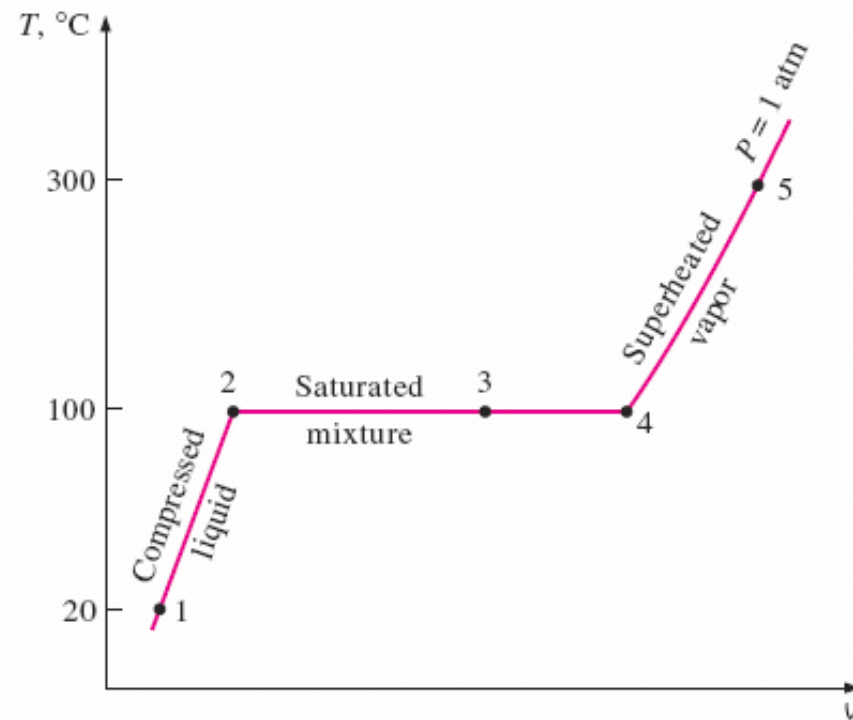
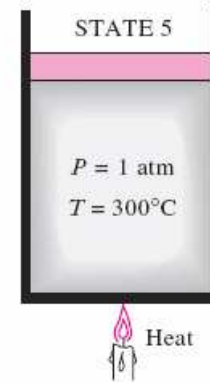
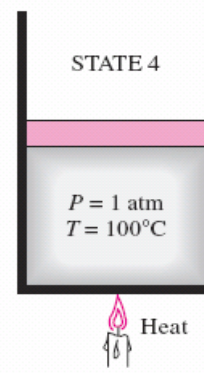
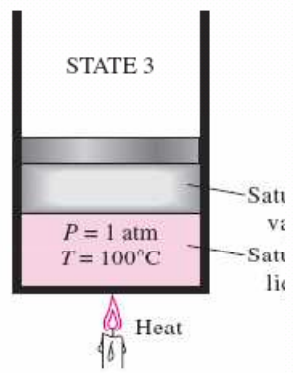
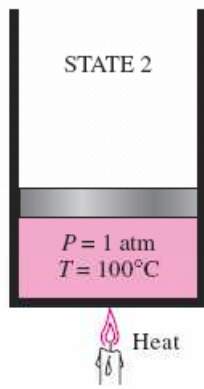
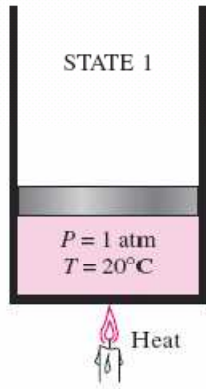
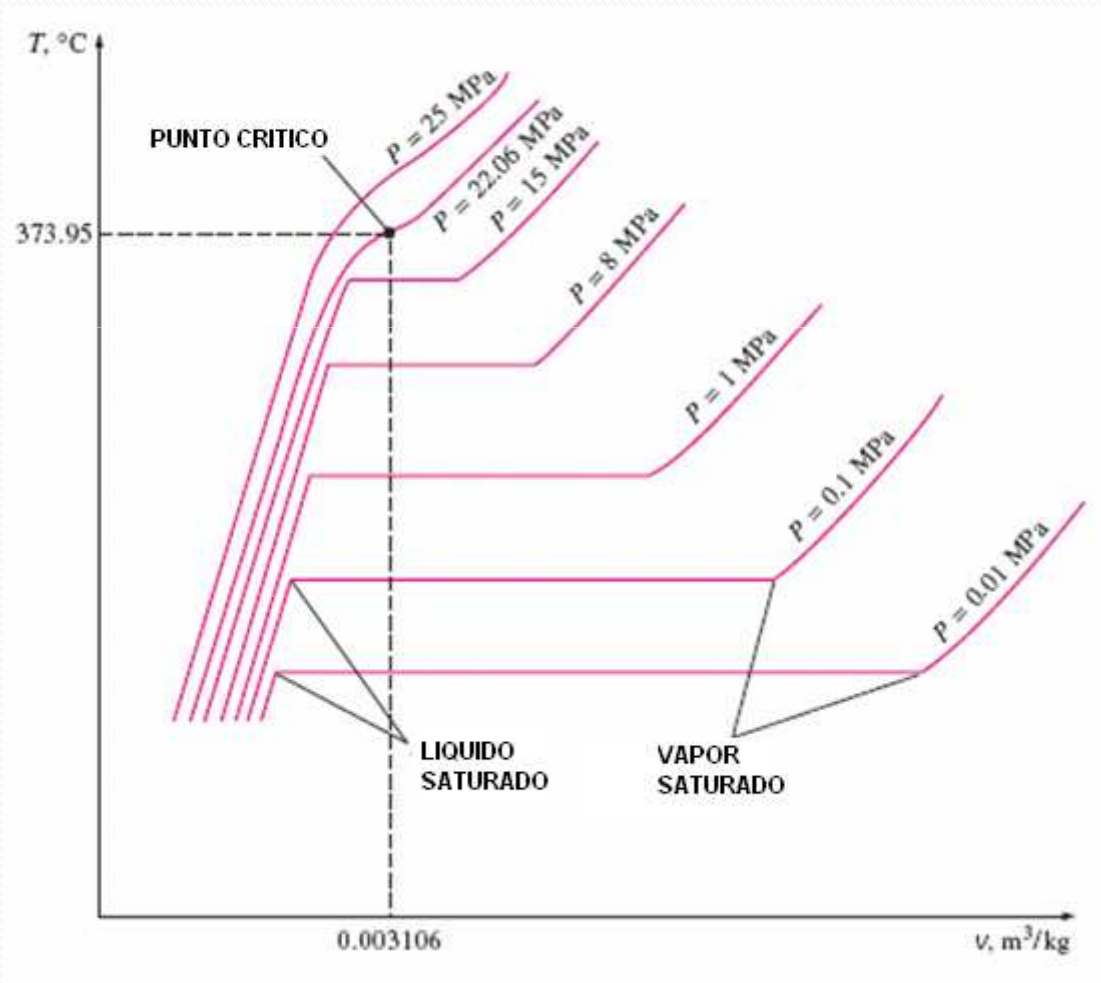




