Fondamenti di fisica generale

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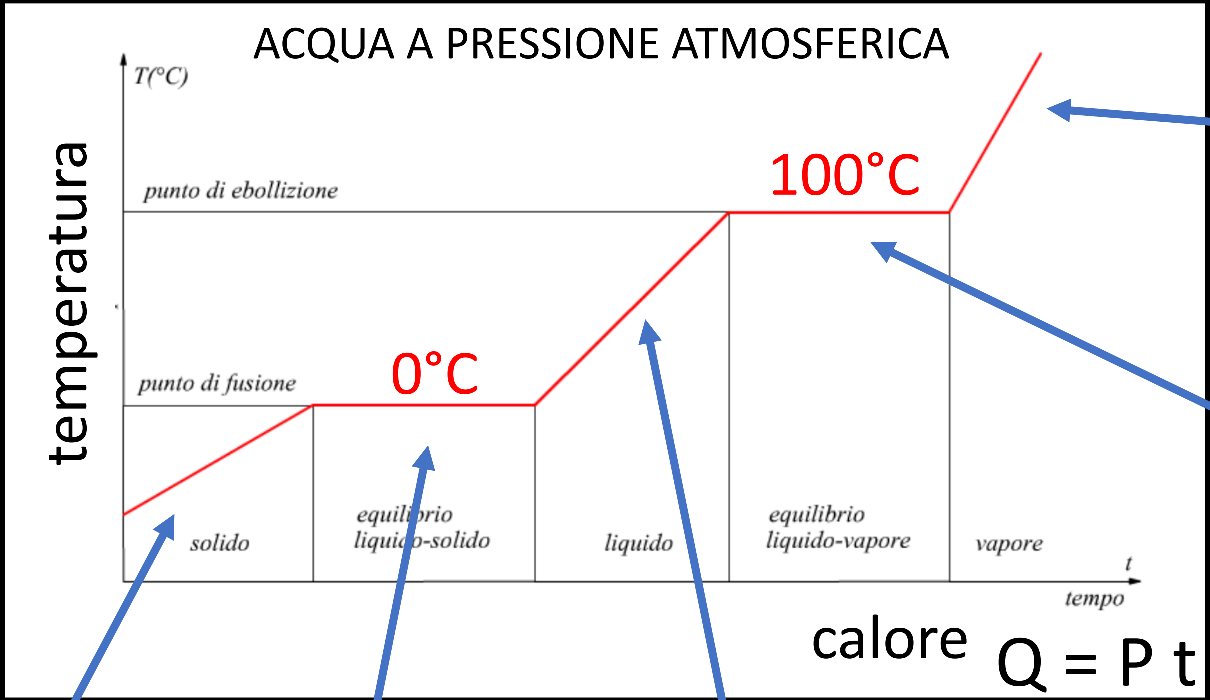
mercoledì 1 dicembre 2021
14:00-15:00
sincrona
https://meet.google.com/khp-neqs-kgd

LEZ 7S

CAMBIAMENTI DI STATO



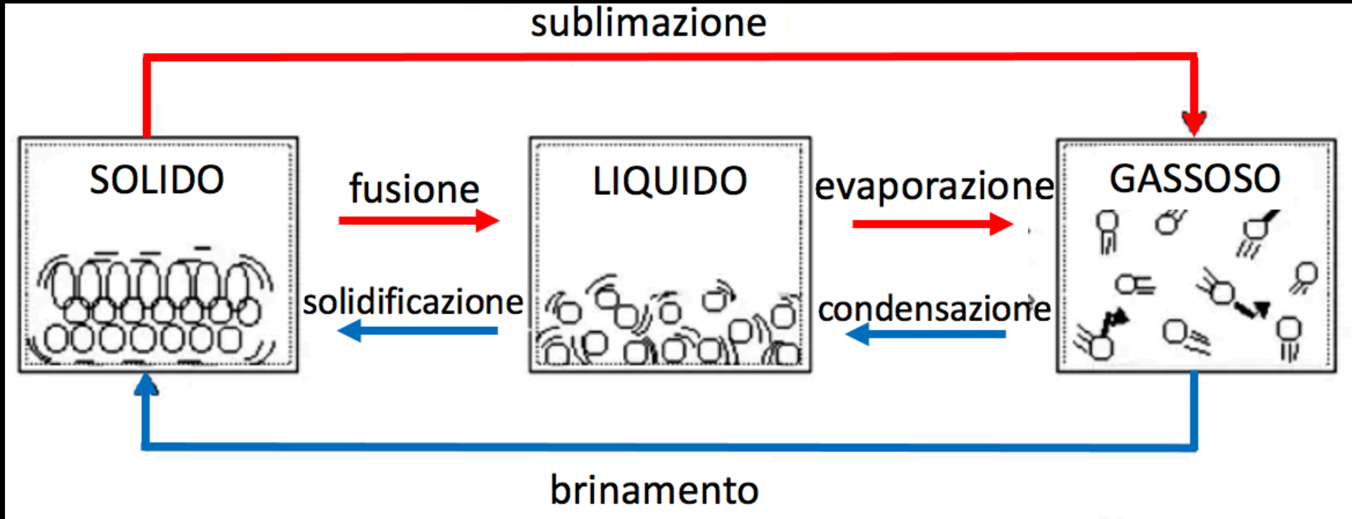
$c_v = Q/(m\Delta T)$
calore specifico vapor acqueo
1,94 kJ/kgK

$Q_v = \lambda_v m$
λ_v = calore latente di vaporizzazione
2272 kJ/kg

$c_S = Q/(m\Delta T)$
calore specifico ghiaccio
2,04 kJ/kgK

$c_L = Q/(m\Delta T)$
calore specifico acqua liquida
4,186 kJ/kgK
(1 cal/g°C)

