In[115]:=
```
sigma[x_] = ((2 * (muz + g x) * nu) / (K * (nu + muz + g x)))^0.5
f[x_] = -(T x / (2 * (nu + muz + g x))) -
  T (((2 / (K * nu))^0.5) * ((muz + g x)^1.5 / (muz + nu + g x)^0.5) *
      ((sinh[x / sigma[x]]) / (cosh[L / sigma[x]]))) / (2 * (muz + nu + g x))
f'[x_]
f''[x_]
```

Out[115]=
$$1.41421 \left(\frac{\text{nu}\ (\text{muz} + \text{g x})}{\text{K}\ (\text{muz} + \text{nu} + \text{g x})}\right)^{0.5}$$

Out[116]=
$$-\frac{\text{T x}}{2\ (\text{muz} + \text{nu} + \text{g x})} - \frac{0.707107 \left(\frac{1}{\text{K nu}}\right)^{0.5} \text{T}\ (\text{muz} + \text{g x})^{1.5} \sinh\left[\frac{0.707107\ \text{x}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x})}\right)^{0.5}}\right]}{(\text{muz} + \text{nu} + \text{g x})^{1.5} \cosh\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x})}\right)^{0.5}}\right]}$$

Out[117]=
$$\frac{\text{g T x\_}}{2\ (\text{muz} + \text{nu} + \text{g x\_})^2} - \frac{\text{T}}{2\ (\text{muz} + \text{nu} + \text{g x\_})} + \frac{1.06066\ \text{g} \left(\frac{1}{\text{K nu}}\right)^{0.5} \text{T}\ (\text{muz} + \text{g x\_})^{1.5} \sinh\left[\frac{0.707107\ \text{x\_}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]}{\cosh\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]\ (\text{muz} + \text{nu} + \text{g x\_})^{2.5}} -$$

$$\frac{1.06066\ \text{g} \left(\frac{1}{\text{K nu}}\right)^{0.5} \text{T}\ (\text{muz} + \text{g x\_})^{0.5} \sinh\left[\frac{0.707107\ \text{x\_}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]}{\cosh\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]\ (\text{muz} + \text{nu} + \text{g x\_})^{1.5}} -$$

$$\left(0.25\ \text{L} \left(\frac{1}{\text{K nu}}\right)^{0.5} \text{T}\ (\text{muz} + \text{g x\_})^{1.5} \left(-\frac{\text{g nu}\ (\text{muz} + \text{g x\_})}{\text{K}\ (\text{muz} + \text{nu} + \text{g x\_})^2} + \frac{\text{g nu}}{\text{K}\ (\text{muz} + \text{nu} + \text{g x\_})}\right)\right.$$

$$\left.\sinh\left[\frac{0.707107\ \text{x\_}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right] \cosh'\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]\right) /$$

$$\left(\cosh\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]^2 \left(\frac{\text{nu}\ (\text{muz} + \text{g x\_})}{\text{K}\ (\text{muz} + \text{nu} + \text{g x\_})}\right)^{1.5} (\text{muz} + \text{nu} + \text{g x\_})^{1.5}\right) -$$

$$\left(0.707107 \left(\frac{1}{\text{K nu}}\right)^{0.5} \text{T}\ (\text{muz} + \text{g x\_})^{1.5}\right.$$

$$\left.\left(\frac{0.707107}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}} - \frac{0.353553\ \text{x\_} \left(-\frac{\text{g nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})^2} + \frac{\text{g nu}}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{1.5}}\right) \sinh'\left[\frac{0.707107\ \text{x\_}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]\right) /$$

$$\left(\cosh\left[\frac{0.707107\ \text{L}}{\left(\frac{\text{nu}\ (\text{muz}+\text{g x\_})}{\text{K}\ (\text{muz}+\text{nu}+\text{g x\_})}\right)^{0.5}}\right]\ (\text{muz} + \text{nu} + \text{g x\_})^{1.5}\right)$$

Out[118]=

$$-\frac{g^2\,T\,x\_}{(muz+nu+g\,x\_)^3}+\frac{g\,T}{(muz+nu+g\,x\_)^2}-\frac{2.65165\,g^2\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]}{\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right](muz+nu+g\,x\_)^{3.5}}+$$

$$\frac{3.18198\,g^2\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{0.5}\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]}{\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right](muz+nu+g\,x\_)^{2.5}}-$$

$$\frac{0.53033\,g^2\left(\frac{1}{K\,nu}\right)^{0.5}T\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]}{\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right](muz+g\,x\_)^{0.5}(muz+nu+g\,x\_)^{1.5}}-$$

$$\left(0.25\,L\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(\frac{2\,g^2\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^3}-\frac{2\,g^2\,nu}{K\,(muz+nu+g\,x\_)^2}\right)\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^2\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}(muz+nu+g\,x\_)^{1.5}\right)+$$

$$\left(0.75\,g\,L\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^2\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}(muz+nu+g\,x\_)^{2.5}\right)-$$

$$\left(0.75\,g\,L\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{0.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^2\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}(muz+nu+g\,x\_)^{1.5}\right)+$$

$$\left(0.375\,L\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)^{2}\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^{2}\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{2.5}(muz+nu+g\,x\_)^{1.5}\right)-$$

$$\left(0.176777\,L^{2}\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)^{2}\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^{2}\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^{3}\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{3.}(muz+nu+g\,x\_)^{1.5}\right)+$$

$$\left(2.12132\,g\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\right.$$

$$\left.\left(\frac{0.707107}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}-\frac{0.353553\,x\_\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}\right)\sinh'\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right](muz+nu+g\,x\_)^{2.5}\right)-\left(2.12132\,g\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{0.5}\right.$$

$$\left.\left(\frac{0.707107}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}-\frac{0.353553\,x\_\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}\right)\sinh'\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Big/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right](muz+nu+g\,x\_)^{1.5}\right)-$$

$$\left(0.707107\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{0.353553\,x\_\left(\frac{2\,g^{2}\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{3}}-\frac{2\,g^{2}\,nu}{K\,(muz+nu+g\,x\_)^{2}}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}-\right.\right.$$

$$\left.\left.\frac{0.707107\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}+\frac{0.53033\,x\_\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^{2}}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)^{2}}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{2.5}}\right)$$

$$\sinh'\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\Bigg/\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\,(muz+nu+g\,x\_)^{1.5}-\right.$$

$$\left(0.5\,L\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)\right.$$

$$\left.\left(\frac{0.707107}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}-\frac{0.353553\,x\_\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}\right)\right.$$

$$\left.\cosh'\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\sinh'\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Bigg/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^2\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}(muz+nu+g\,x\_)^{1.5}\right)+$$

$$\left(0.0883883\,L^2\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)^2\right.$$

$$\left.\sinh\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\cosh''\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Bigg/$$

$$\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]^2\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{3.}(muz+nu+g\,x\_)^{1.5}-\right.$$

$$\left(0.707107\left(\frac{1}{K\,nu}\right)^{0.5}T\,(muz+g\,x\_)^{1.5}\right.$$

$$\left.\left(\frac{0.707107}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}-\frac{0.353553\,x\_\left(-\frac{g\,nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)^2}+\frac{g\,nu}{K\,(muz+nu+g\,x\_)}\right)}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{1.5}}\right)^2\right.$$

$$\left.\sinh''\left[\frac{0.707107\,x\_}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\right)\Bigg/\left(\cosh\left[\frac{0.707107\,L}{\left(\frac{nu\,(muz+g\,x\_)}{K\,(muz+nu+g\,x\_)}\right)^{0.5}}\right]\,(muz+nu+g\,x\_)^{1.5}\right)$$

In[56]:=