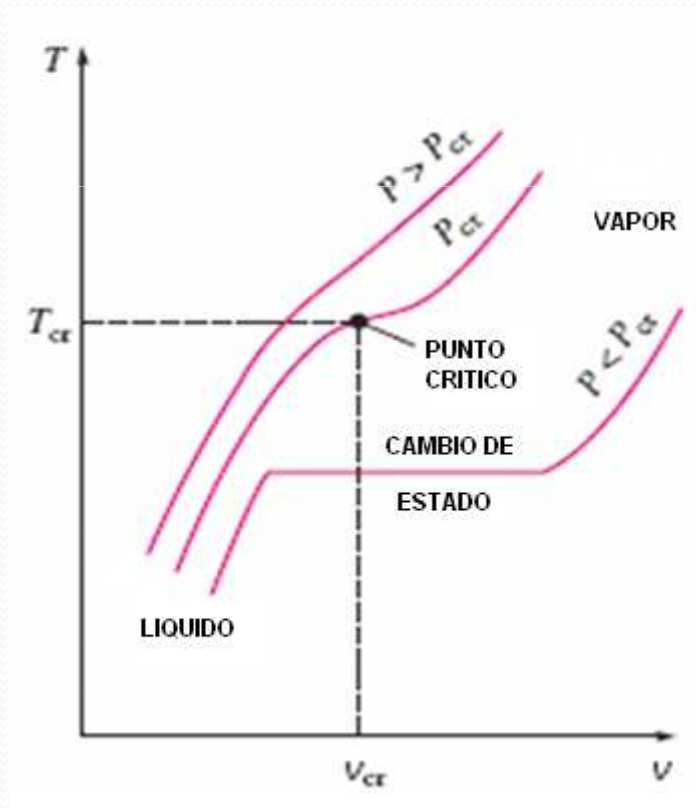
# SUSTANCIAS PURAS



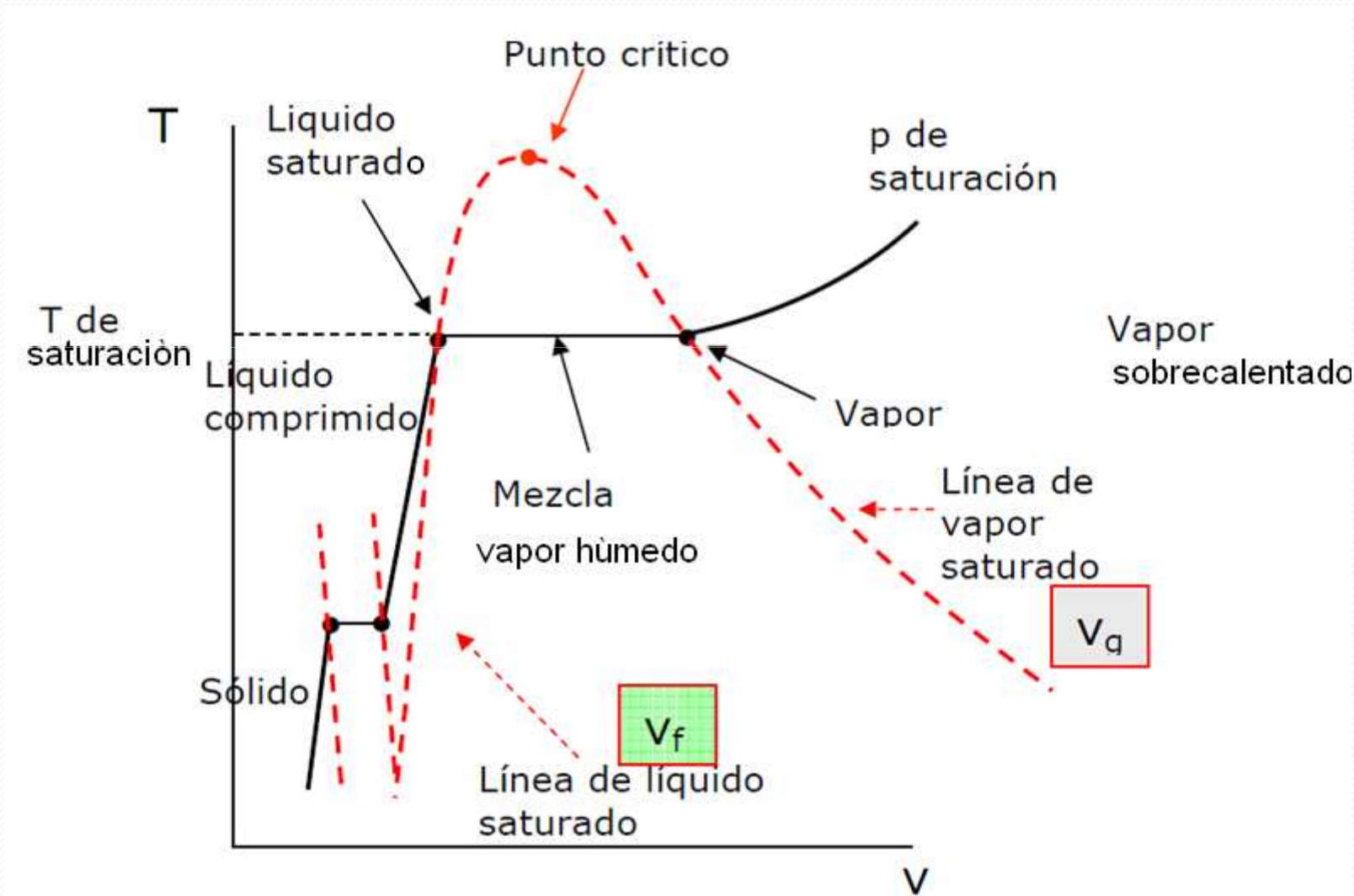
# Diagrama T-v



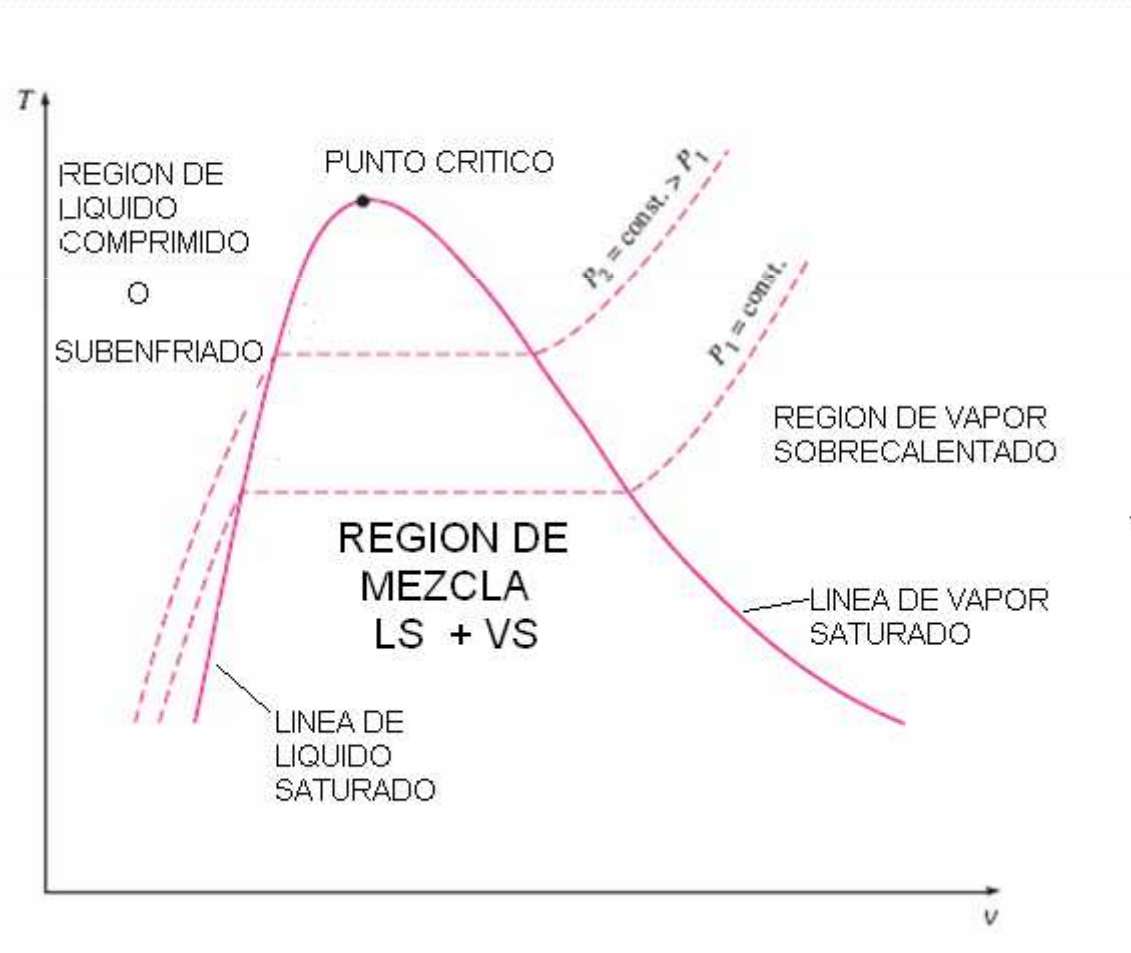
# Punto crítico



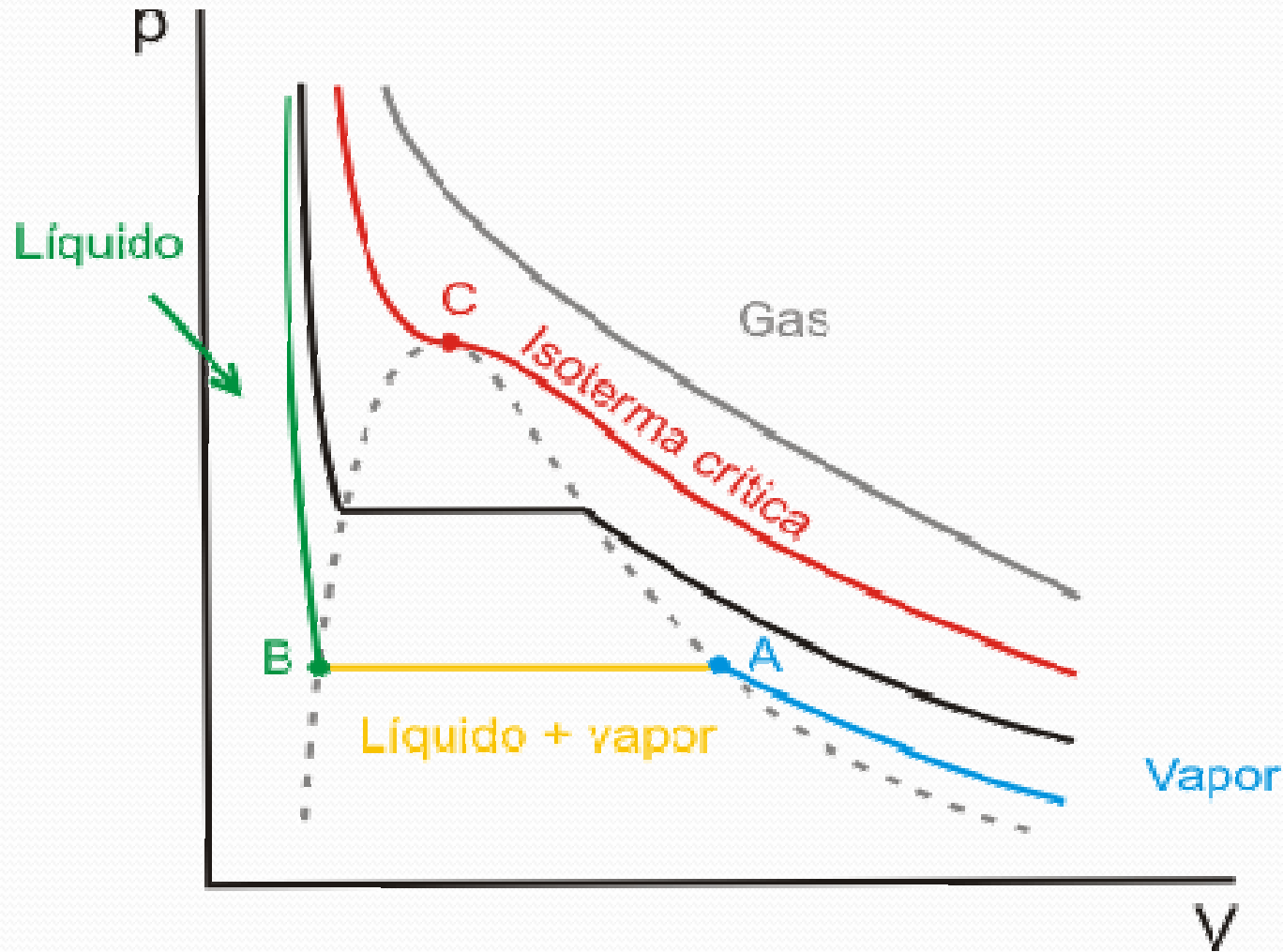
