^{m} m_S S_S \right)$$

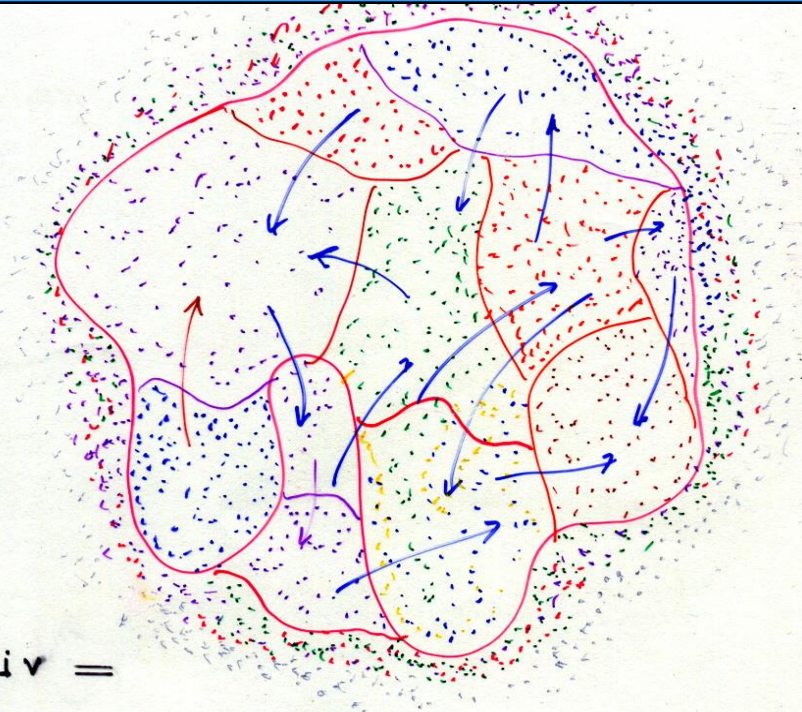
$$d_i S_1 > 0, \; d_i S_2 < 0, \; d_i S_3 > 0, \; d_i S_4 < 0, \ldots$$



Perfil Entrópico de Sistemas Adiabáticos Complejos

Concepción de Clausius y Prigogine





$$\Delta S_{univ} =$$

$$= \frac{dSg}{dT} = \frac{dSg_1}{dT} \pm \frac{dSg_2}{dT} \pm \frac{dSg_3}{dT} + + + \frac{dSg_n}{dT}$$

$$\frac{dSg_1}{dT} > 0, \frac{dSg_2}{dT} < 0, \frac{dSg_i}{dT} < 0 \ldots, \frac{dSg}{dT} > 0$$

ACOPLAMIENTO DE ENTROPIA INTERNA DEL UNIVERSO.

CONCLUSIONES

1.Es posible proponer un proceso termomecánico con acoplamiento de entropía. Aquí, simultáneamente se crea y destruye entropía en diferentes regiones del universo, mostrando soluciones insòlitas de las leyes de la termodinàmica.

2. El proceso presenta un comportamiento excepcional en el sentido de ser, más eficiente termodinámicamente que cualquier proceso reversible operando bajo el mismo cambio de estado.

3. El proceso se puede sustituir en una de las etapas de un ciclo convencional como el Ciclo de Carnot para generar un ciclo irreversible de mayor eficiencia que el correspondiente ciclo equivalente de Carnot.

4. Empleando procesos con acoplamiento de entropía interna, se pueden mejorar los ciclos clásicos convencionales. Es posible acoplar procesos isobáricos, isotérmicos e isocóricos.

5. Este estudio sugiere la posibilidad de diseñar máquinas más eficientes que las actuales. Implica el manejo de la supereficiencia de la naturaleza y la manipulación de las fuerzas entrópicas.

6. Estas transformaciones implican la conversión simultánea de orden y desorden. Entropía y Antientropía. Inversiòn de la flecha del tiempo y Simetría y Antisimetrìa de los flujos entròpicos.

7. Las concepciones de Clausius , Prigogine, Caratheodory, Boltzmann, Carnot, Kelvin, entre otros deben reinterpretarse para explicar la producción y destrucción de entropía .

Esto conduce a presentar la Segunda Ley según

$$dS \geq \frac{\delta Q}{T} \qquad dS_g \gtreqless 0$$

$$\Delta S_U \gtreqless 0$$

8. Desde el punto de vista filosófico sugiere que si el universo actual se concibe como un conjunto de subsistemas interconectados, tal como es la realidad, entonces es posible la existencia de fenómenos acoplados con creación y destrucción de entropía que pueden mantener la entropía total del universo, por debajo del límite de la Muerte Térmica de la termodinámica clásica. Los sistemas parecen resucitar del Apocalipsis Entròpico.

9. Los procesos creadores de entropía actúan como una fuerza Homogenizante de la energía y los destructores como una fuerza Heterogenizante. Este antagonismo explica la dinámica del universo y la existencia de los seres y su multiplicidad.

Revelan lo efímero y lo eterno de este universo impermanente y probabilístico.

Metafísicamente,
Vislumbra otras
Dimensiones de la
Realidad, la Vida, la
Muerte, el Caos y
Anticaos ,
Transustanciación,
Resurrección,   Milagros,
Alquimia, Dioses y
Demonios.