

## Scaling Laws

|            | Quantity                       | Equation               | $L^n$    |
|------------|--------------------------------|------------------------|----------|
| Mechanical | Surface area                   | $A$                    | $L^2$    |
|            | Volume                         | $V$                    | $L^3$    |
|            | Mass                           | $m = V \rho$           | $L^3$    |
|            | Gravity force                  | $F_g = m g$            | $L^3$    |
|            | Maximum mechanical forces      | $F \propto E \cdot A$  | $L^2$    |
|            | Stiffness (spring constant)    |                        | $L$      |
|            | Deformation due to gravity     |                        | $L^2$    |
|            | Mechanical energies            |                        | $L^3$    |
|            | Mechanical velocities          |                        | $L^0$    |
|            | (Undamped) resonance frequency |                        | $L^{-1}$ |
|            | Damping time constant          |                        | $L^2$    |
| Thermal    | Thermal capacity               | $C = c m$              | $L^3$    |
|            | Heat energy                    | $Q = C \cdot \Delta T$ | $L^3$    |
|            | Heat flux                      |                        | $L$      |
|            | Thermal time constant          |                        | $L^2$    |
| Electrical | Electrical charge              |                        | $L^2$    |
|            | Maximum electric potential     |                        | $L$      |
|            | Electric capacity              |                        | $L$      |
|            | Electric field energy          |                        | $L^3$    |
|            | Electrical resistance          |                        | $L^{-1}$ |
|            | Electric current               |                        | $L^2$    |
|            | Inductivity                    |                        | $L$      |
|            | Magnetic field energy          |                        | $L^5$    |
|            | Electric time constants        | $\tau_C$               | $L^0$    |
|            |                                | $\tau_L$               | $L^2$    |
|            | (Undamped) resonance frequency |                        | $L^{-1}$ |