# Diagrama T-v



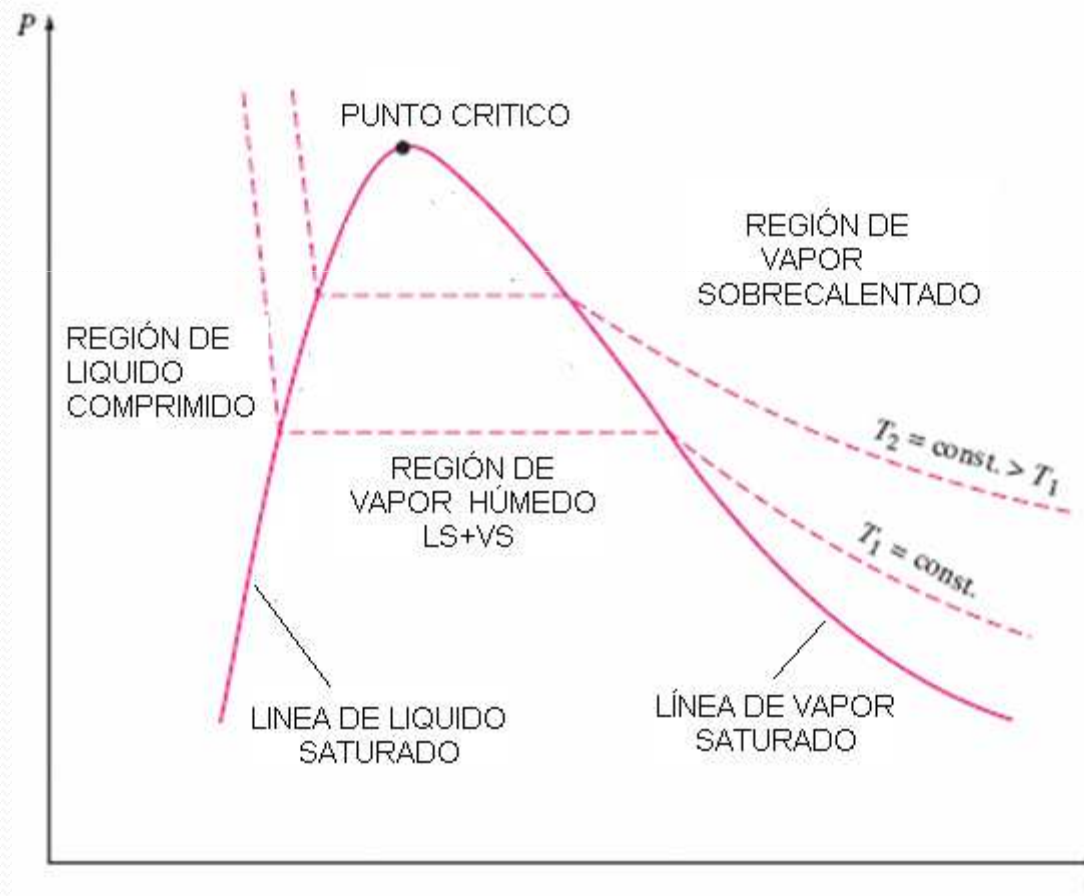
# Estados en el diagrama T-v



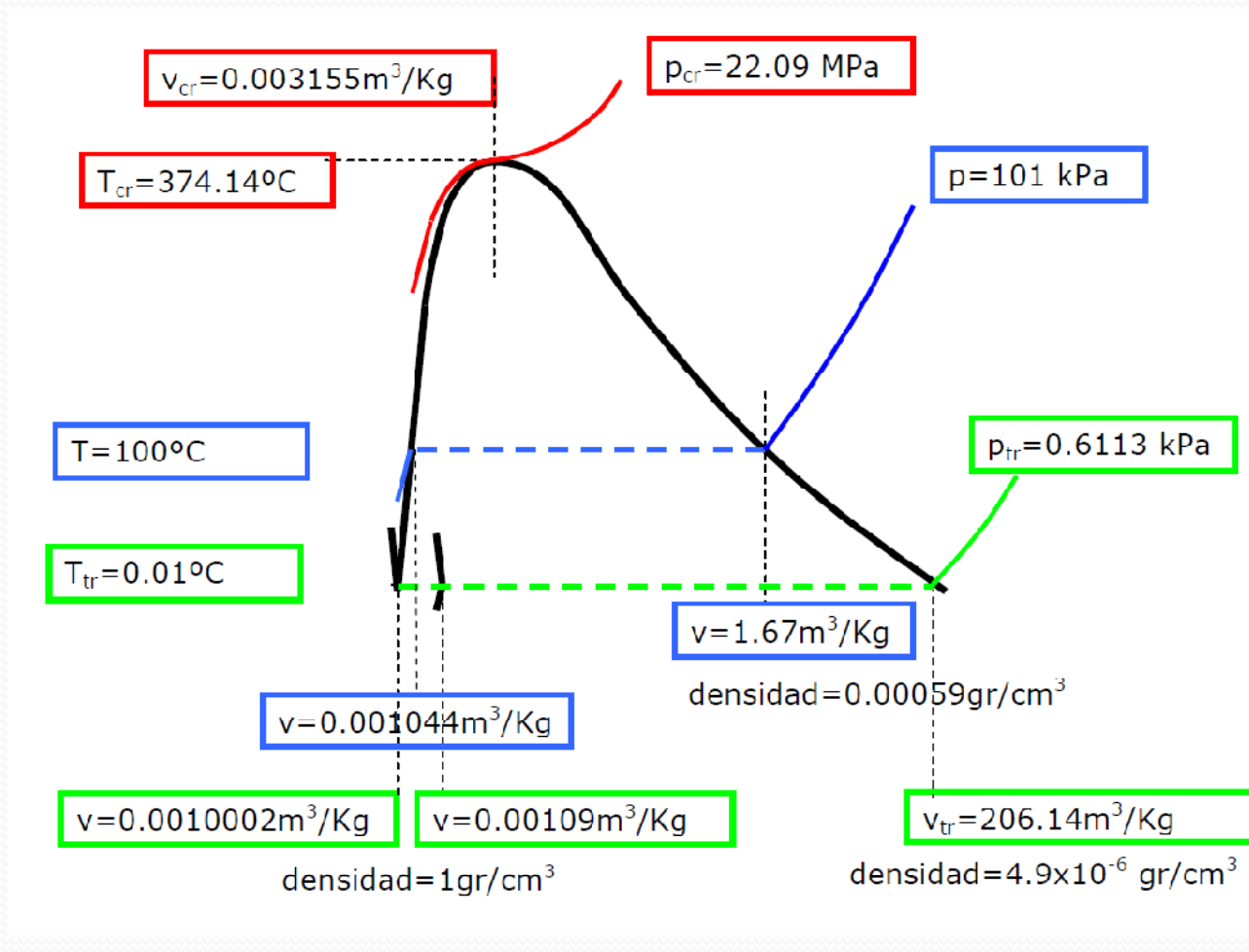
En la figura inferior se han representado las denominadas isotermas de Andrews. Dichas isotermas