Título de la nota 09/12/2020

Clase 66 9 diciembre 2020

$$\bar{V}^3+\bar{V}^2\left[2c-b-\frac{RT}{p}\right]+\bar{V}\left[c^2-\frac{2RcT}{p}-2cb+\frac{a}{pT}\right]-\left[c^2\left(b+\frac{RT}{p}\right)+\frac{ab}{pT}\right]=0$$

$$\left(\frac{L}{mol}\right)^3+\left(\frac{L}{mol}\right)^2\left[\frac{L}{mol}-\frac{L}{mol}-\frac{L}{mol}\right]$$

$$\frac{L}{mol}\left[\left(\frac{L}{mol}\right)^2-\frac{(atm\,L/mol\,K)(K)}{atm}\right]=\left(\frac{L}{mol}\right)^3$$

$$\left(\frac{L}{mol}\right)^2\left[\left(\frac{L}{mol}+\frac{L}{mol}\right)+\left(\frac{(atm\,L^2\,K)\left(\frac{L}{mol}\right)}{atm\,K}\right)\right]$$

$$\left[\frac{L^3}{mol^3}+\frac{L^3}{mol^3}\right]$$

$$\bar{V}^3+\bar{V}^2\left[2c-b-\frac{RT}{p}\right]+\bar{V}\left[c^2-\frac{2RcT}{p}-2cb+\frac{a}{pT}\right]-\left[c^2\left(b+\frac{RT}{p}\right)+\frac{ab}{pT}\right]=0$$

Redlich - Kwong (1949)

$$p=\frac{RT}{\left(\bar{V}-b\right)}-\left[\frac{a}{\left(\bar{V}^2+\bar{V}b\right)T^{0.5}}\right]$$

$(\bar{V}-b)$ $\quad$ $\bar{V}(\bar{V}+b)$

Despejar T

$$T^3 - T\frac{\left[p^2\left(\overline{V}-b\right)^2\right]}{R^2} - \frac{a^2\left(\overline{V}-b\right)^2}{R^2\left(\overline{V^2}+\overline{V}b\right)^2} = 0$$

$$p = \frac{RT}{\bar{v}-b} - \frac{a}{\left(\bar{v}^2+\bar{v}b\right)T^{0.5}}$$

$$p + \frac{a}{\left(\bar{v}^2+\bar{v}b\right)T^{0.5}} = \frac{RT}{\left(\bar{v}-b\right)}$$

$$\left\{\frac{\left[p\left(\bar{v}^2+\bar{v}b\right)T^{0.5}\right]+a}{\left(\bar{v}^2+\bar{v}b\right)T^{0.5}}\right\}\left(\bar{v}-b\right) = RT$$

$$\frac{\left\{\left[p(\bar{v}^2+\bar{v}b)T^{0.5}\right]+a\right\}}{(\bar{v}^2+\bar{v}b)T^{0.5}}(\bar{v}-b)=RT$$

$$\frac{\left[\bar{p}(\bar{v}^2+\bar{v}b)T^{0.5}\right](\bar{v}-b)+a(\bar{v}-b)}{(\bar{v}^2+\bar{v}b)T^{0.5}}=RT$$

$$\frac{\left[\bar{p}(\bar{v}^2+\bar{v}b)T^{0.5}\right](\bar{v}-b)+a(\bar{v}-b)}{(\bar{v}^2+\bar{v}b)}=RT^{1.5}$$

$$\frac{\left[\bar{p}(\bar{v}^2+\bar{v}b)T^{0.5}\right](\bar{v}-b)+a(\bar{v}-b)]}{(\bar{v}^2+\bar{v}b)}=RT^{1.5}$$

$$\left\{T^{0.5}(p)(\bar{v}-b)+\frac{a(\bar{v}-b)}{(\bar{v}^2+\bar{v}b)}=RT^{1.5}\right\}^2$$

$$T(p^2)(\bar{v}-b)^2+\frac{a^2(\bar{v}-b)^2}{(\bar{v}^2+\bar{v}b)^2}=R^2T^3$$

$$T^3-T\left[\frac{p^2(\bar{v}-b)^2}{R^2}\right]-\frac{a^2(\bar{v}-b)^2}{R^2(\bar{v}^2+\bar{v}b)^2}=0$$

$$T^3 - T\left[\frac{p^2(\bar{v}-b)^2}{R^2}\right] - \frac{a^2(\bar{v}-b)^2}{R^2(\bar{v}^2+\bar{v}b)^2} = 0$$