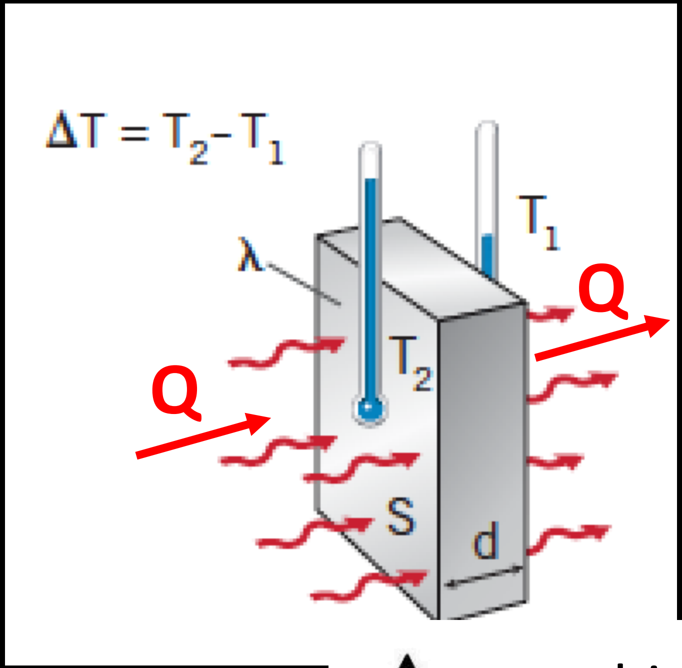
$Q_f = \lambda_f m$
λ_f = calore latente di fusione
333 kJ/kg