fueron medidas experimentalmente, y representan la presión en función del volumen a distintas temperaturas.



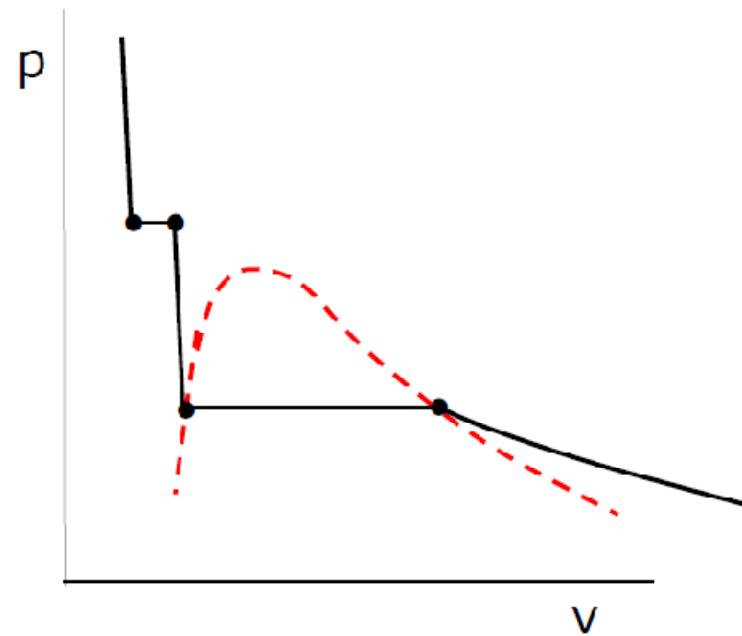
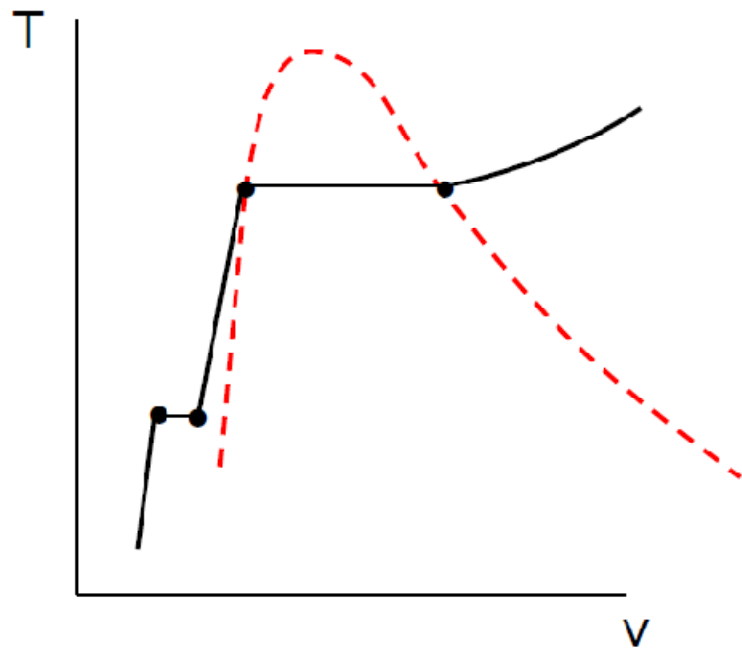
# Estados en el diagrama p-v



