# Introduzione al sistema di unità di misura S.I.


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# **SI**: che cos'è?

- The 11th General Conference on Weights and Measures (1960) adopted the name Système International d'Unités (*International System of Units*, international abbreviation **SI**), for the recommended practical system of units of measurement.

- `http://www.bipm.org/en/si/`

# S.I.: Obblighi di legge

- Direttiva UE 27 luglio 1976 (**76/770/CEE**)
- DPR n. 802 del 12/08/1982
- **Obbligano** all'uso del S.I. nella redazione di atti tecnici

# metre **m**

The metre is the *length* of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

# kilogram **kg**

The kilogram is the unit of *mass*; it is equal to the mass of the international prototype of the kilogram.

# second **s**

The second is the *duration* of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

# Ampere **A**

The ampere is that *constant current* which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 m apart in vacuum, would produce between these conductors a force equal to $2 \times 10^{-7}$ newton per metre of length.

# Kelvin K

The kelvin, unit of *thermodynamic temperature*, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

# candela **cd**

The candela is the *luminous intensity*, in a given direction, of a source that emits monochromatic radiation of frequency $540 \times 10^{12}$ hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

# mole **mol**

1. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12.
2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

# Altri sistemi

- **CGS**
  massa: gr
  lunghezza: cm
  forza: dina
  lavoro: erg
  pressione: baria (dina/cm$^2$)

- **SISTEMA TECNICO**
  forza: kilogrammo forza
  lavoro: kilogrammetro

# Prefissi ammessi

| | | | | | |
|---|---|---|---|---|---|
| • $10^{1}$ | deca | da | $10^{-1}$ | deci | d |
| • $10^{2}$ | hecto | h | $10^{-2}$ | centi | c |
| • $10^{3}$ | kilo | k | $10^{-3}$ | milli | m |
| • $10^{6}$ | mega | M | $10^{-6}$ | micro | µ |
| • $10^{9}$ | giga | G | $10^{-9}$ | nano | n |
| • $10^{12}$ | tera | T | $10^{-12}$ | pico | p |
| • $10^{15}$ | peta | P | $10^{-15}$ | femto | f |
| • $10^{18}$ | exa | E | $10^{-18}$ | atto | a |
| • $10^{21}$ | zetta | Z | $10^{-21}$ | zepto | z |
| • $10^{24}$ | yotta | Y | $10^{-24}$ | yocto | y |

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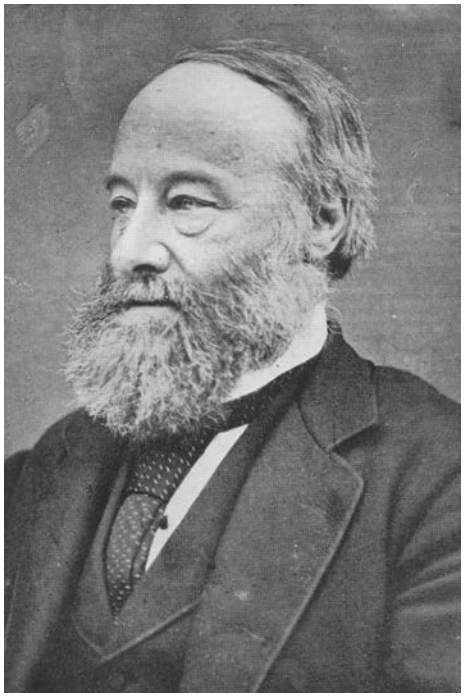
# Prefissi (Es.)

- $2.3\ \mathrm{cm}^3 = 2.3\ (\mathrm{cm})^3 = 2.3\ (10^{-2}\ \mathrm{m})^3 = 2.3 \times 10^{-6}\ \mathrm{m}^3$
- $1\ \mathrm{cm}^{-1} = 1\ (\mathrm{cm})^{-1} = 1\ (10^{-2}\ \mathrm{m})^{-1} = 10^2\ \mathrm{m}^{-1} = 100\ \mathrm{m}^{-1}$
- $1\ \mathrm{V/cm} = (1\ \mathrm{V})/(10^{-2}\ \mathrm{m}) = 10^2\ \mathrm{V/m} = 100\ \mathrm{V/m}$
- $5000\ \mu\mathrm{s}^{-1} = 5000\ (\mu\mathrm{s})^{-1} = 5000\ (10^{-6}\ \mathrm{s})^{-1} = 5 \times 10^9\ \mathrm{s}^{-1}$

# Derived units

- Derived units are products of powers of base units. Coherent derived units are products of powers of base units that include *no numerical factor other than 1*. The base and coherent derived units of the SI form a coherent set, designated the set of coherent SI units.

