T(°K)	Patm	roots		
322	15	1.511	0.098	0.217
322	20	1.053	0.098	0.235
322	25	0.763	0.097	0.261
322	30	0.539	0.097	0.310
322	35	0.096	[0.362 ± 0.1140 i]	

Methyl Chloride

$T_c = 416.3\ K$

$P_c = 65.9\ atm$

$z_c = 0.276$

$a = 7.47\ lt^2 atm/mole^2$

$b = 0.0648\ lt/mole$

$$-\int v\,dP = \int P\,dV - \int d(PV) = 0$$

$$\int_{V_L}^{V_g} \left(\frac{RT}{V-b} - \frac{a}{V^2}\right) dV - P^{SAT}(V_g - V_L) = 0$$

For $T = 322\ K$

$$26.42 \ln\left[\frac{V_g - b}{V_L - b}\right] + a\left(\frac{1}{V_g} - \frac{1}{V_L}\right) - P^{SAT}(V_g - V_L) = 0$$

Method:

Guess P^{SAT}, Compute V_g & V_L,

Evaluate VDW integral,

iterate until integral = 0

For P = 15; roots are 1.511 & 0.098

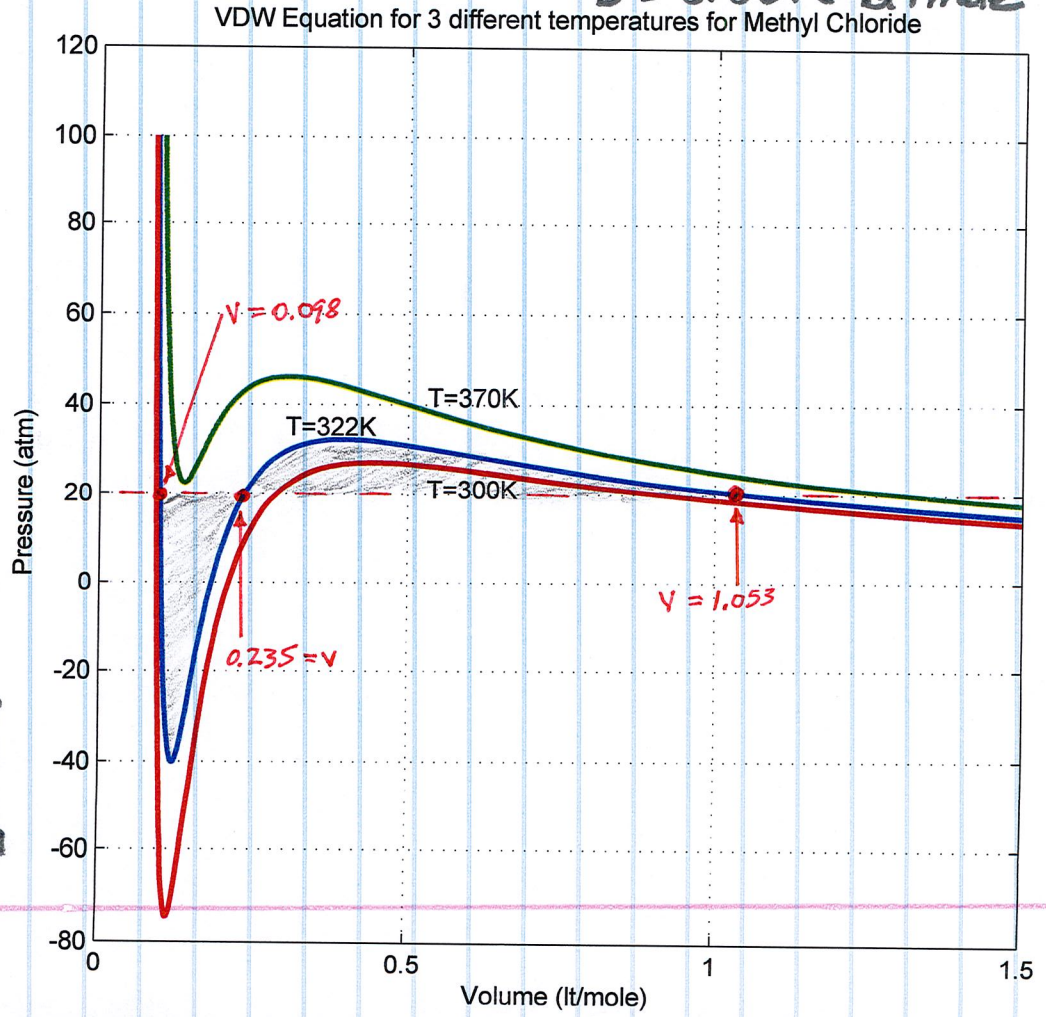
$$26.42 \ln\left[\frac{1.511 - b}{0.098 - b}\right] + a\left[\frac{1}{1.511} - \frac{1}{0.098}\right] - 15(1.511 - 0.098) = 7.229$$