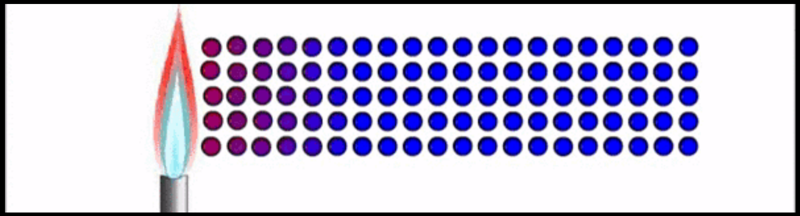
TERMODINAMICA

CONDUZIONE

TRASMISSIONE DEL CALORE



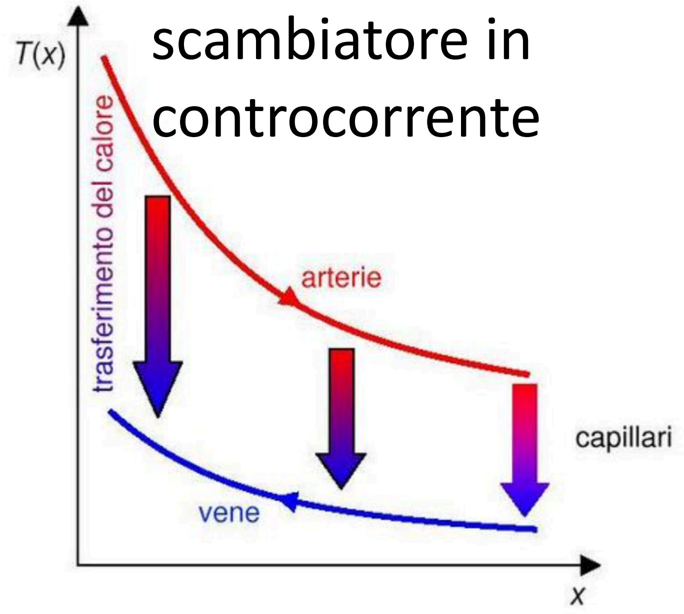
trasmissione per contatto

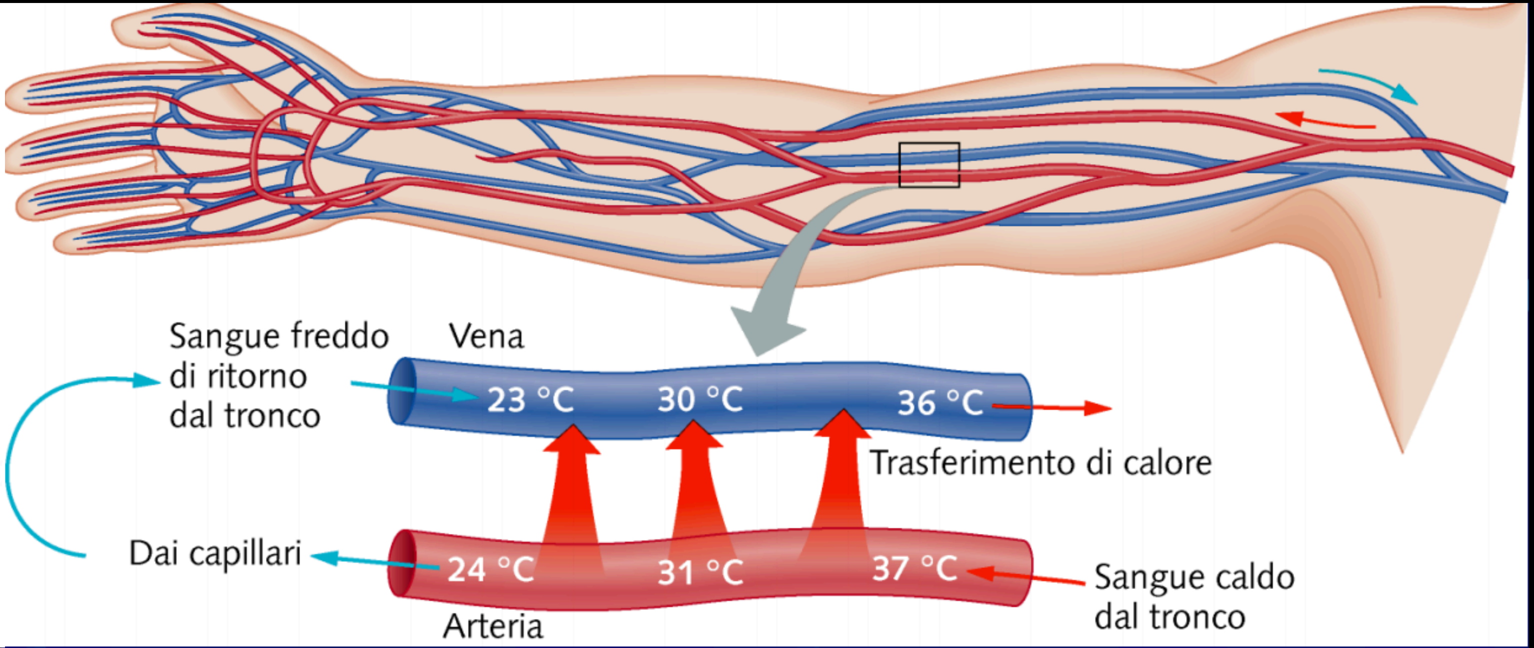


potenza termica $$\frac{dQ}{dt} = \lambda\, S\, \frac{\Delta T}{d}$$

conducibilità termica λ (dipende dal materiale) 1-100 W/(m·K)

scambiatore in controcorrente



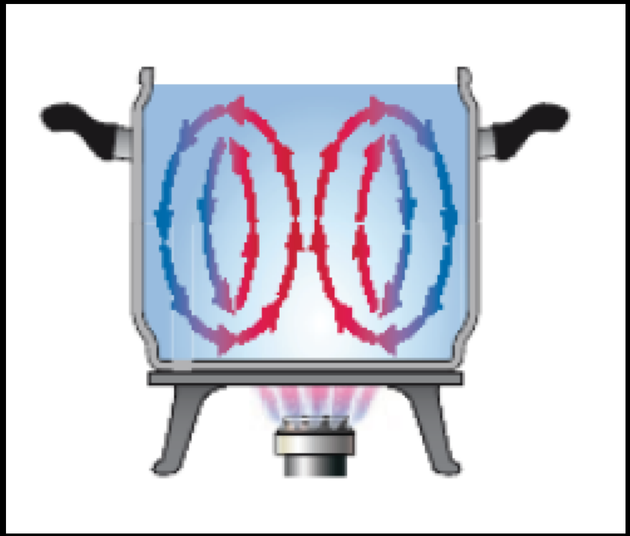


TERMODINAMICA

CONVEZIONE

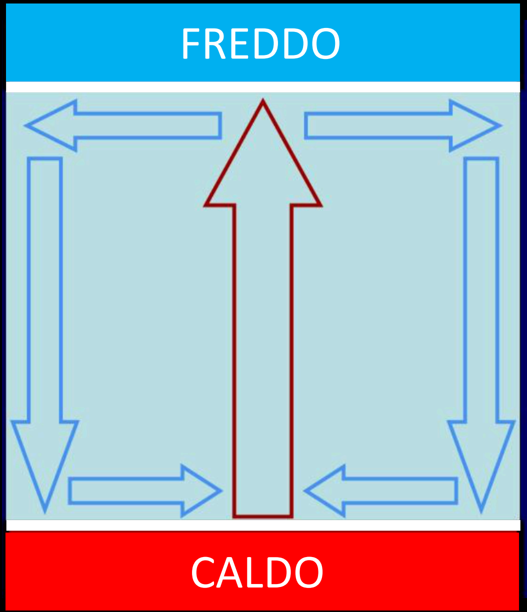
TRASMISSIONE DEL CALORE

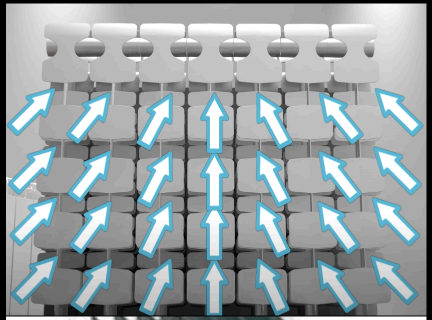
trasmissione per spostamento del mezzo fluido

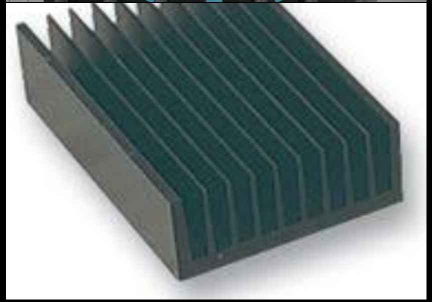


moti convettivi

S







dilatazione termica
principio di Archimede

S superficie del corpo a contatto col fluido

$$\frac{dQ}{dt} = h\, S\, \Delta T$$

coefficiente di adduzione h
dipende dalla superficie e dalla velocità
0,1-1 W/(m^2·K)

ELEMENTI RADIATORE TERMOSIFONE
ALETTE RAFFREDDAMENTO CPU

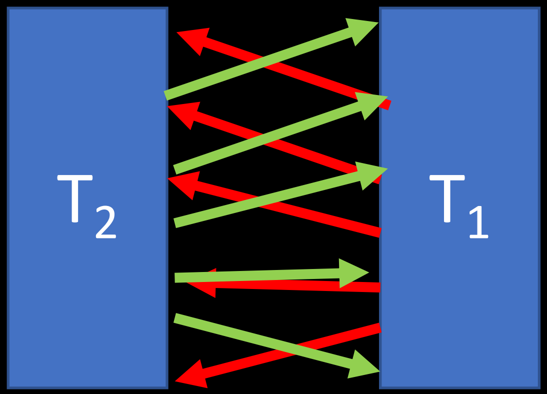
$$\frac{dQ}{dt} = \varepsilon\sigma\, S\, T^4$$