# Es.: Joule



James Prescott Joule (1818-1889)

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# Es.: Joule

*forza*lunghezza = massa*accelerazione*lunghezza*

$J = N\ m = kg\ m\ s^{-2}\ m = kg\ m^2\ s^{-2}$

**Es:** *Quanti Joule 'sviluppo' nel sollevare una mela (circa 100 g) per 1 m?*

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# Energia

| **Energia** | J | erg | cal | eV |
|---|---|---|---|---|
| J | 1 | $10^{7}$ | 0.239 | $6.24 \cdot 10^{18}$ |
| erg | $10^{-7}$ | 1 | $2.39 \cdot 10^{-8}$ | $6.24 \cdot 10^{11}$ |
| cal | 4.184 | $4.184 \cdot 10^{7}$ | 1 | $2.61 \cdot 10^{19}$ |
| eV | $1.602 \cdot 10^{-19}$ | $1.602 \cdot 10^{-12}$ | $3.83 \cdot 10^{-20}$ | 1 |

**J : Joule**

erg : erg (CGS)

cal : caloria

eV : elettronvolt

# Potenza

| **Potenza** | W | Kpm/s | CV | HP |
|---|---|---|---|---|
| W | 1 | 0.102 | $1.36 \cdot 10^{-3}$ | $1.34 \cdot 10^{-3}$ |
| Kpm/s | 9.80 | 1 | 0.01333 | 0.01315 |
| CV | 736 | 75 | 1 | 0.986 |
| HP | 745.2 | 76.04 | 1.014 | 1 |

**W : watt**

Kpm/s : kilogrammetro al secondo (SIST. TECNICO)

CV : cavallo-vapore

HP : horse-power

# Pressione

| **Pressione** | Pa | atm | bar | torr (mmHg) | $mH_2O$ | $kp/cm^2$ |
|---|---|---|---|---|---|---|
| Pa | 1 | $9.869 \cdot 10^{-6}$ | $10^{-5}$ | $7.5 \cdot 10^{-3}$ | $1.019 \cdot 10^{-4}$ | $1.019 \cdot 10^{-5}$ |
| atm | $1.013 \cdot 10^{5}$ | 1 | 1.013 | 763.3 | 10.33 | 1.033 |
| bar | $10^{5}$ | 0.9869 | 1 | 750 | 10.2 | 1.02 |
| torr (mmHg) | $1.333 \cdot 10^{2}$ | $1.31 \cdot 10^{-3}$ | $1.333 \cdot 10^{-3}$ | 1 | 0.0135 | 0.00135 |
| $mH_2O$ | $9.81 \cdot 10^{3}$ | 0.0968 | 0.098 | 73.5 | 1 | 0.1 |
| $kp/cm^2$ | $9.81 \cdot 10^{4}$ | 0.968 | 0.98 | 735.7 | 10 | 1 |

**Pa : Pascal ($N/m^2$)**

atm : atmosfera

torr : Torricelli o millimetri di mercurio

$mH_2O$ : metri d'acqua

$kp/cm^2$ : chilogrammo su centimetro quadrato
(atmosfera metrica)

