Fitting the Sutherland Equation to Temperature-Viscosity Data

The Sutherland equation is commonly used to describe the variation of gas viscosity with temperature.

$$\mu = \frac{b \cdot T^{3/2}}{T + S}$$

There are two constants in the equation, b and S. These are typically found by fitting experimental temperature-viscosity data to the equation.

This application finds the Sutherland coefficients for Helium.

Experimental temperatures and viscosities

$$\text{temperatures} := [273.15, 373.15, 473.15, 573.15, 673.15]$$

$$\text{viscosities} := \left[1.869 \times 10^{-5}, 2.315 \times 10^{-5}, 2.729 \times 10^{-5}, 3.120 \times 10^{-5}, 3.492 \times 10^{-5}\right]$$

Fit the Sutherland equation

$$\text{sutherland} := \text{Statistics:-NonlinearFit}\left(\frac{b \cdot T^{1.5}}{T + S}, \text{temperatures}, \text{viscosities}, T\right)$$

$$\text{sutherland} = \frac{1.557 \times 10^{-6} \cdot T^{1.500}}{T + 105.102}$$

Plot data and curve fit

$$p1 := \text{plot}(\text{temperatures}, \text{viscosities}, \text{style} = \text{point})$$

$$p2 := \text{plot}(\text{sutherland}, T = \min(\text{temperatures}) .. \max(\text{temperatures}))$$

plots:-display(p1, p2, labels = ["Temperature (K)", "Viscosity (Pa s)"], labeldirections = [horizontal, vertical]) =