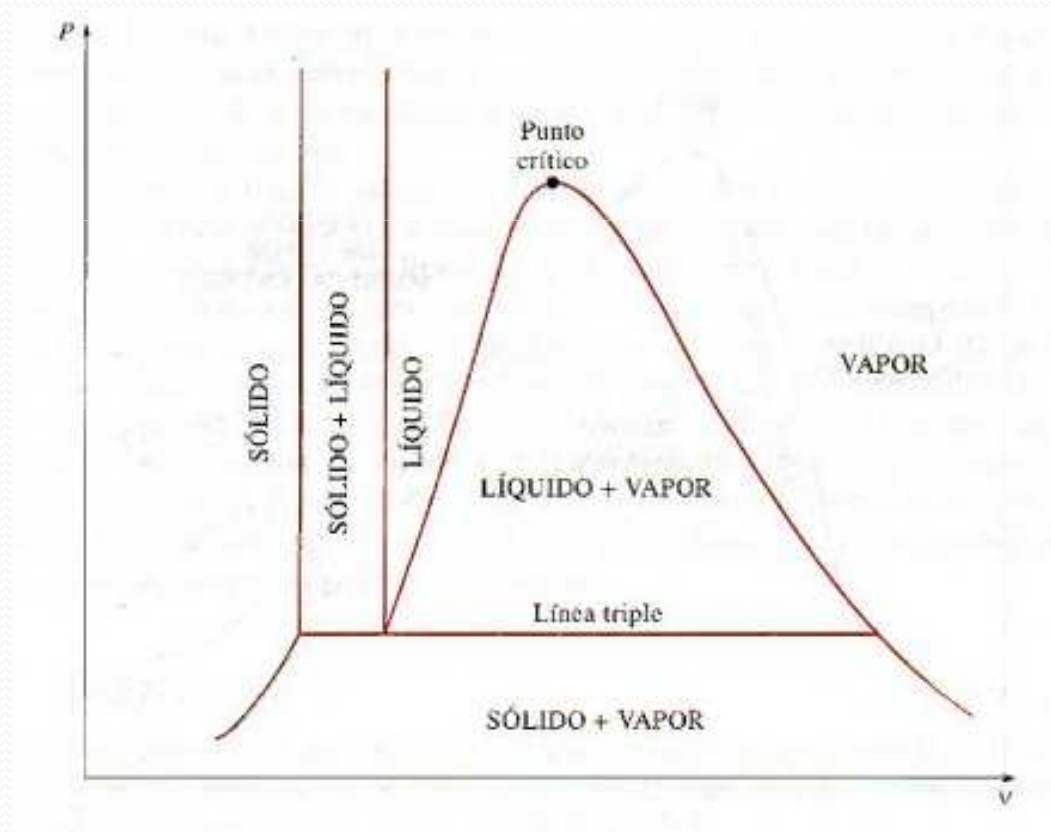
# Datos del agua



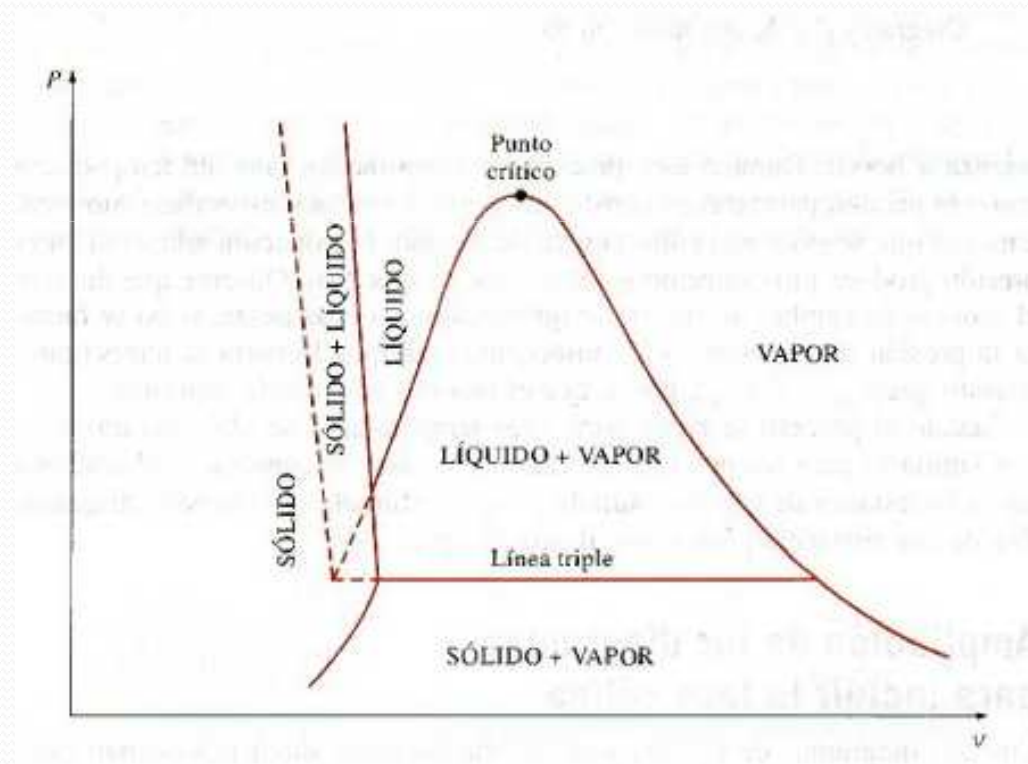
# Diagramas T-v y p-v



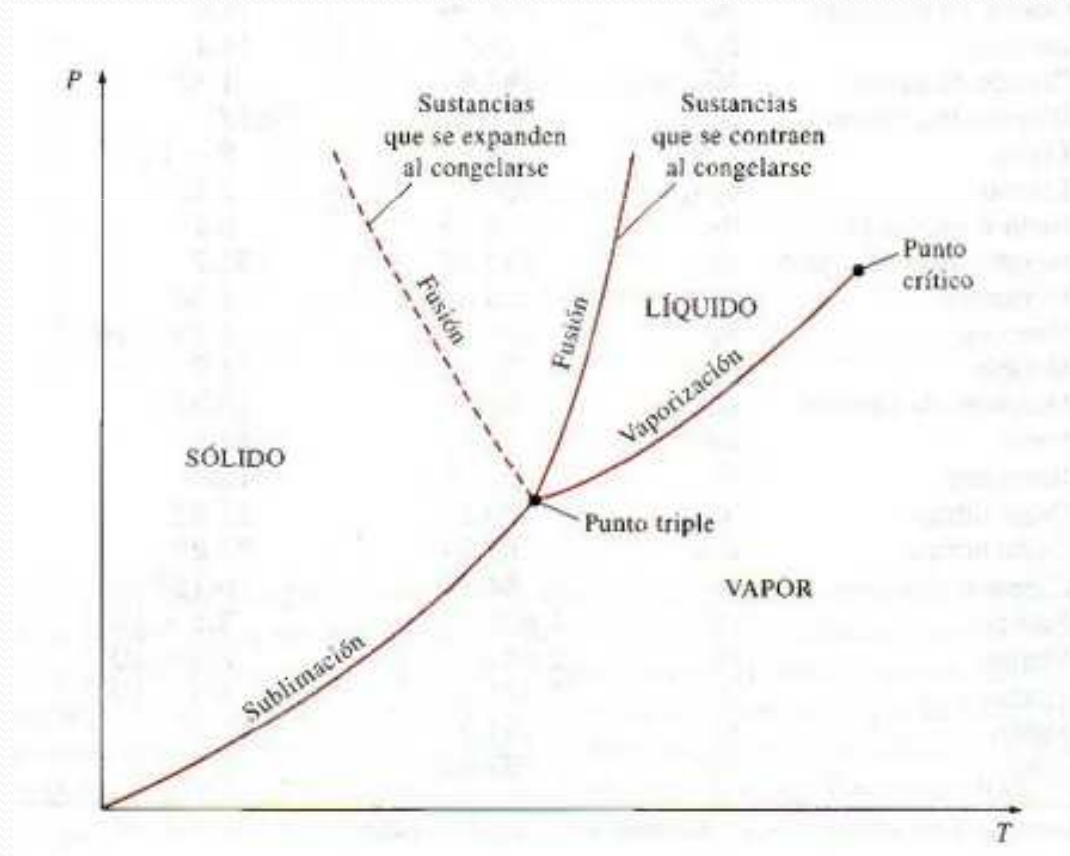
# Diagrama p-v en sustancias que se contraen al solidificar