# Massa

| |
|---|
| 1 lb(USA) =0.453600 kg |
| 1 lb(GB) = 0.435600 kg |

Kg: kilogrammo
lb(USA): Libbra USA
lb(GB): Libbra UK

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# Temperatura

| | | | |
|---|---|---|---|
| $T(K)$ | $= T(°C) + 273.15$ | $= 5/9\ T(°F) + 255.37$ | $= 5/4\ T(°R) + 273.15$ |
| $T(°C)$ | $= T(K) - 273.15$ | $= 5/9\ [T(°F) - 32]$ | $= 5/4\ T(°R)$ |
| $T(°F)$ | $= 9/5\ [T(K) - 255.37]$ | $= 9/5\ T(°C) + 32$ | $= 9/4\ T(°R) + 32$ |
| $T(°R)$ | $= 4/5\ [T(K) - 273.15]$ | $= 4/5\ T(°C)$ | $= 4/9\ [T(°F) - 32]$ |

K : kelvin o scala di temperatura termodinamica assoluta

- ° C : grado Celsius o centigrado
- ° F : grado Fahrenheit (grado UK o USA)
- ° R : grado Réamur o ottantigrado (grado tedesco)

# Es.: Equazione di stato dei gas perfetti

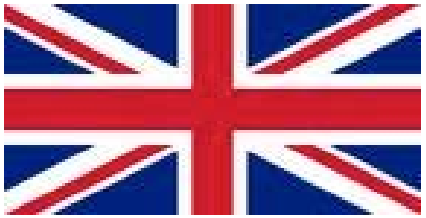
- $pV = nR_uT$
- $pV/M = nR_uT/M$
- $pv = nR_uT/(M_{mol}*n)$
- $pv = (R_u/M_{mol})T$
- $pv = RT$

$R_u = 8.314$ J $mol^{-1}$ $K^{-1}$

R invece **dipende** dal gas

# Grandezze non S.I.

**BTU** British Termal Unit



Quantità di calore richiesta per alzare la temperatura di 454 grammi di acqua da 60 a 61 gradi Fahrenheit

1 btu ≅ 1 055 J

# Grandezze non S.I.

KiloWattOra **KWh**

1000 watt x 3600 s =

3 600 000 J


(fornitura residenziale ENEL = 3 KWh)

# **Es.**: Samsung AQV12AW

- Classe di efficienza energetica: A/A
- 12000 Btu
- Tecnologia Inverter Energy Saving: si
- Colore unità interne: bianco
- Funzione riscaldamento: si
- Sistema purificazione aria: nano silver

***Posso utilizzarlo con i 3 KWh di un'utenza residenziale?***

# Grandezze non S.I.

**tep** (tonnellata equivalente di petrolio)

**toe** (tonne of oil equivalent)

1 tep = 42 GJ

# **Es.**: Samsung AQV12AW (ii)

Ipotizzando un funzionamento a pieno regime di

6 h giornaliere

per i 3 mesi estivi

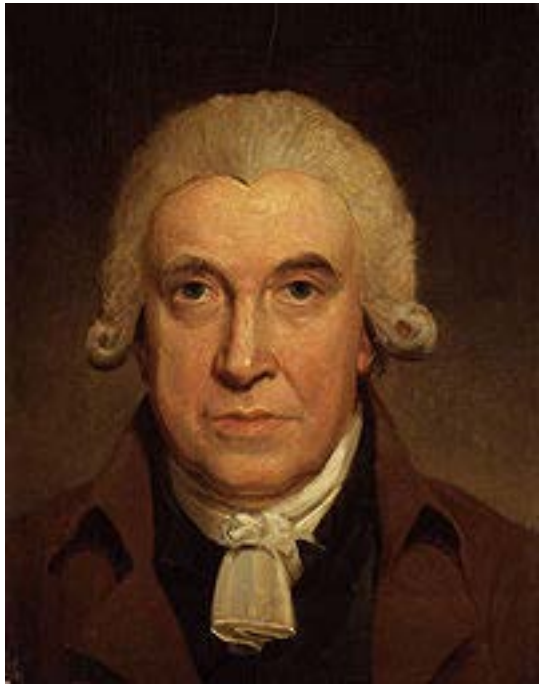
**quanti tep si consumano?**

# Es.: Horse Power


HP (= CV) = **potenza** di una macchina a vapore “equivalente” a un cavallo che solleva 33000 libbre e le sposta alla velocità di un piede al secondo.

Quanti **watt** corrispondono a 1 HP?

# Es.: Horse Power



James Watt (1736-1819)

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