GAS IDEALA

5.1* * GAS IDEALAREN DEFINIZIOA

- GAS IDEALAREN EGOERA-EKUAZIOA
  - VIRIAL GARAPENA
  - LIMITEA

5.2 - GAS IDEALAREN BARNE-ENERGIA

5.3
- DEFINIZIOAREN BIA : SAIAKUNTZAK
- DEFINIZIOA BERA
- LEHENENGO PRINTZIPIOAREN ADIERAZPENAK : GAS IDEALA

5.4 - GAS IDEALAREN BERO-AHALMENAK

5.5 * PROZESU ADIABATIKOAK

- MATEMATIKOKI
- GRAFIKOKI

** * PROZESU POLITROPIKOAK

- MATEMATIKOKI
- GRAFIKOKI

*5.1 irakurri

ESPANTSIO ASKEA

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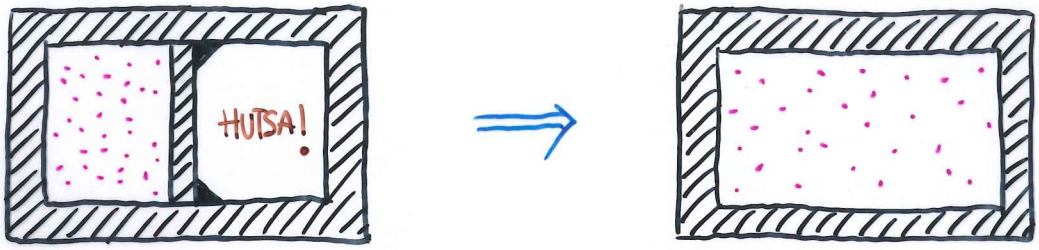


$$Q = \Delta U - W$$

$Q = 0$ ADIABATIKOA

$W = 0$ "HUTSAREN" KONTRAKO ESPANTSIOA

$$\Delta U = 0 \Rightarrow U_f - U_i = 0 \Rightarrow U_f = U_i$$

($dU \neq 0$; $dU = 0 \Rightarrow U = KTE.$)

KONTUZ !!!

GAS IDEALA KONTZEPTUAREN DEFINIZIOAREN BILA

* $U = U(T,V)$ $\quad dU = \left(\frac{\partial U}{\partial T}\right)_V dT + \left(\frac{\partial U}{\partial V}\right)_T dV$

ESPANTSIO ASKEA $dU = 0$ ETA ONARTUZ $dT = 0 \Rightarrow \left(\frac{\partial U}{\partial V}\right)_T = 0$

* $U = U(T,P)$ $\quad dU = \left(\frac{\partial U}{\partial T}\right)_P dT + \left(\frac{\partial U}{\partial P}\right)_T dP$

ESPANTSIO ASKEA $dU = 0$ ETA ONARTUZ $dT = 0 \Rightarrow \left(\frac{\partial U}{\partial P}\right)_T = 0$

dU + PROZESU ISOTERMIKOA $\boxed{U = U(T)}$

ESPERIENTZIAREN ARABERA: $\left(\frac{\partial U}{\partial P}\right)_T \neq 0 \Rightarrow U = U(T,P)$

$\left(\frac{\partial U}{\partial P}\right)_T = f(T) \Rightarrow U = f(T)P + F(T)$

GAS IDEALA

$P \cdot V = nRT$

$\left(\frac{\partial U}{\partial P}\right)_T = 0$

$\left[\left(\frac{\partial U}{\partial V}\right)_T = 0\right]$

$\Rightarrow U = U(T)$

EGOERA-EKUAZIOAK

$P \cdot V = nRT$ MEKANIKOA

$U = U(T)$ TERMIKOA

LEHENENGO PRINTZIPIOAREN ADIERAZPENA : GAS IDEALAREN KASUA

$$Q = \Delta U - W$$ OROKORRA

$$\delta Q = dU - \delta W$$

$$\delta W = -p\,dV$$ SISTEMA HIDROSTATIKOA (SOILIK)

$$\boxed{\delta Q = dU + p\,dV}$$

$$C_V = \left(\frac{\delta Q}{dT}\right)_V \Rightarrow \left[\frac{\delta Q}{dT} = \frac{dU}{dT} + p\frac{dV}{dT}\right]_V$$

$$dU = \left(\frac{\partial}{\partial T}\right)_V dT + \left(\frac{\partial}{\partial V}\right)_T dV$$

$$\left[\frac{\delta Q}{dT} = \left(\frac{\partial U}{\partial T}\right)_V \frac{dT}{dT} + \left\{\left(\frac{\partial U}{\partial V}\right)_T + p\right\}\frac{dV}{dT}\right]_V \quad \left(\frac{dV}{dT} \to 0\right)$$

$C_V = \left(\frac{\partial U}{\partial T}\right)_V$ OROKORRA $\longrightarrow$ $U = U(T)$ $\longrightarrow$ $C_V = \left(\frac{dU}{dT}\right) \rightsquigarrow$ $\boxed{dU = C_V\,dT}$ GAS IDEALA !!!