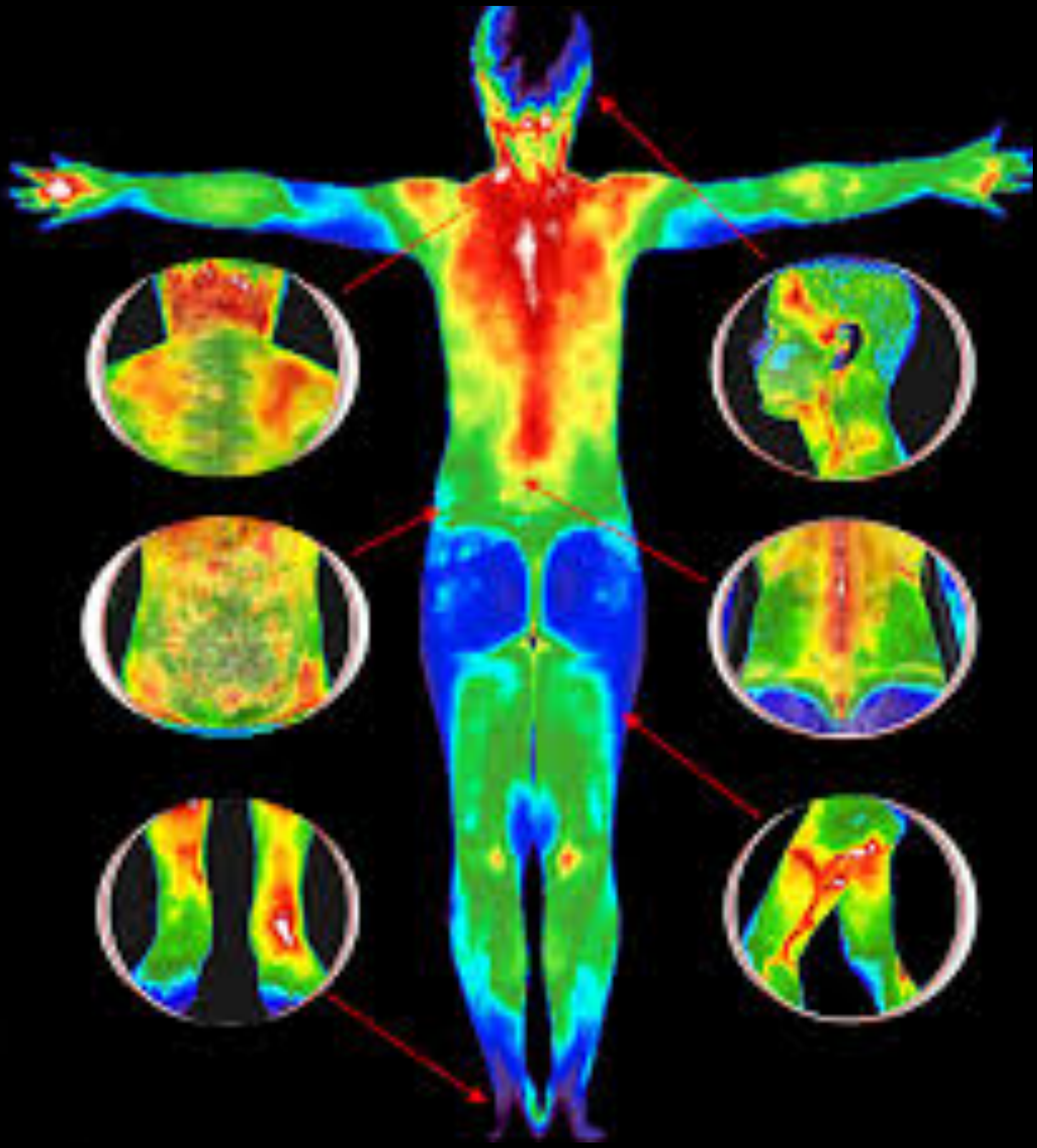
costante di Stefan-Boltzmann $\sigma = 5{,}67 \times 10^{-8}\ W/m^2K$