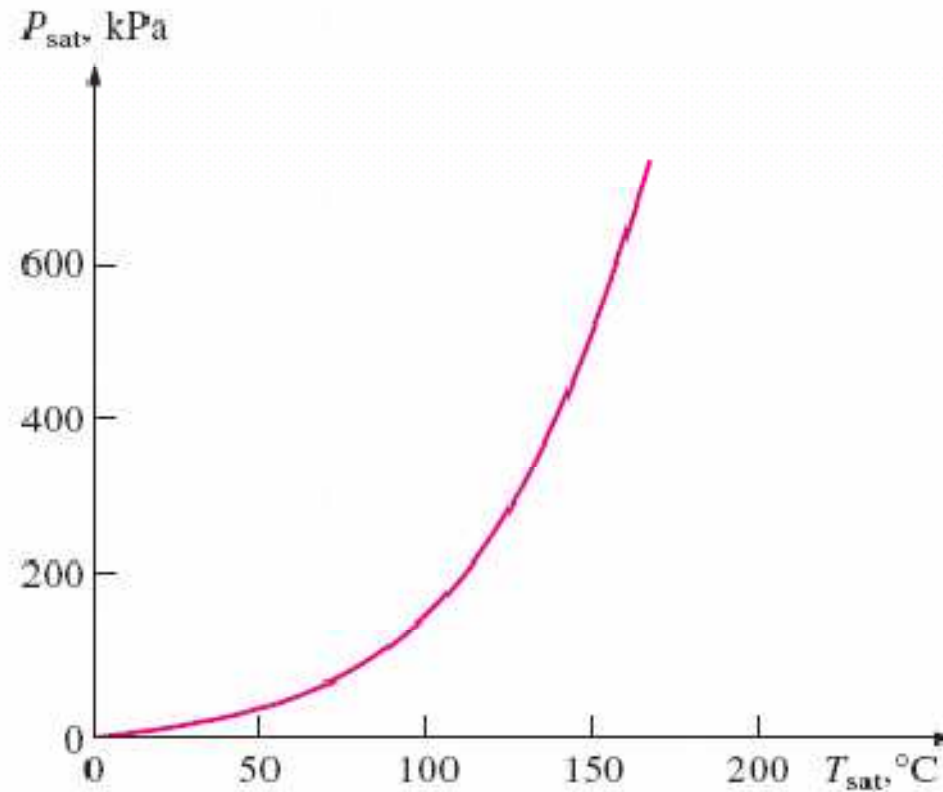
# Diagrama p-v en sustancias que se expanden al solidificar



