

Solving for Quantities with Different Units

You may use solve blocks to solve for quantities of unlike units, but you must structure the output in a particular way. This example determines the velocity of flow through a straight length of pipe.

$$\rho := 62.4 \frac{\text{lb}}{\text{ft}^3} \quad D := 1\text{in} \quad \mu := 6.72 \cdot 10^{-4} \frac{\text{lb}}{\text{ft} \cdot \text{s}}$$

$$\Delta P := 10 \frac{\text{lbf}}{\text{in}^2} \quad \Delta L := 100\text{ft} \quad g_c := 32.174 \text{lb} \frac{\text{ft}}{\text{lbf} \cdot \text{s}^2}$$

Guess values for unknowns

$$f := 1 \times 10^{-3} \quad v := 10 \frac{\text{ft}}{\text{s}} \quad \text{NRe} := 1 \times 10^4$$

Given

$$\text{NRe} = \frac{\rho \cdot v \cdot D}{\mu} \quad \frac{\Delta P}{\rho} = 4 \cdot f \cdot \frac{v^2 \cdot \Delta L}{2 \cdot D \cdot g_c}$$

$$\frac{1}{\sqrt{\frac{f}{2}}} = 2.5 \cdot \ln\left(\text{NRe} \cdot \sqrt{\frac{f}{8}}\right) + 1.75$$

$$\begin{pmatrix} \text{vsol} \\ \text{fsol} \\ \text{NResol} \end{pmatrix} := \text{Find}(v, f, \text{NRe})$$

Mathcad cannot store values with different dimensions in a single array. When solving simultaneously for variables with different units, assign the results of the **Find** statement to individual variables by enclosing them in a vector, but do not evaluate the vector as a whole. The first value in the **Find** argument list will be stored in the first element name in the vector on the left hand side, et cetera.

$$\text{vsol} = 2.406 \frac{\text{m}}{\text{s}} \quad \begin{pmatrix} \text{vsol} \\ \text{fsol} \\ \text{NResol} \end{pmatrix} = \blacksquare$$

$$\text{fsol} = 4.966 \times 10^{-3}$$

$$\text{NResol} = 6.108 \times 10^4$$