coefficiente di emissività $\varepsilon \approx 1$

2200 Cal/d --> 100 W di cui circa
50 % per irraggiamento infrarosso

$$\frac{dQ}{dt} = \varepsilon\sigma S\,(T_2^4 - T_1^4)$$





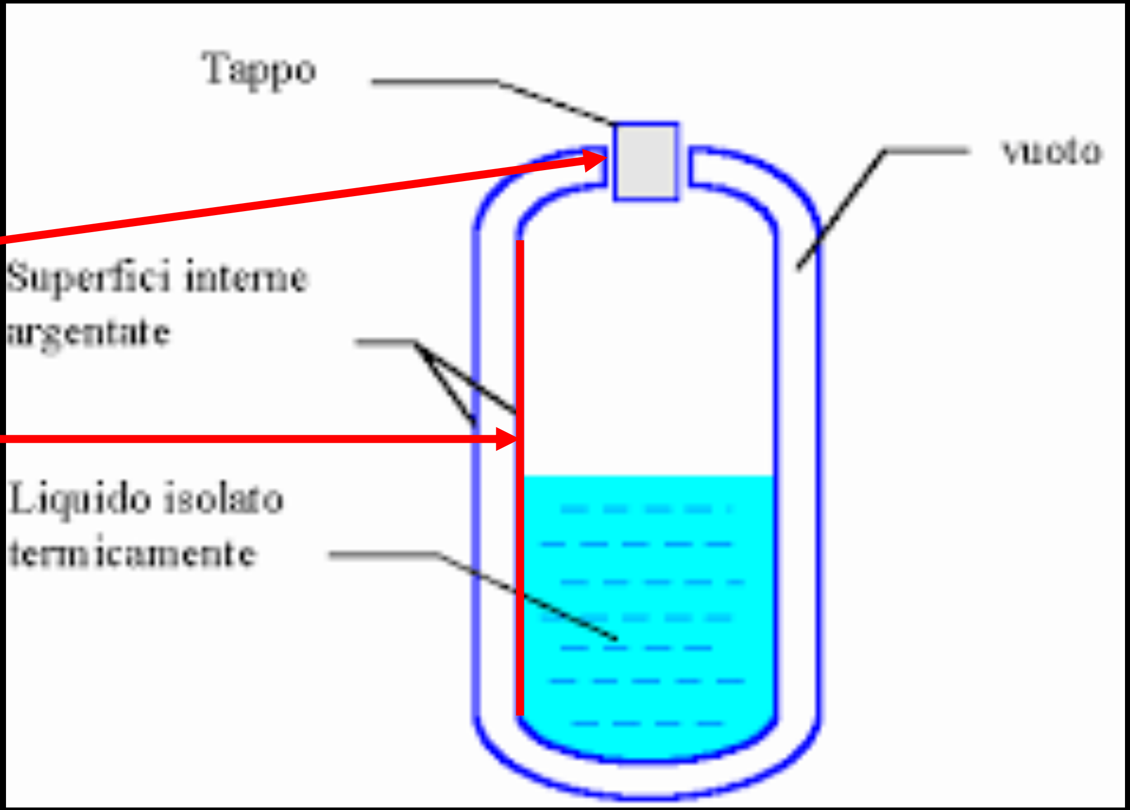
il dewar (thermos): come isolare termicamente l'interno dall'esterno

occorre ridurre la possibilità di trasmissione del calore

$$\frac{dQ}{dt} = \lambda S \frac{\Delta T}{d}$$ vetro (o acciaio) sottile

$$\frac{dQ}{dt} = h S \Delta T$$ contenitore chiuso

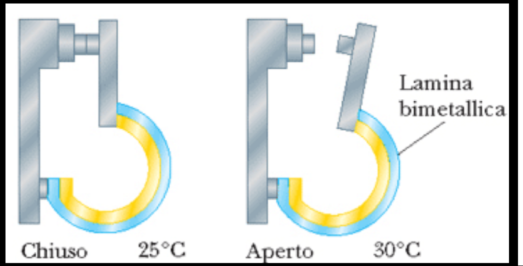
$$\frac{dQ}{dt} = \varepsilon\sigma S T^4$$ pareti altamente riflettenti

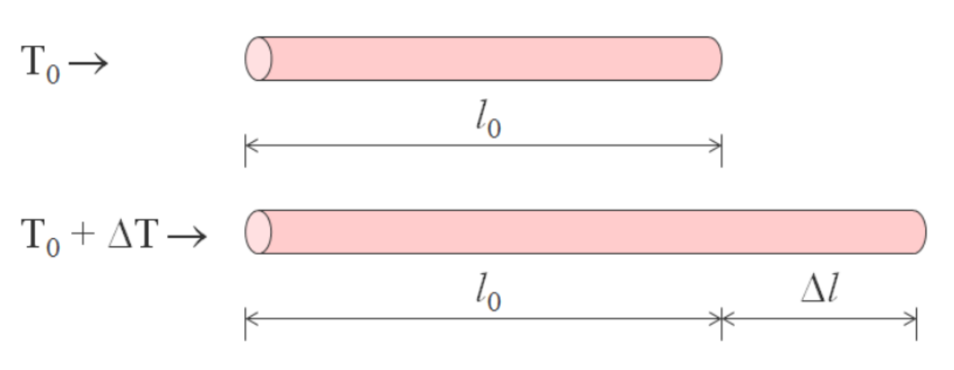


DILATAZIONE TERMICA

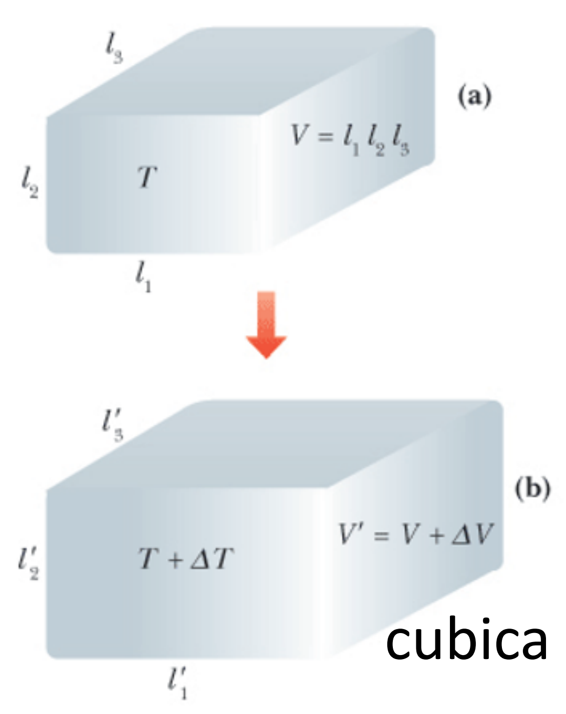
temperatura –> agitazione termica –> distanza interatomica

lineare –> $\ell(T) = \ell(T_0)\,[1 + \alpha\,(T-T_0)]$ $\alpha = 0{,}1\text{-}10\ 10^{-6}\ 1/K$





$$\frac{\Delta\ell}{\ell(T_0)} = \alpha\,\Delta T$$



cubica → GAS

se $V(T_0) = l_1(T_0)\; l_2(T_0)\; l_3(T_0)$ allora $V(T) = V(T_0) + \Delta V =$

$= l_1(T_0)\,[1 + \alpha\,\Delta T] \times l_2(T_0)\,[1 + \alpha\,\Delta T] \times l_3(T_0)\,[1 + \alpha\,\Delta T] =$

