Mechanical equivalents of electricity

$mass := kg$

$velocity := \frac{m}{sec}$

$E := mass \cdot velocity^2$ Einstein's definition of energy (E=mc^2)

$E = 1\,J$ $kg \cdot \left(\frac{m}{sec}\right)^2 = 1\,J$

$\frac{E}{sec} = 1\,W$ Time rate of change of energy is power

$\frac{kg}{sec} \cdot \left(\frac{m}{sec}\right)^2 = 1\,W$ Equivalent power calculations, thus

$ohm\,amp^2 = 1\,W$ $\frac{kg \cdot m^2}{sec^3} = 1\,W$

Mechanical to Electrical Conversion factors

$R := \frac{kg}{sec}$ mechanical equivalent of resistance $K_R := ohm \cdot \frac{sec}{kg}$

$I := \frac{m}{sec}$ velocity is the mechanical equivalent of current $K_I := amp \cdot \frac{sec}{m}$

$I^2 \cdot R = 1\,W$

$V := \sqrt{I^2 \cdot R \cdot R}$ the power equation can be manipulated to get voltage

$V = 1\,N$ $V := \frac{kg \cdot m}{sec^2}$ thus force is equivalent to voltage $K_V := volt \cdot \frac{sec^2}{kg \cdot m}$

$C := \frac{I}{\left(\frac{V}{sec}\right)}$ $C = 1\,\frac{s^2}{kg}$ Use i=Cdv/dt to calculate the mechanical equivalent of capacitance $K_C := farad \cdot \frac{kg}{s^2}$

$L := \frac{V}{\left(\frac{I}{sec}\right)}$ $L = 1\,kg$ Use V=Ldi/dt to calculate the mechanical equivalent of inductance. $K_L := \frac{henry}{kg}$

$\sqrt{L \cdot C} = 1\,s$ sanity check. Good!

$\sqrt{\frac{L}{C}} \cdot K_R = 1\,\Omega$ Characteristic impedance sanity check. Good!

"Interesting" conversions

Magnetic flux

$\text{weber} = 1\,\text{Wb}$

$\text{volt}\cdot\text{sec} = 1\,\text{Wb}$

$\text{tesla}\cdot\text{m}^2 = 1\,\text{Wb}$

$\frac{\text{volt}\cdot\text{sec}}{\text{m}^2} = 1\,\text{T}$

$\text{coul}\cdot\text{ohm} = 1\,\text{Wb}$

Magnetic field (B)

$\text{tesla} = 1\,\text{T}$

$\frac{\text{newton}}{\text{amp}\cdot\text{m}} = 1\,\text{T}$

$\frac{\text{newton}\cdot\text{sec}}{\text{coul}\cdot\text{m}} = 1\,\text{T}$

$\text{tesla} = 1 \times 10^4\,\text{gauss}$

Current (I)

$\text{amp} = 1\,\text{A}$

$\frac{\text{coul}}{\text{sec}} = 1\,\text{A}$

Inductance (H)

$\text{volt}\cdot\frac{\text{sec}}{\text{amp}} = 1\,\text{H}$

$\frac{\text{Wb}}{\text{amp}} = 1\,\text{H}$

Capacitance (F)

$\text{amp}\cdot\frac{\text{sec}}{\text{volt}} = 1\,\text{F}$

Voltage (V)

$\text{volt} = 1\,\text{V}$

$\frac{\text{joule}}{\text{coul}} = 1\,\text{V}$

$\frac{\text{joule}}{\text{amp}\cdot\text{sec}} = 1\,\text{V}$

$\frac{\text{newton}\cdot\text{m}}{\text{amp}\cdot\text{sec}} = 1\,\text{V}$

$\text{tesla}\cdot\frac{1}{\text{sec}}\cdot\text{m}^2 = 1\,\text{V}$

$\text{tesla}\cdot\text{Hz}\cdot\text{m}^2 = 1\,\text{V}$

Coulomb

$\text{coul} = 1\,\text{C}$

$\text{amp}\cdot\text{sec} = 1\,\text{C}$