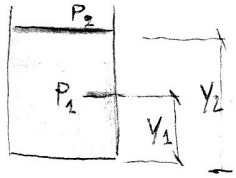
TERMODINAMICA

VARIAZIONE della PRESSIONE IN UN FLUIDO A RIPOSO



$$p_2 - p_1 = -\rho g h$$

$$p = p_0 + \rho g h$$

$$p = \frac{dF}{dA} \quad \left[\frac{N}{m^2} = Pa\right]$$

$p_0 = 101325\ Pa$

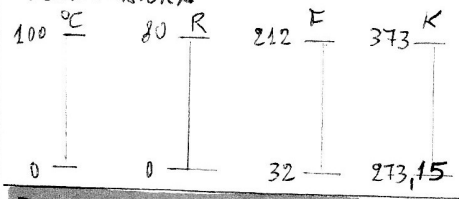
$1\ bar = 10^5\ Pa$

$1\ atm = 101325\ Pa$

$14\ PSI = 1\ atm$

$1\ Torr = 1\ mm\ Hg = 133{,}322\ Pa$

TEMPERATURA



$$T_C = T_K - 273{,}15$$

$$T_F = \frac{9}{5} T_C + 32$$

DILATAZIONE TERMICA

$\Delta L = \alpha L \Delta T$

$\Delta A = 2\alpha A \Delta T$

$\Delta V = 3\alpha V \Delta T$

α è il coeff. di dilat. lineare

β volumica

per i fluidi $\Delta V = \beta V \Delta T$

IL GAS PERFETTO

$$pV = NKT$$

$$pV = mRT$$

K = COSTANTE di BOLTZMAN $= 1{,}38 \cdot 10^{-23}\ J/K$

N = NUMERO DI MOLECOLE

$N = m N_A$

m = numero di moli

N_A = numero di Avogadro $= 6{,}022 \cdot 10^{23}$ molecole/mol

R = costante molare dei gas $= 8{,}31\ \frac{J}{mol \cdot K}$

Il CALORE è energia che fluisce tra un sistema e il suo ambiente a causa della differenza di temperatura fra essi esistente

Convenzione: $Q > 0$ se ceduto dall'AMBIENTE → SISTEMA

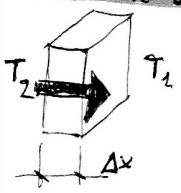
$Q < 0$ se ceduto SISTEMA → AMBIENTE

$L > 0$: compiuto dall'AMBIENTE → SISTEMA

$L < 0$: compiuto dal SISTEMA → AMBIENTE

TRASMISSIONE del CALORE

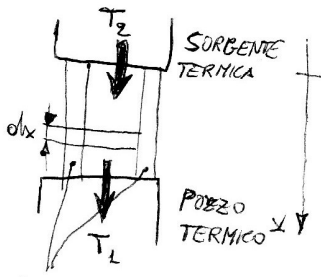
CONDUZIONE del CALORE

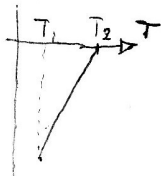


$$H = K \frac{A \Delta T}{\Delta x}$$

K = conducibilità termica

$T_2 > T_1$





$$H = -KA \frac{dT}{dx}$$

gradiente termico

CAPACITÀ TERMICA

$$Q = C \Delta T$$

CAPACITÀ TERMICA SPECIFICA

$$c_s = \frac{C}{m}$$

$$Q = c_s m \Delta T$$

CAPACITÀ TERMICA MOLARE

$$= c_s \cdot M = 25\ J/mol\,K$$

massa molare

ENERGIA INTERNA di UN GAS IDEALE

$E_{INT\ MOL\ monoatomica} = \frac{3}{2} NKT = \frac{3}{2} mRT$

$E_{INT\ MOL\ biatomica} = \frac{5}{2} NKT = \frac{5}{2} mRT$

$E_{INT\ MOL.\ POLIATOMICA} = 3NKT = 3mRT$

$$C_V = \frac{3}{2} R = 124{,}65\ \frac{J}{mol \cdot K}$$

$$C_p = C_V + R$$

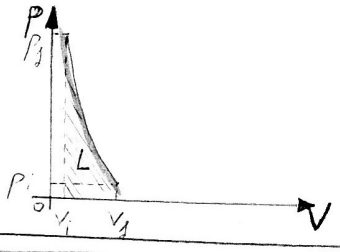
$$\gamma = \frac{C_p}{C_V}$$

CALORE LATENTE di TRASFORMAZIONE $\quad C_L = \frac{Q}{m}$

1° PRINCIPIO TERMODINAMICA : $\boxed{\Delta E_{int} = Q + L}$ $\Delta E_{int} = m c_V \Delta T$ | $L = -\int p\,dV$

TRASFORMAZIONI

ADIABATICA



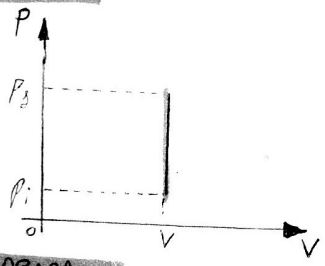
$\boxed{Q = 0}$ $\boxed{\Delta E_{int} = L}$

$\boxed{L = \frac{1}{\gamma - 1}\left[p_f V_f - p_i V_i\right]}$

$\boxed{p V^{\gamma} = cost}$

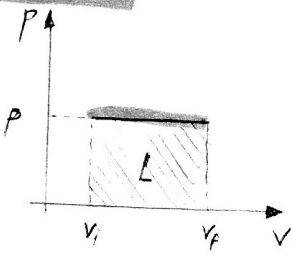
$\boxed{T V^{\gamma - 1} = cost}$

ISOCORA



$\boxed{\Delta V = 0}$ $\boxed{L = 0}$ $\boxed{\Delta E_{int} = Q}$ $\boxed{Q = m c_V \Delta T}$

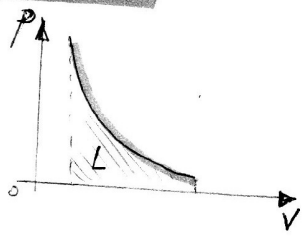
ISOBARA



$\boxed{\Delta p = 0}$ $\boxed{\Delta E_{int} = Q + L}$ $\boxed{Q = m c_p \Delta T}$

$\boxed{L = -p(V_f - V_i)}$

ISOTERMA



$\boxed{\Delta E_{int} = 0}$ $\boxed{Q = -L}$

$\boxed{L = -mRT \ln\left(\frac{V_f}{V_i}\right)}$

ESPANSIONE LIBERA

$\boxed{Q = L = 0}$ $\boxed{\Delta E = 0}$ $\boxed{\Delta T = 0}$

$\gamma = \frac{5}{3} = 1{,}67$	GAS	MONOATOMICO
$\gamma = \frac{7}{5} = 1{,}40$	GAS	BIATOMICO
$\gamma = \frac{4}{3} = 1{,}33$	GAS	POLIATOMICO

$\boxed{C_p = C_V + R}$

$C_V = \frac{3}{2}R$	(GAS MONOATOMICO)	$\Rightarrow C_p = \frac{5}{2}R$
$C_V = \frac{5}{2}R$	(GAS BIATOMICO)	$\Rightarrow C_p = \frac{7}{2}R$
$C_V = 3R$	(GAS POLIATOMICO)	$\Rightarrow C_p = 4R$