$= l_1(T_0)\; l_2(T_0)\; l_3(T_0)\,[1 + \alpha\,\Delta T]^3$

$(1 + \alpha\,\Delta T)^3 = 1^3 + 3\,1^2\,(\alpha\,\Delta T) + 3\,1\,(\alpha\,\Delta T)^2 + (\alpha\,\Delta T)^3$

$\sim l_1(T_0)\; l_2(T_0)\; l_3(T_0)\,[1 + 3\alpha\,\Delta T] =$

$= V(T_0) + V(T_0)\,3\alpha\,\Delta T$

$$\frac{\Delta V}{V(T_o)} = 3\alpha\,\Delta T = \gamma\,\Delta T$$

TERMODINAMICA

EQUAZIONE DI STATO DEI GAS PERFETTI

pressione (Pa) — quantità di gas (mol)

$$pV = nRT$$

volume (m³) — temperatura (K)

$$R = 8{,}3145 \, \frac{\mathrm{J}}{\mathrm{mol \cdot K}}$$

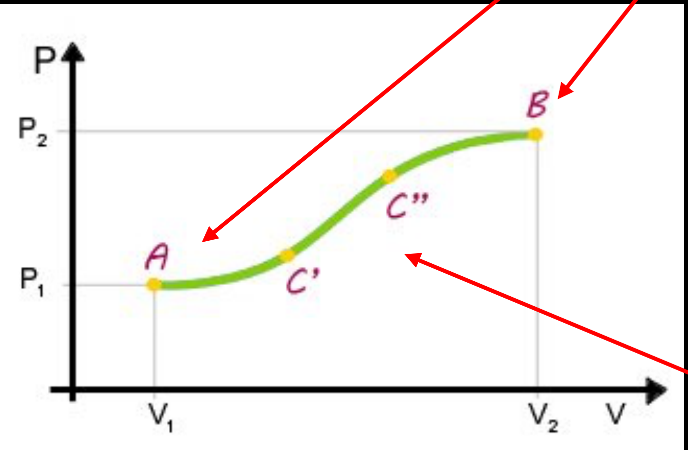
pressione
volume
temperatura

EQUILIBRIO

lavoro
calore

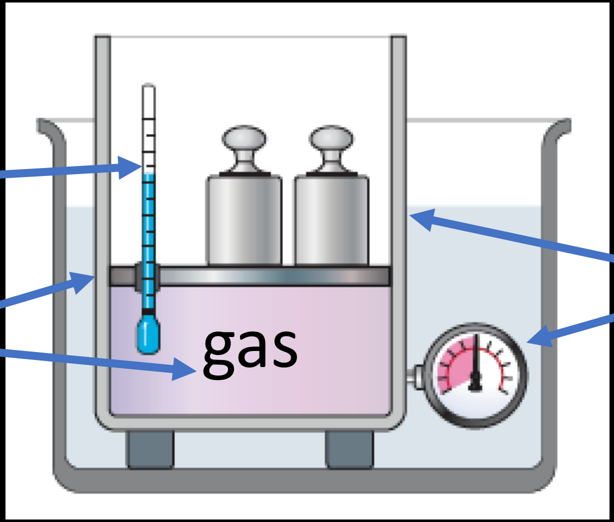
un gas occupa tutto il volume del contenitore esercitando sulle sue pareti una pressione che è anche funzione della temperatura

le tre variabili di stato p, V, T non sono indipendenti:
per descrivere lo stato di equilibrio ne bastano due → Clayperon: p, V



pistone fermo,
temperatura fissa
→ sistema in equilibrio

temperatura
volume



pressione

EQUAZIONE DI STATO DEI GAS PERFETTI

pressione (Pa) — quantità di gas (mol)

$$pV = nRT$$

volume (m^3) — temperatura (K)

$$R = 8{,}3145 \frac{\mathrm{J}}{\mathrm{mol} \cdot \mathrm{K}}$$

pressione $p = F/S$

1 pascal = 1 newton/1 metro quadro

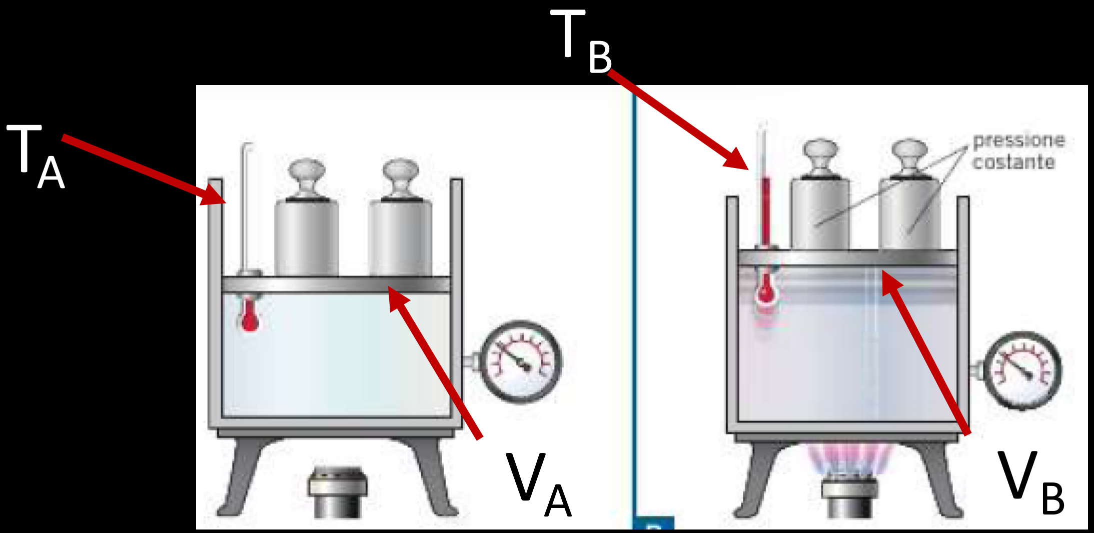
1 Pa = 1 N/1 m^2

(1 atm = 101,3 kPa = 760 mmHg)