$$a = \frac{atm\,L^2\,K^{0.5}}{mol^2} = \frac{0.4278\,R^2\,T_c^{2.5}}{p_c}$$

$$b = \frac{L}{mol} = \frac{0.0867\,R\,T_c}{p_c}$$

$$T^3 - T\left[\frac{p^2\left(\bar{V}-b\right)^2}{R^2}\right] - \frac{a^2\left(\bar{V}-b\right)^2}{R^2\left(\bar{V}^2+\bar{V}b\right)^2} = 0$$

$$K^3 - K\left[\frac{atm^2\left(\frac{L}{mol}\right)^2}{\left(atm\,L/mol\,K\right)^2}\right] \therefore K^3 - K\left(K^2\right)$$

$$\frac{\left(\frac{atm\,L^2}{mol^2}K^{0.5}\right)^2\left(\frac{L}{mol}\right)^2}{\left(\frac{atm\,L}{mol\,K}\right)^2\left[\left(\frac{L}{mol}\right)^2\right]^2}$$

$$\frac{K}{\frac{1}{K^2}} = K^3$$

Obtención de ecuación cúbica de la temperatura tipo Redlich-Kwong

Introducir los valores en las celdas de color amarillo

Tc (K)	126.1500
V (L/mol)	2.0000
pc (atm)	33.5000
p sistema (atm)	4.5750
a ($atmL^2K^{0.5}/mol^2$)	15.3476
b (L/mol)	0.0268
R (atmL/molK)	0.082

Modelo 2

$$T^3 - T\frac{\left[p^2\left(\overline{V}-b\right)^2\right]}{R^2} - \frac{a^2\left(\overline{V}-b\right)^2}{R^2\left(\overline{V}^2+\overline{V}b\right)^2} = 0$$

T^3	T^2	T	Cte
1	0	-12120.1830	-8301.2018

T ideal (K)	111.5854
T real (K)	110.433

Resolución de la ecuación tipo $AT^3+BT^2+CT+D=0$

A=	1	
B=	0	
C=	-12120.1830	
D=	-8301.2018	
Expresión	4	decimales

	Real	Imaginaria	
T1=	110.433	0.000	+110.4326
T2=	-109.748	0.000	-109.7476
T3=	-0.685	0.000	-0.6849

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$$\bar{V}^3-\bar{V}^2\left[\frac{RT}{p}\right]-\bar{V}\left[b^2+\frac{bRT}{p}-\frac{a}{pT^{0.5}}\right]-\left[\frac{ab}{pT^{0.5}}\right]=0$$

$$p=\frac{RT}{\left(\bar{V}\text{-}b\right)}-\left[\frac{a}{\left(\bar{V}^2+\bar{V}b\right)T^{0.5}}\right]$$

$$\frac{\left[p\left(\bar{v}^2+\bar{v}b\right)T^{0.5}+a\right]\left[\bar{v}-b\right]}{\left(\bar{v}^2+\bar{v}b\right)T^{0.5}}=RT$$

$$\frac{\left[p\left(\bar{v}^2+\bar{v}b\right)T^{0.5}\right]\left(\bar{v}-b\right)+a\left(\bar{v}-b\right)}{\left(\bar{v}^2+\bar{v}b\right)T^{0.5}}=RT$$

$$\frac{\left[p\left(\bar{v}^2+\bar{v}b\right)T^{0.5}\right]\left(\bar{v}-b\right)+a\left(\bar{v}-b\right)}{T^{0.5}}=RT\left(\bar{v}^2+\bar{v}b\right)$$

$$\frac{p\left(\bar{v}^3+\bar{v}^2b\right)T^{0.5}-p\left(\bar{v}^2b+\bar{v}b^2\right)T^{0.5}}{pT^{0.5}}+\frac{a\left(\bar{v}-b\right)}{pT^{0.5}}=\frac{RT\bar{v}^2+RT\bar{v}b}{p}$$

$$\bar{v}^3+\bar{v}^2b-\bar{v}^2b-\bar{v}b^2+\frac{a\bar{v}}{pT^{0.5}}-\frac{ab}{pT^{0.5}}=\frac{RT\bar{v}^2+RT\bar{v}b}{p}$$

$$\bar{v}^3-\bar{v}b^2+\frac{\bar{v}a}{pT^{0.5}}-\frac{\bar{v}RTb}{p}-\frac{RT\bar{v}^2}{p}-\frac{ab}{pT^{0.5}}=0$$

$$\bar{V}^3 - \bar{V}b^2 + \frac{\bar{V}a}{pT^{0.5}} - \frac{\bar{V}RTb}{p} - \frac{RT\bar{V}^2}{p} - \frac{ab}{pT^{0.5}} = 0$$

