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1 Abstract
The Maxima/Gnuplot code for plotting the van der Waals locus of liquid and vapor molar volumes as a function of pressure and temperature (all reduced) is presented.

2 Introduction
The Sage equations from reference 2 which are used to plot the coexistence curve of liquid and vapor pressures and temperatures are re-interpreted here using Maxima (and Gnuplot).

Using Maxima, one can essentially employ Gnuplot to plot the same function as the original Sage material presented in papers 96 & 97 but employing more sophisticated annotations (among other things). The code (we actually use wxMaxima, not Maxima itself) is:

```plaintext
reset;
vg(x) := -1/6*(4*x*exp(2*x) - exp(4*x) + 1)*exp(x)/(x*exp(3*x) + x*exp(x) - exp(3*x) + exp(x)) + 1/3 $

vl(x) := -1/6*(4*x*exp(2*x) - exp(4*x) + 1)*exp(-x)/(x*exp(3*x) + x*exp(x) - exp(3*x) + exp(x)) + 1/3$

T(d) :=
```

\(^1\)(Emeritus) Carl.David@uconn.edu

\[ -27/4*(((4*d*\exp(2*d) - \exp(4*d) + 1)*((4*d*\exp(2*d) - \exp(4*d) + 1)*\exp(-d) \\
/\left(\begin{array}{c} d*\exp(3*d) + d*\exp(d) - \exp(3*d) + d*\exp(d) - \\
de*\exp(d) - \exp(3*d) + \exp(d) \end{array}\right) - 2)\^2 + 4*\left(\begin{array}{c} d*\exp(2*d) - \exp(4*d) + 1)*\exp(d)/(d*\exp(3*d) + d*\exp(d) - \\
de*\exp(d) - \exp(3*d) + \exp(d) \end{array}\right) - 2)\^2 + 4*\left(\begin{array}{c} d*\exp(2*d) - \exp(4*d) + 1)*\exp(d)/(d*\exp(3*d) + d*\exp(d) - \\
de*\exp(d) - \exp(3*d) + \exp(d) \end{array}\right) - 2) + 2*\left(\begin{array}{c} d*\exp(2*d) - \exp(4*d) + 1)*\exp(d)/(d*\exp(3*d) + d*\exp(d) - \\
de*\exp(d) - \exp(3*d) + \exp(d) \end{array}\right) - 2) \] \\
\]

\[ p(d) := 8*T(d)/(3*vg(d)-1)-3/vg(d)^2\]

These last four equations were cut from the Sage output and pasted into the Maxima code; then a major editing was done to get exponentiation into Maxima acceptable form.

\[
\text{wxplot2d([vg(x),vl(x)],[x,0.1,1]);}
\]
\[
\text{wxplot2d(T(x),[x,0.1,1]);}
\]
\[
\text{wxplot2d(p(x),[x,0.1,1]);}
\]
\[
\text{s1:parametric(T(d),vg(d),p(d),d,0.0,0.9)}
\]
\[
\text{s2:parametric(T(d),vl(d),p(d),d,0.0,0.9)}
\]
\[
\text{draw3d(nticks=21,line_width=2,color=red,key="gas",s1,}
\]
\[
\text{line_width=2,color=blue,key="liquid",s2,}
\]
\[
\text{zlabel="p",xlabel="T",ylabel="v"};}
\]
\[
\text{/*wxdraw3 draws here; else draws in rotatable gnuplot window*/}
\]
\[
\text{draw_file(terminal = 'png, file_name = "~/Desktop/vdw5_out");}
\]

The results are shown in Figure 1 (below). Note that the default view was used.
Figure 1: The full “3D” plot done using Maxima. The code shown does not work on a Windows 10 machine, only an Ubuntu equipped device. The non-closure of the two loci at (1,1,1) remains a mystery. (We remind the reader that these are reduced variables notwithstanding the labels show.) When running this code as actually shown, the plot shows up in a separate window, which allows the user to re-orient the plot using the mouse. The drawing shown here was generated by the last line of code.