volume molare <–> pressione atmosferica, 0°C

$V_m = RT/p = 8{,}31 \times 273{,}15 \,/\, 101{,}3 \cdot 10^3 = 22{,}4 \cdot 10^{-3}\ m^3$

EQUAZIONE DI STATO DEI GAS PERFETTI



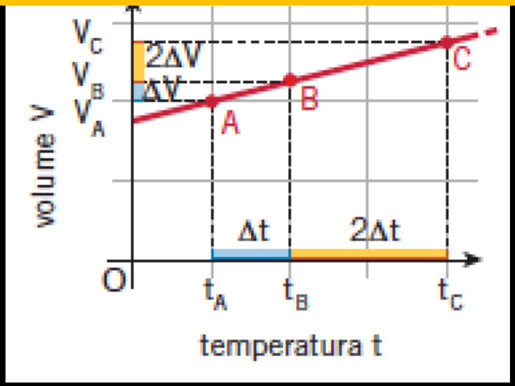
legge di Volta - Gay Lussac

$$p V = n R T$$

$$V = (n R/p) T$$

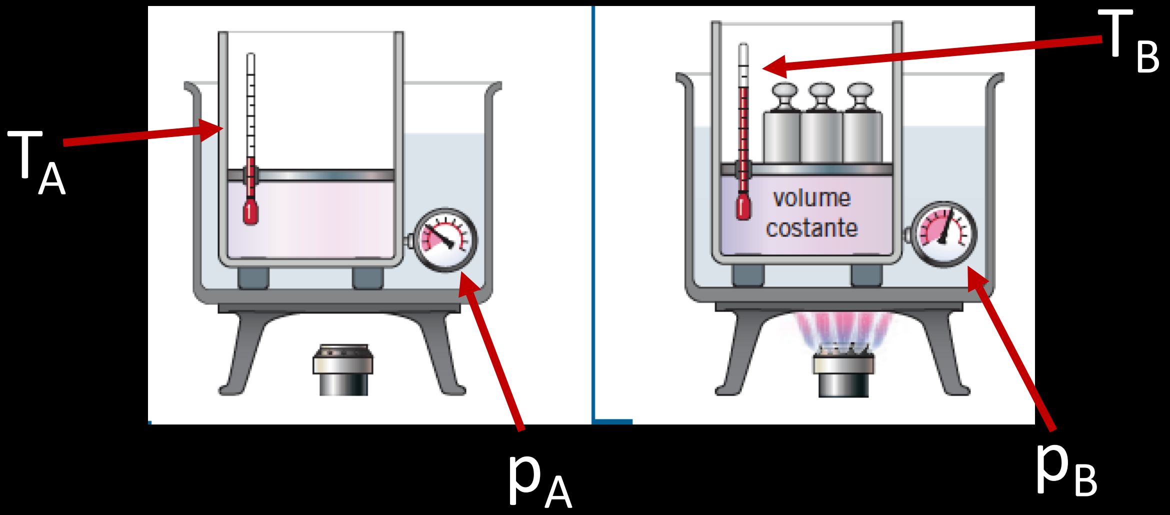
pressione costante

$$p = F/S$$



$$R = 8{,}3145 \frac{J}{mol \cdot K}$$

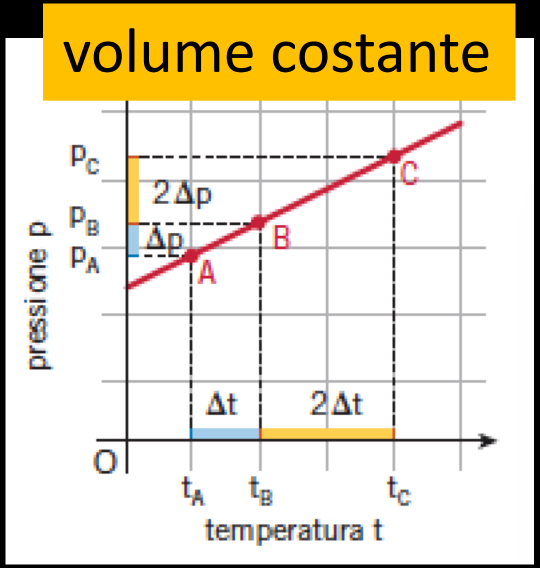
EQUAZIONE DI STATO DEI GAS PERFETTI



legge di Volta - Gay Lussac

$$p\,V = n\,R\,T$$

$$p = (n\,R/V)\,T$$



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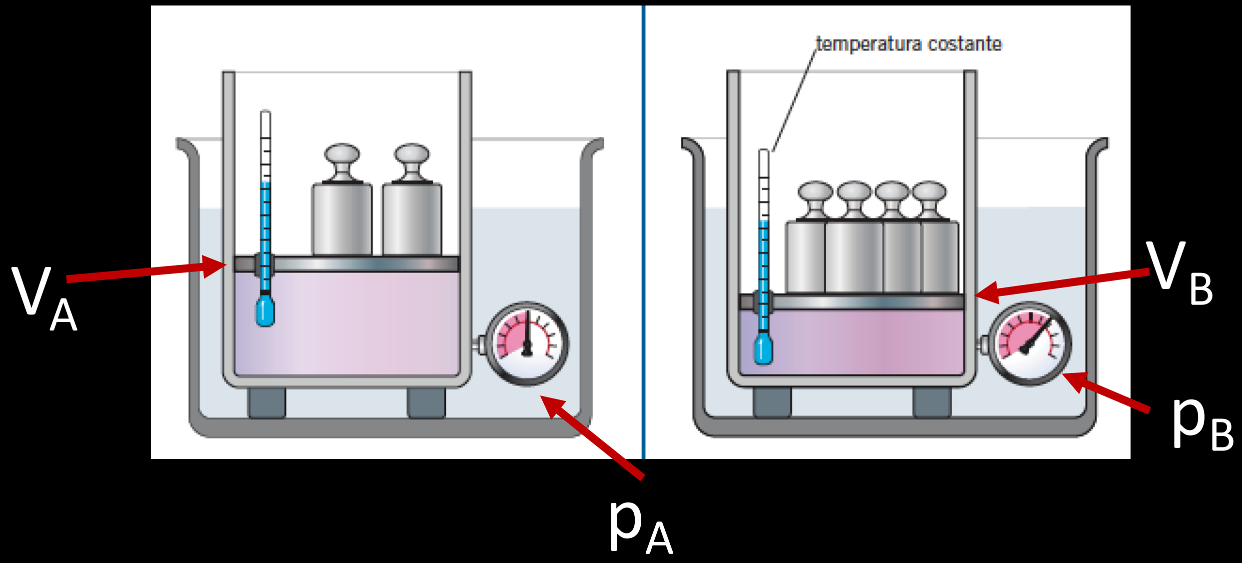