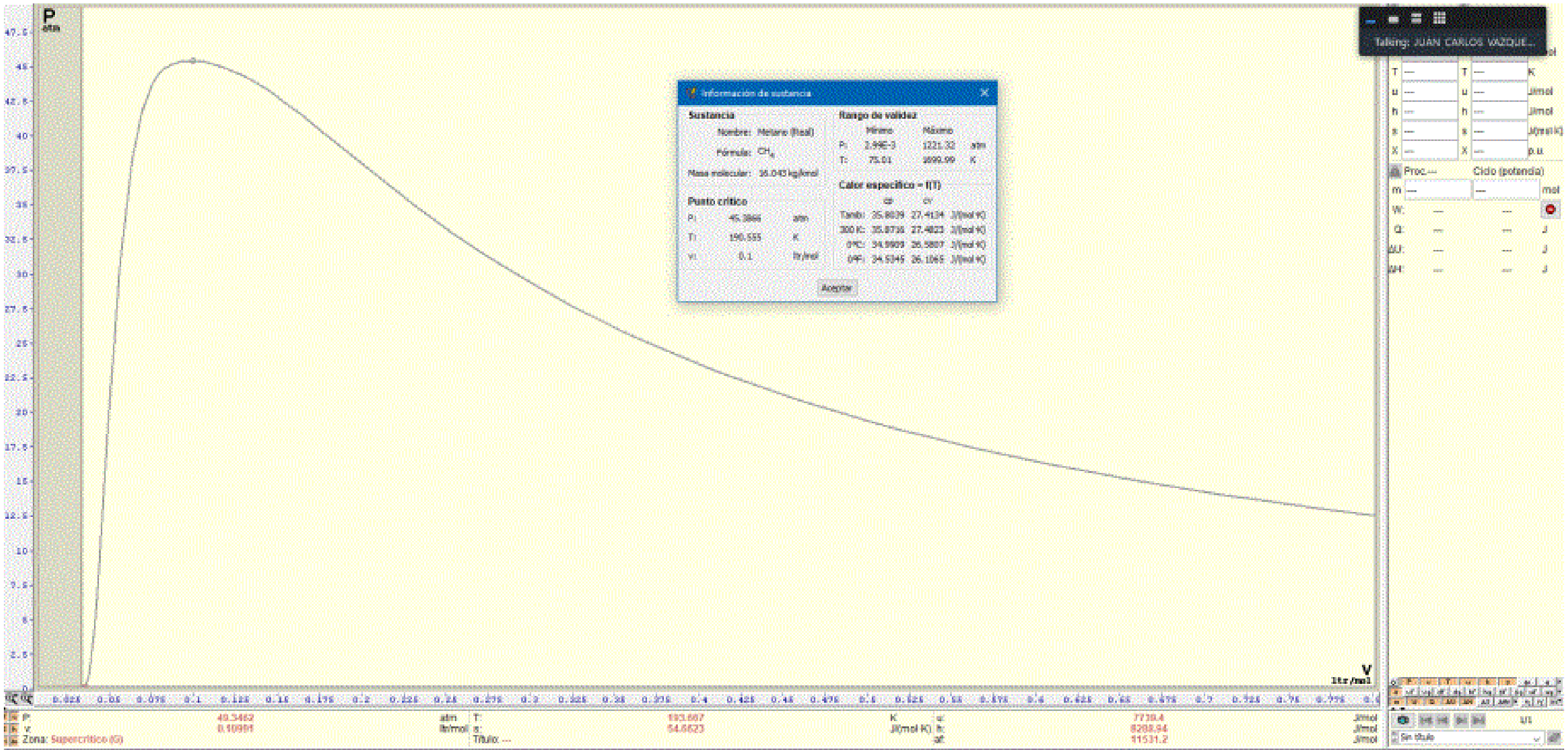
$$\bar{V}^3 - \bar{V}^2\left(\frac{RT}{p}\right) - \bar{V}\left(b^2 + \frac{RTb}{p} - \frac{a}{pT^{0.5}}\right) - \frac{ab}{pT^{0.5}} = 0$$