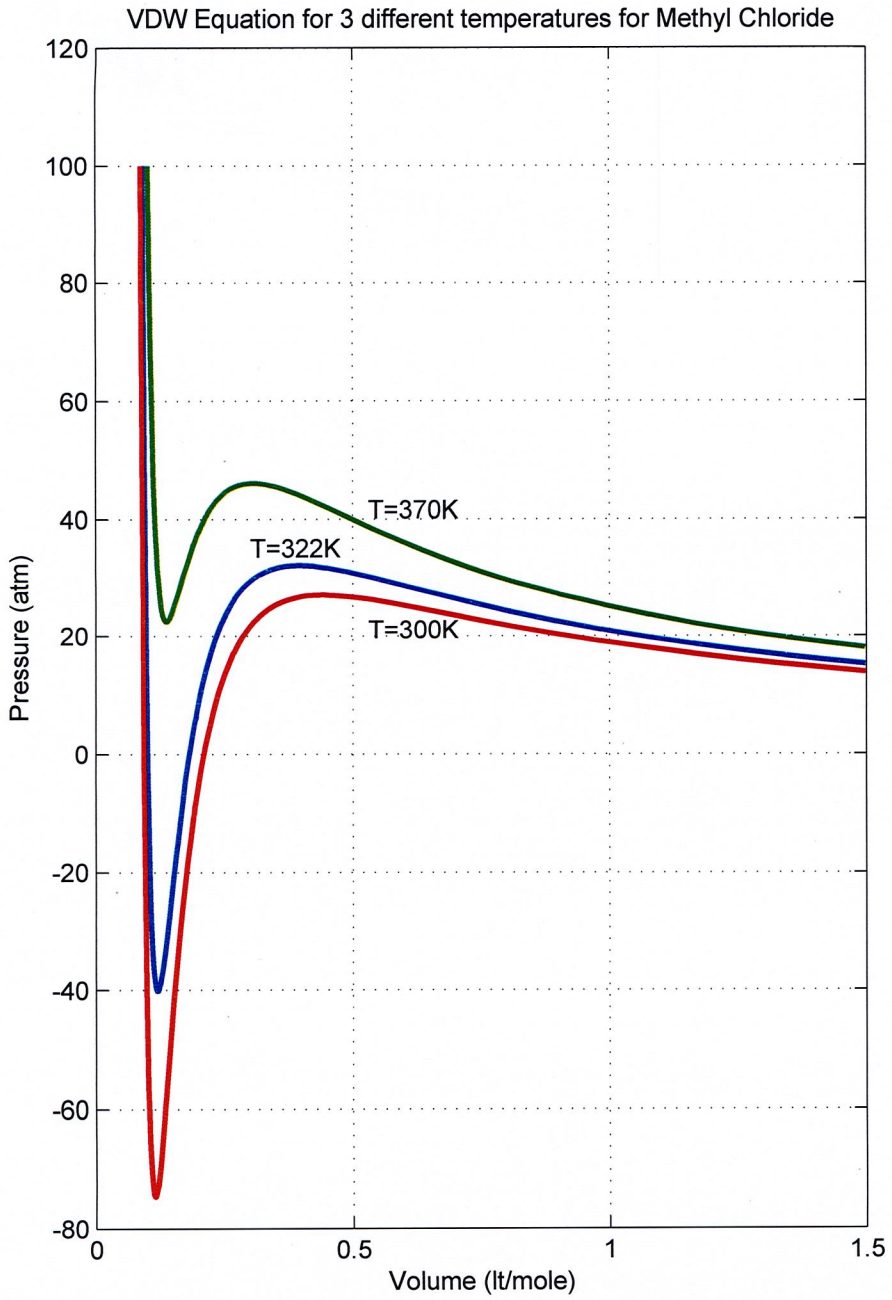
Similarly: $P^s = 20$, RHS = 1.413

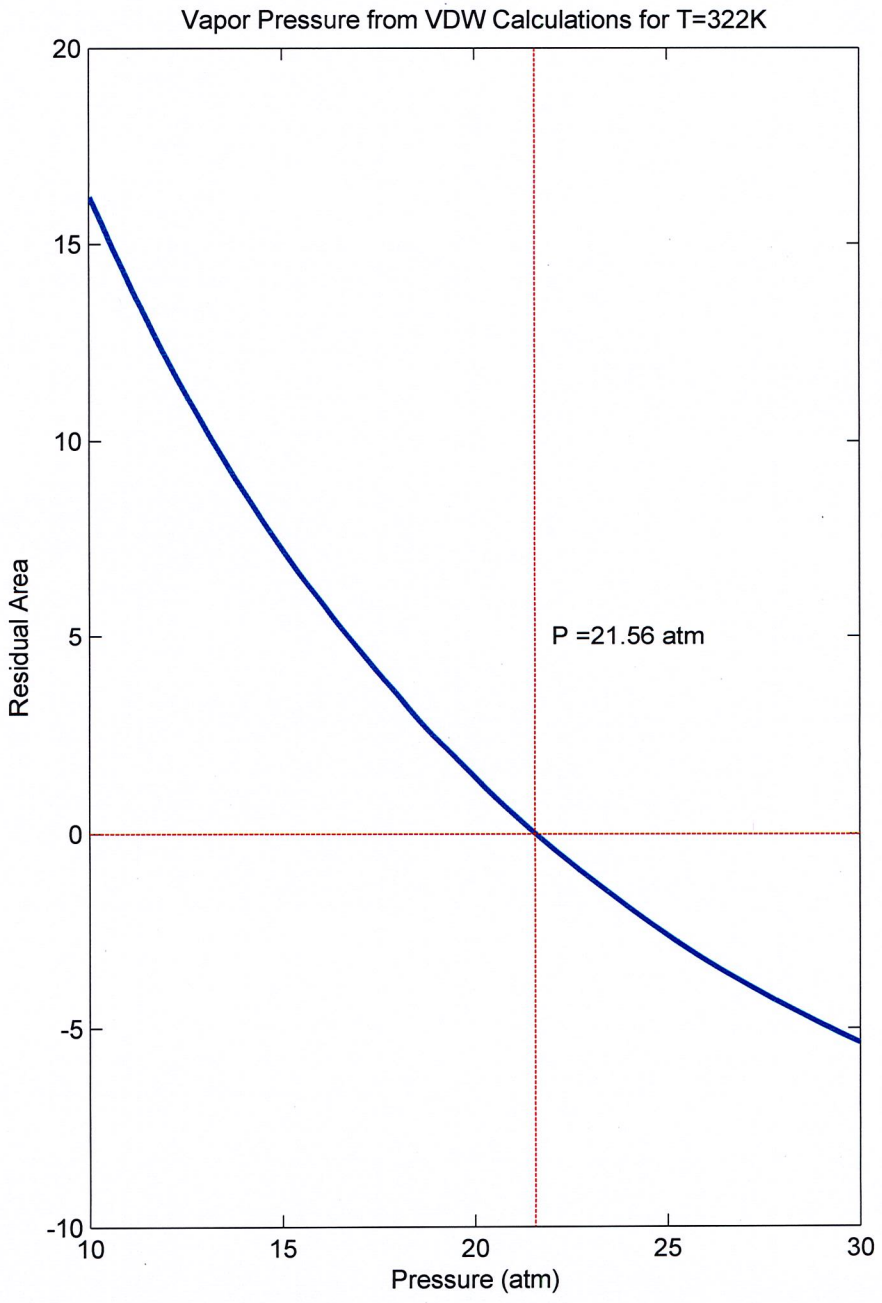
$P^s = 25$, RHS = −2.596

$P^s = 21.6$, RHS = 0 ⟸ ANS

Compare with actual $P^{SAT} = 10.49\ atm$ ⇒ Don't use VDW for vapor pressure!




VDW Equation for 3 different temperatures for Methyl Chloride
Pressure (atm)
Volume (lt/mole)
T=370K
T=322K
T=300K
120
100
80
60
40
20
0
-20
-40
-60
-80
0
0.5
1
1.5


Vapor Pressure from VDW Calculations for T=322K
Residual Area
Pressure (atm)
P =21.56 atm
20
15
10
5
0
-5
-10
10
15
20
25
30