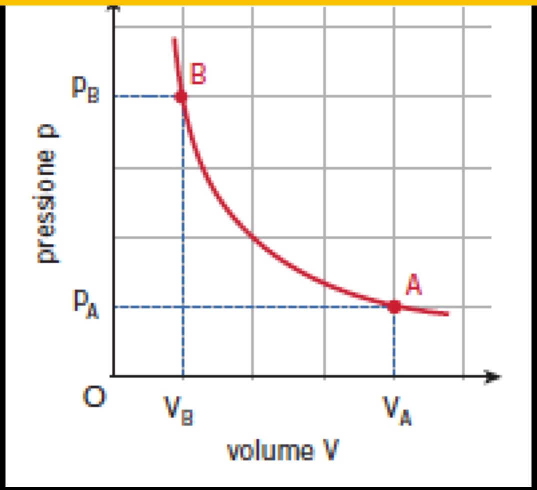


legge di Boyle

temperatura costante

$$p\,V = n\,R\,T$$

$$p = (n\,R\,T)/V$$



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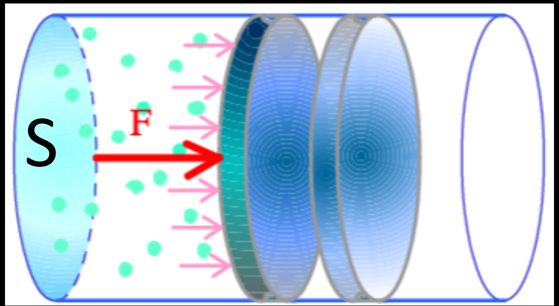
Lunedì 6 dicembre 2021

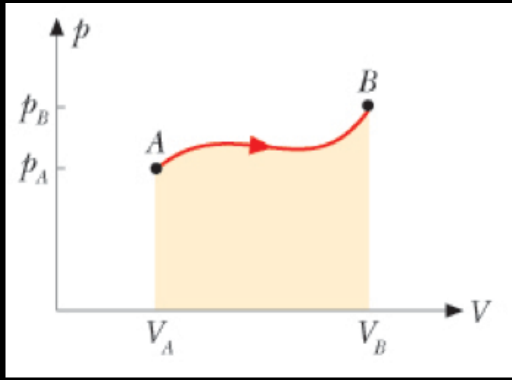
11:15-12:45

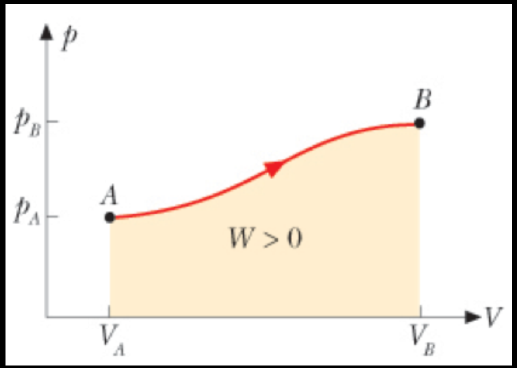
Aula Valdoni

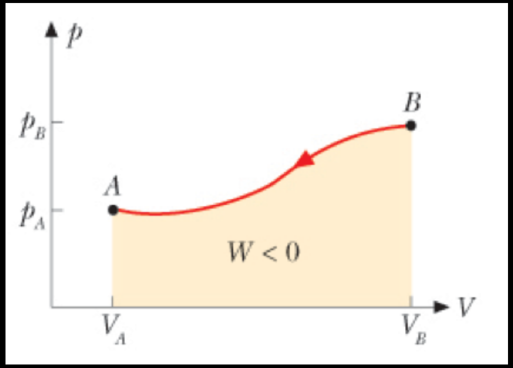
$$dL = \vec{F} \cdot d\vec{s}$$



dx







dV = S dx

p = F/S → F = p S

dL = F dx = pS dx = p dV

$$L = \int_A^B p\, dV$$

$$L = \int_{V_A}^{V_B} p\, dV > 0$$

espansione

$$L = \int_{V_B}^{V_A} p\, dV < 0$$

compressione