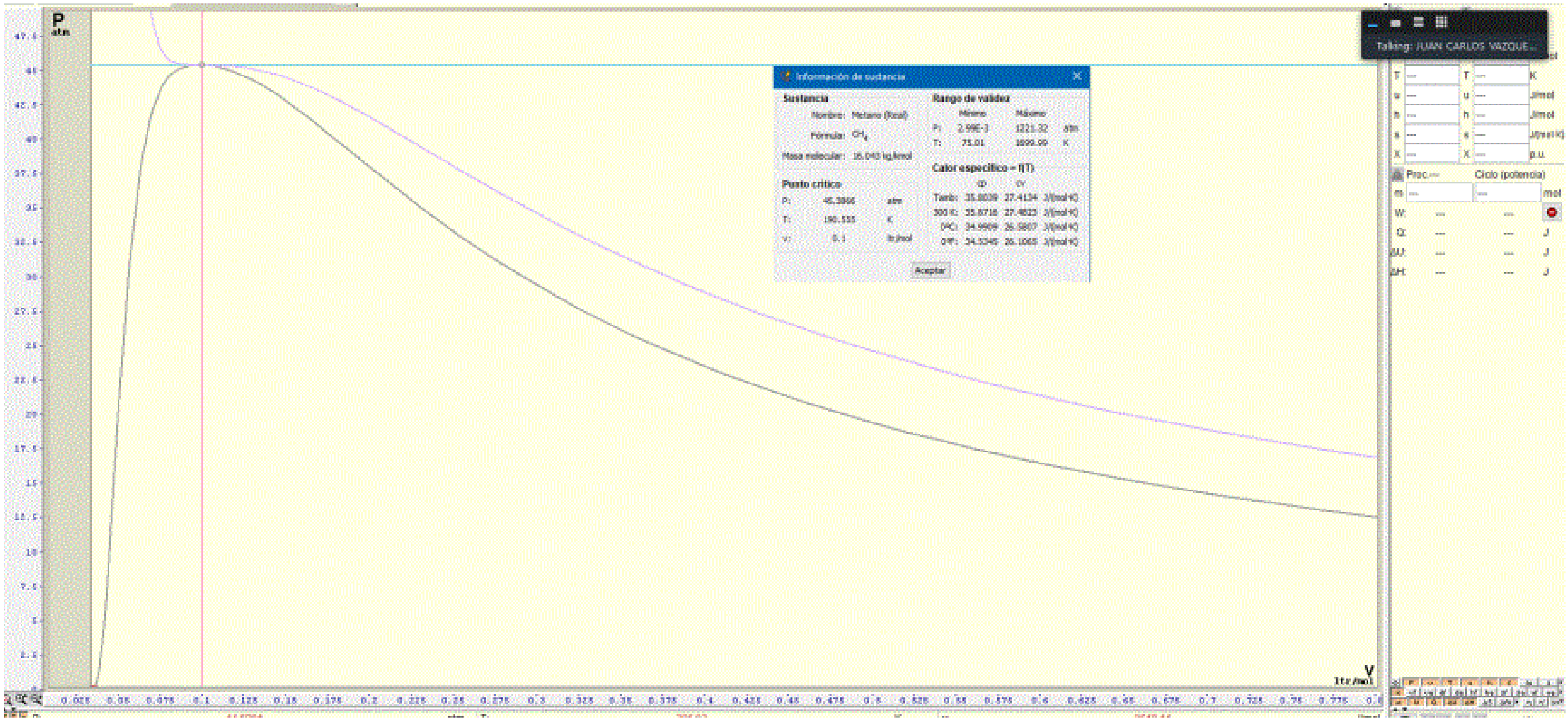
$$\bar{V}^3 - \bar{V}^2\left[\frac{RT}{p}\right] - \bar{V}\left[b^2 + \frac{bRT}{p} - \frac{a}{pT^{0.5}}\right] - \left[\frac{ab}{pT^{0.5}}\right] = 0$$

$$\left(\frac{L}{mol}\right)^3 - \left(\frac{L}{mol}\right)^2\left(\frac{L}{mol}\right) - \frac{L}{mol}\left[\left(\frac{L}{mol}\right)^2 + \left(\frac{L}{mol}\right)^2 - \frac{atm\,L^2\,K^{0.5}}{atm\,mol^2\,K^{0.5}}\right.$$

$$\left.\frac{L}{mol}\left[\left(\frac{L}{mol}\right)^2\right]\right] = \left(\frac{L}{mol}\right)^3$$

$$- \frac{\left(\frac{atm\,L^2\,K^{0.5}}{mol^2}\right)\left(\frac{L}{mol}\right)}{atm\,K^{0.5}} = \left(\frac{L}{mol}\right)^3$$