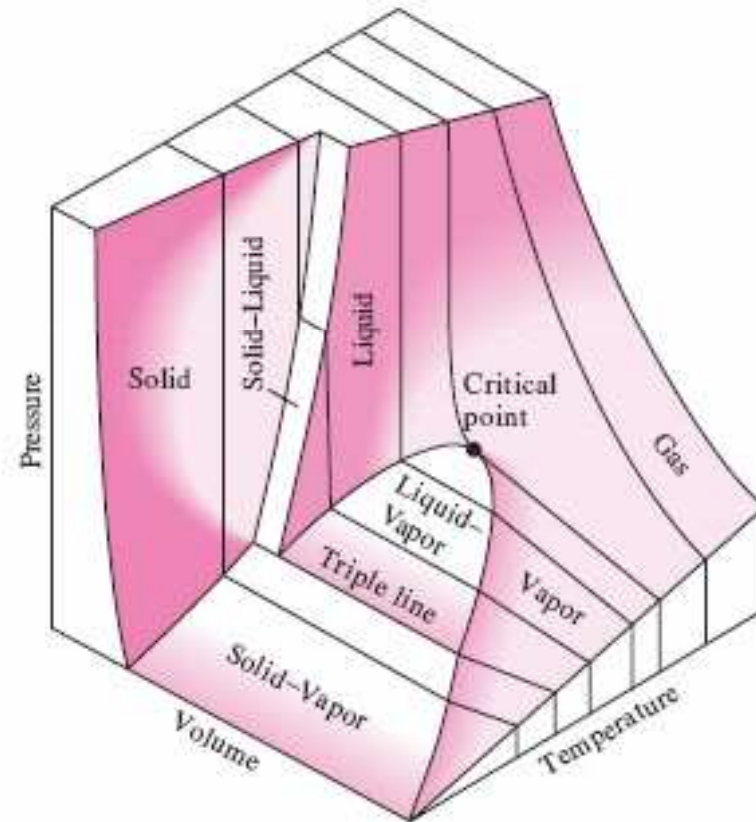
# Diagrama p-T



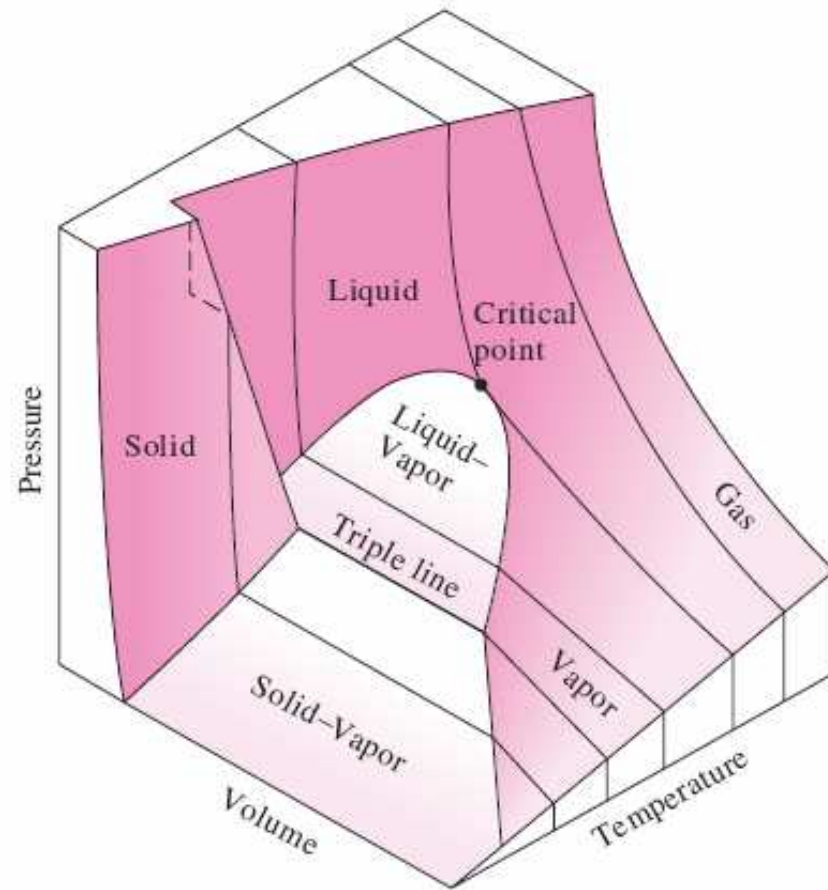
# Curva de saturación



# Diagrama p-v-T en sustancias que se contraen al solidificar



# Diagrama p-v-T en sustancias que se expanden al solidificar



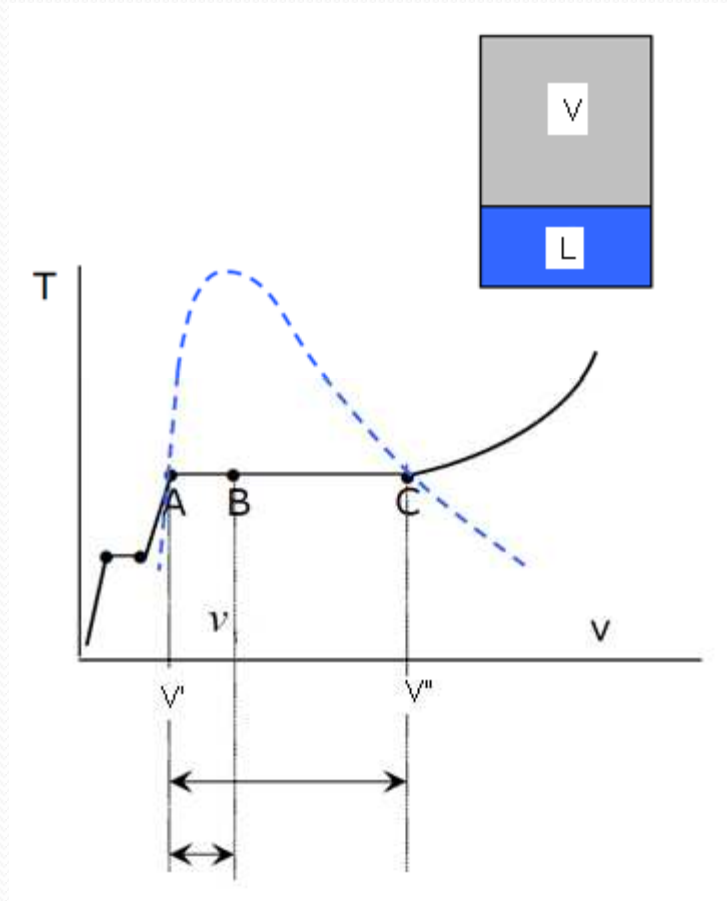
# ZONA DE VAPOR HÚMEDO

Título del vapor

$$x = \frac{m_{vs}}{m_{total}} = \frac{m_{vs}}{m_{ls} + m_{vs}}$$

$$0 \leq x \leq 1$$

# Volumen



$$V_t = V_L + V_V$$

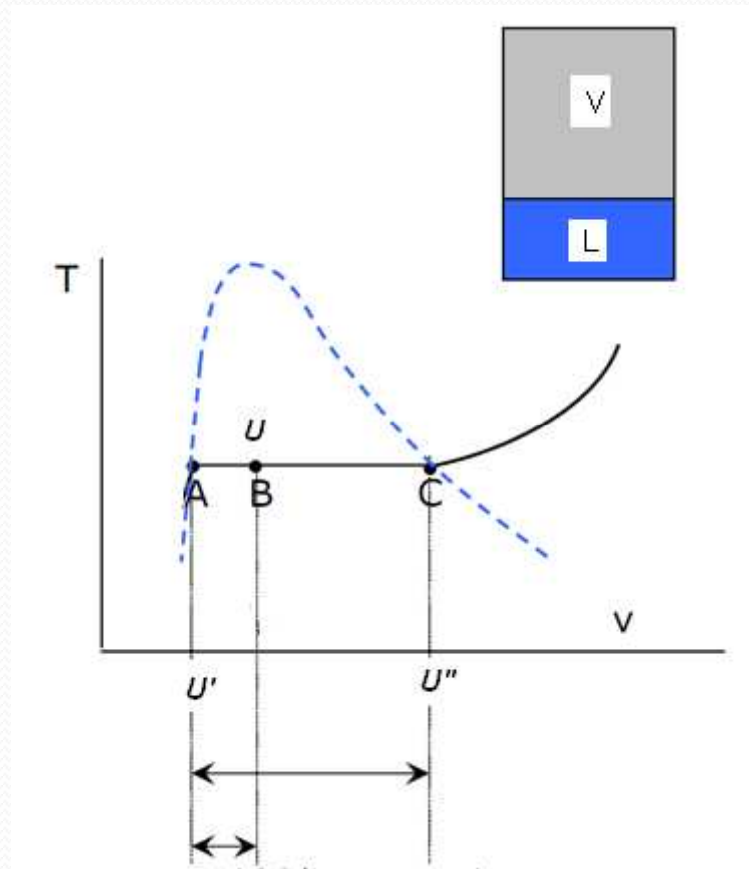
$$m_t v_t = m_l v' + m_v v''$$

$$v_t = \frac{m_l v'}{m_t} + \frac{m_v v''}{m_t}$$

$$v_t = (1 - x)v' + xv''$$

$$x = \frac{v_t - v'}{v'' - v'}$$

# Energía interna



$$U_t = U_L + U_V$$

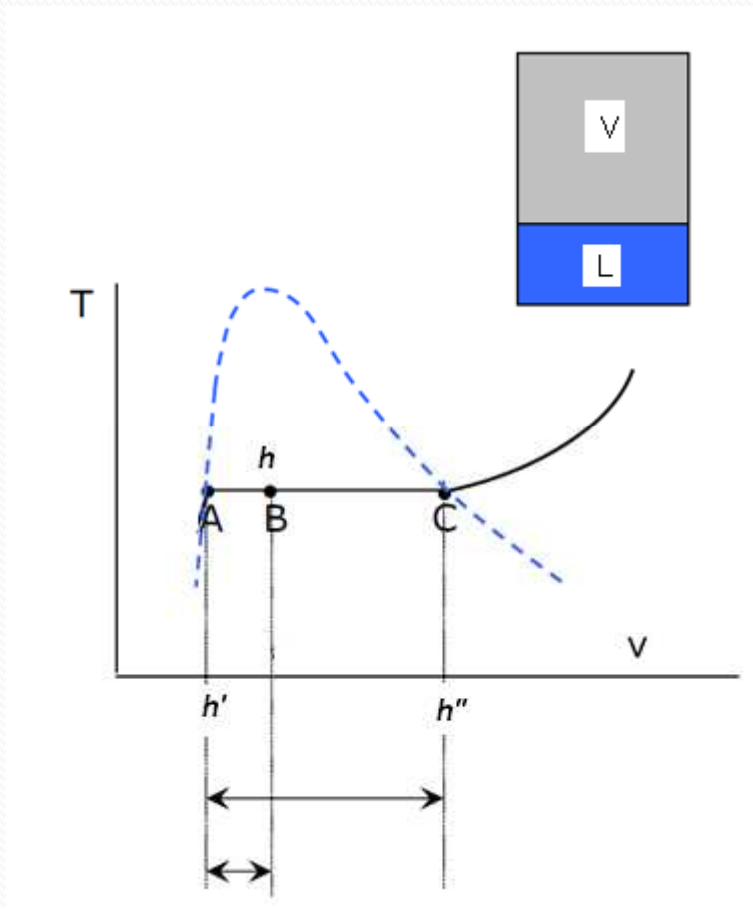
$$m_t u_t = m_l u' + m_v u''$$

$$u_t = \frac{m_l u'}{m_t} + \frac{m_v u''}{m_t}$$

$$u_t = (1 - x)u' + xu''$$

$$x = \frac{u_t - u'}{u'' - u'}$$

# Entalpía



$$H_t = H_L + H_V$$