(1) - $\boxed{\delta Q = C_V\,dT + p\,dV}$

$P \cdot V = nRT \Rightarrow d(PV) = d(nRT)$

$C_p = C_V + nR$

(2) - $\boxed{\delta Q = C_p\,dT - V\,dp}$

LEHENENGO PRINTZIPIOA GAS IDEALEAN

PROZESU ADIABATIKOAK ADIERAZPENAK

$$\delta Q = dU - \delta W$$ LEHENENGO PRINTZIPIOA OROKORRA

$$\delta Q = C_v dT + p dV$$
$$\delta Q = C_p dT - V dp$$ GAS IDEALAREN KASUAN

PROZESUA ADIABATIKOA DA: $\delta Q = 0$

$$0 = C_v dT + p dV \quad \Rightarrow \quad p dV = -C_v dT$$
$$0 = C_p dT - V dp \quad \Rightarrow \quad V dp = C_p dT$$

$$\frac{p}{V} \cdot \frac{dV}{dp} = -\frac{C_v}{C_p}$$

GAS IDEALETAN

$$\frac{1}{p} dp = -\frac{C_p}{C_v} \frac{1}{V} dV$$

PROZESU ADIABATIKOARI DAGOKION ADIERAZPEN DIFERENTZIALA

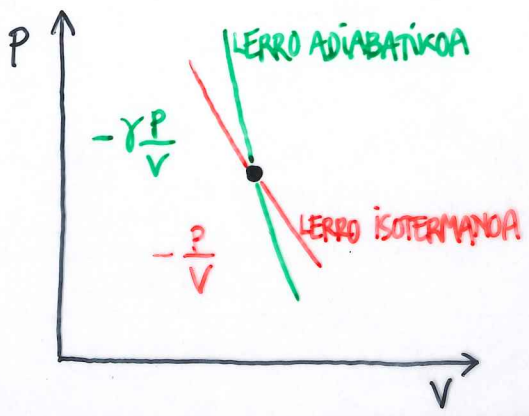
$\gamma \equiv \frac{C_p}{C_v}$ INDIZE ADIABATIKOA $[\gamma > 1 \; ; \; C_p > C_v]$

$$\frac{1}{p} dp = -\gamma \frac{1}{V} dV$$

$$P V^{\gamma} = \text{Kte}$$

PROZESU ADIABATIKOARI DAGOKION ADIERAZPENA

$$\{P, V\} \Rightarrow P V^{\gamma} = K'$$
$$\{P, T\} \Rightarrow T P^{\frac{1-\gamma}{\gamma}} = K''$$
$$\{T, V\} \Rightarrow T V^{\gamma - 1} = K'''$$



PROZESU POLITROPIKOAK ADIERAZPENAK

GAS IDEALA (-ETAN) $PV^j = Kte$ ADIERAZPENA DUTEN PROZESUAK

j EDOZEIN IZAN DAITEKE

$Kte = P_0 V_0^j = P_1 V_1^j = \dots$

W (i) $\delta W = -pdV$

$PV^j = C \Rightarrow p = \frac{C}{V^j}$

$$\left.\begin{array}{l}\delta W = -pdV \\ PV^j = C \Rightarrow p = \frac{C}{V^j}\end{array}\right\} \delta W = -\frac{C}{V^j}dV \Rightarrow W = -C\int \frac{1}{V^j}dV$$

$$W = \frac{1}{(j-1)}(P_2V_2 - P_1V_1)$$

$$W = \frac{1}{(j-1)} nR(T_2 - T_1)$$

ΔU (ii) $U = U(T) \Rightarrow dU = C_v dT \Rightarrow \Delta U = C_v \Delta T$

$$\Delta U = C_v(T_2 - T_1) \qquad \Delta U = C_v nR(T_2 - T_1)$$

Q (iii) $Q = \Delta U - W$

$$Q = nR(T_2 - T_1)\left[C_v - \frac{1}{(j-1)}\right]$$

$$Q = \frac{(T_2 - T_1)}{(j-1)}[jC_v - C_p]$$

$$Q = \frac{(T_2 - T_1)}{(j-1)} nR[jC_v - C_p]$$

$j = 1$	ISOTERMIKOA	$(T = C')$
$j = 0$	ISOBAROA	$(p = C'')$
$j = \pm\infty$	ISOKOROA	$(V = C''')$
$j = \gamma \left(\equiv \frac{c_p}{c_v}\right)$	ADIABATIKOA	$(S = C^{IV})$