P
atm
Información de sustancia
Sustancia
Nombre: Metano (Real)
Formula: CH4
Masa molecular: 16.043 kg/kmol
Punto crítico
P: 45.3966 atm
T: 190.555 K
v: 0.1 ltr/mol
Rango de validez
Mínimo Máximo
P: 2.99E-3 1221.32 atm
T: 75.01 1699.99 K
Calor específico = f(T)
cp cv
Tamb: 35.8039 27.4134 J/(mol·K)
300 K: 35.8716 27.4823 J/(mol·K)
0ºC: 34.9909 26.5807 J/(mol·K)
0ºF: 34.5345 26.1065 J/(mol·K)
Aceptar
Talking: JUAN CARLOS VAZQUE...
Proc.
Ciclo (potencia)
V
ltr/mol

Obtención de la presión de un gas con el modelo tipo Redlich-Kwong

Introducir los valores en las celdas de color amarillo

Tc (K)	190.56
V sistema (L/mol)	2.0000
pc (atm)	45.3866
a (atmL^{2}K$^{0.5}$/mol^2)	31.7681
b (L/mol)	0.0298
R (atmL/molK)	0.082
T sistema(K)	250.00

Modelo

$$p=\frac{RT}{(\bar{V}-b)}-\left[\frac{a}{(\bar{V}^2+\bar{V}b)T^{0.5}}\right]$$

p ideal (atm	10.2500
p real (atm)	9.9104

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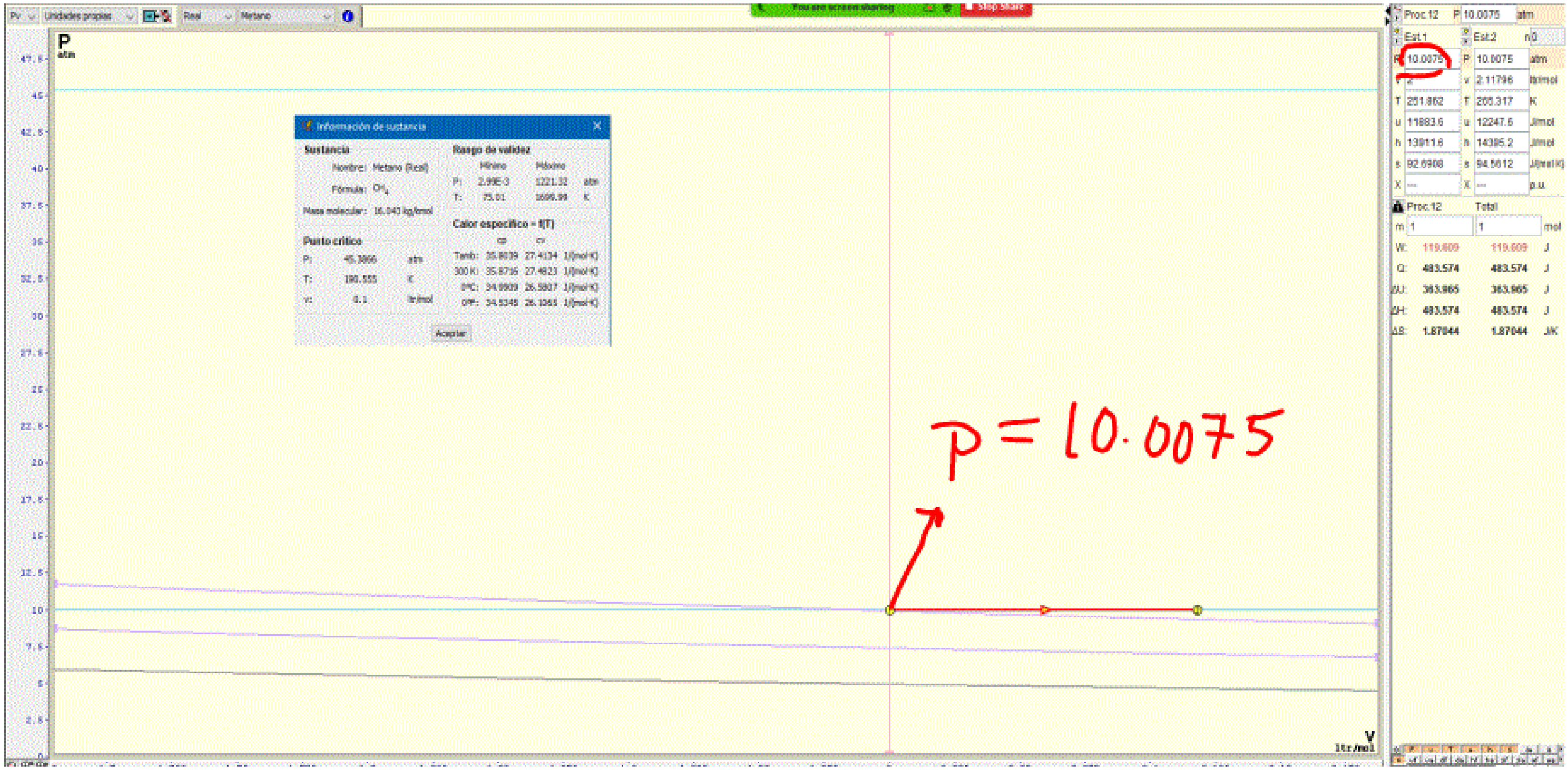
Información de sustancia
Sustancia
Nombre: Metano (Real)
Fórmula: CH4
Rango de validez
Mínimo
Máximo
Calor específico = f(T)
Punto crítico
Aceptar
Talking: JUAN CARLOS VAZQUE...
Proc.---
Ciclo (potencia)
P
atm
V
ltr/mol


P = 10.0075
Información de sustancia
Sustancia
Nombre: Metano (Real)
Rango de validez
Punto crítico
Calor específico = f(T)
Aceptar
Proc 12
P 10.0075 atm
Est.1
Est.2
P 10.0075
v 2.11796
T 251.862
T 265.317
u 11883.6
u 12247.6
h 13911.6
h 14395.2
s 92.6908
s 94.5612
W: 119.609
Q: 483.574
ΔU: 363.965
ΔH: 483.574
ΔS: 1.87044


P
atm
V
ltr/mol
Información de sustancia
Sustancia
Nombre: Metano (Real)
Fórmula: CH4
Masa molecular: 16.043 kg/kmol
Punto crítico
P: 45.3866 atm
T: 190.555 K
v: 0.1 ltr/mol
Rango de validez
Mínimo Máximo
P: 2.99E-3 1221.32 atm
T: 75.01 1699.99 K
Calor específico = f(T)
cp cv
Tamb: 35.8039 27.4134 J/(mol·K)
300 K: 35.8716 27.4823 J/(mol·K)
0ºC: 34.9909 26.5807 J/(mol·K)
0ºF: 34.5345 26.1065 J/(mol·K)
Aceptar
Proc 12
Est 1
Est 2
P 10.0075
v 2
T 251.862
u 11883.6
h 13911.6
s 92.6908
P 10.0075
v 2.11786
T 266.317
u 12247.6
h 14395.2
s 94.5612
atm
ltr/mol
K
J/mol
J/(mol·K)
Proc 12
Total
m 1
1
mol
W: 119.609
119.609
Q: 483.574
483.574
ΔU: 363.965
363.965
ΔH: 483.574
483.574
ΔS: 1.87044
1.87044
J
J/K

Obtención de la presión de un gas con el modelo tipo Clausius

Introducir los valores en las celdas de color amarillo

Tc (K)	190.56
V sistema(L/mol)	2.0000
pc (atm)	45.4000
a ($atmL^2K/mol^2$)	432.3653
b (L/mol)	0.0140
R (atmL/molK)	0.082
T sistema(K)	250.00
c (L/mol)	0.0291
Vc (L/mol)	0.1000

Modelo

$$p=\frac{RT}{(\bar{V}-b)}-\left[\frac{a}{(\bar{V}+c)^2 T}\right]$$

p ideal (atm)	10.2500
p real (atm)	9.9020

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Volumen (L)	4.0000
Temperatura (K)	250.00
moles (n)	2.0000
a_M ($atmL^2/mol^2$)	2.2689
b_M (L/mol)	0.0430
R (atmL/molK)	0.082

p ideal (atm)	10.2500
p real (atm)	9.9081

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