$$m_t h_t = m_l h' + m_v h''$$

$$h_t = \frac{m_l h'}{m_t} + \frac{m_v h''}{m_t}$$

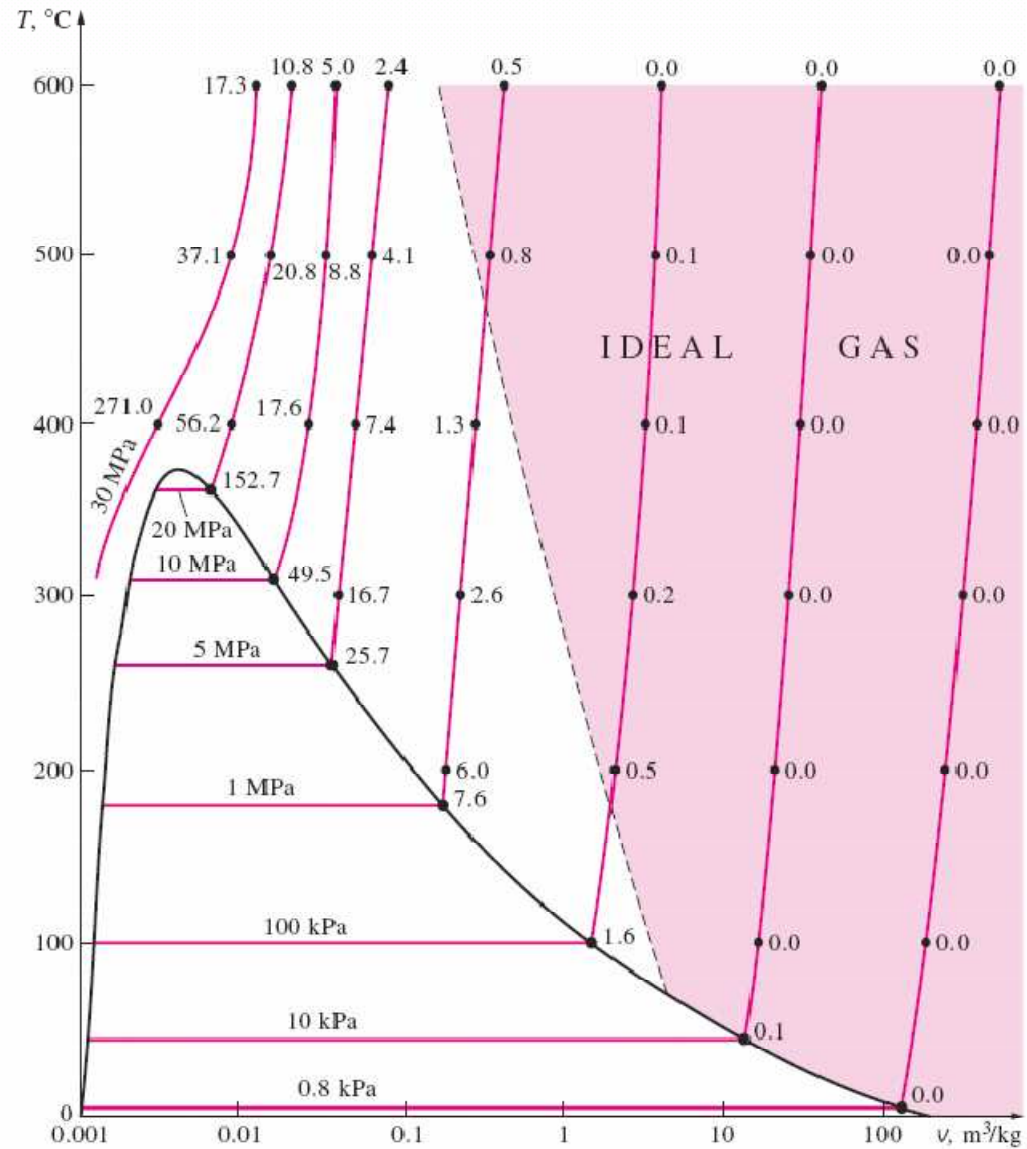
$$h_t = (1 - x)h' + xh''$$

$$x = \frac{h_t - h'}{h'' - h'}$$

# TÍTULO DEL VAPOR

$$x = \frac{v_t - v'}{v'' - v'} = \frac{u_t - u'}{u'' - u'} = \frac{h_t - h'}{h'' - h'} = \frac{s_t - s'}{s'' - s'}$$

# Gas real



# Van der Waals

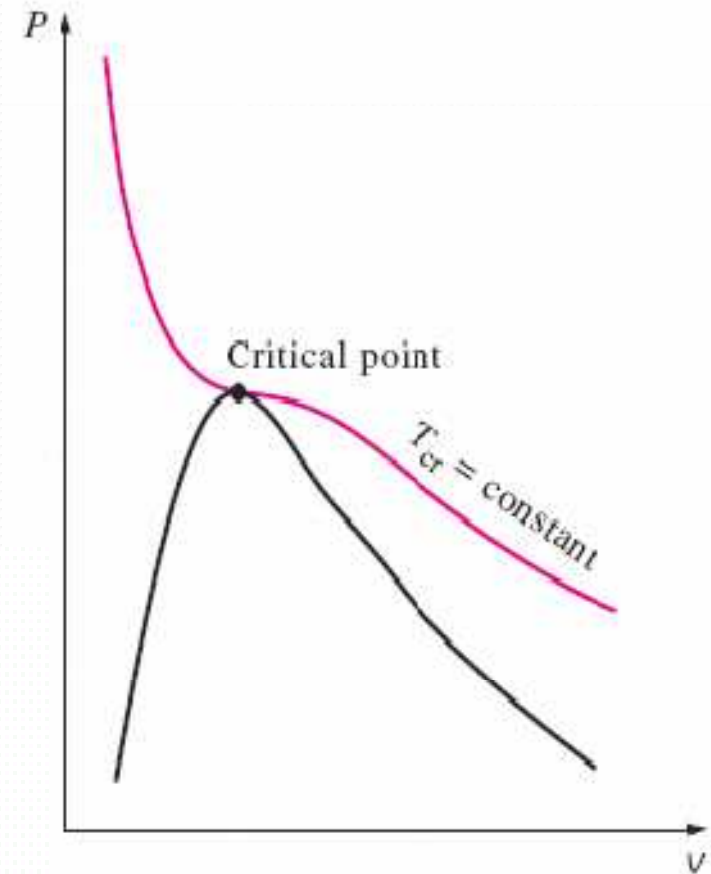
$$\left(P + \frac{a}{v^2}\right)(v - b) = RT$$

$$p = \frac{RT}{v - b} - \frac{a}{v^2}$$

$$\left(\frac{\partial P}{\partial v}\right)_{T=T_{\text{cr}}=\text{const}} = 0 \quad \text{and} \quad \left(\frac{\partial^2 P}{\partial v^2}\right)_{T=T_{\text{cr}}=\text{const}} = 0$$

$$T_R = \frac{T}{T_{\text{cr}}} \quad \text{and} \quad P_R = \frac{P}{P_{\text{cr}}}$$

$$a = \frac{27R^2 T_{\text{cr}}^2}{64P_{\text{cr}}} \quad \text{and} \quad b = \frac{RT_{\text{cr}}}{8P_{\text{cr}}}$$

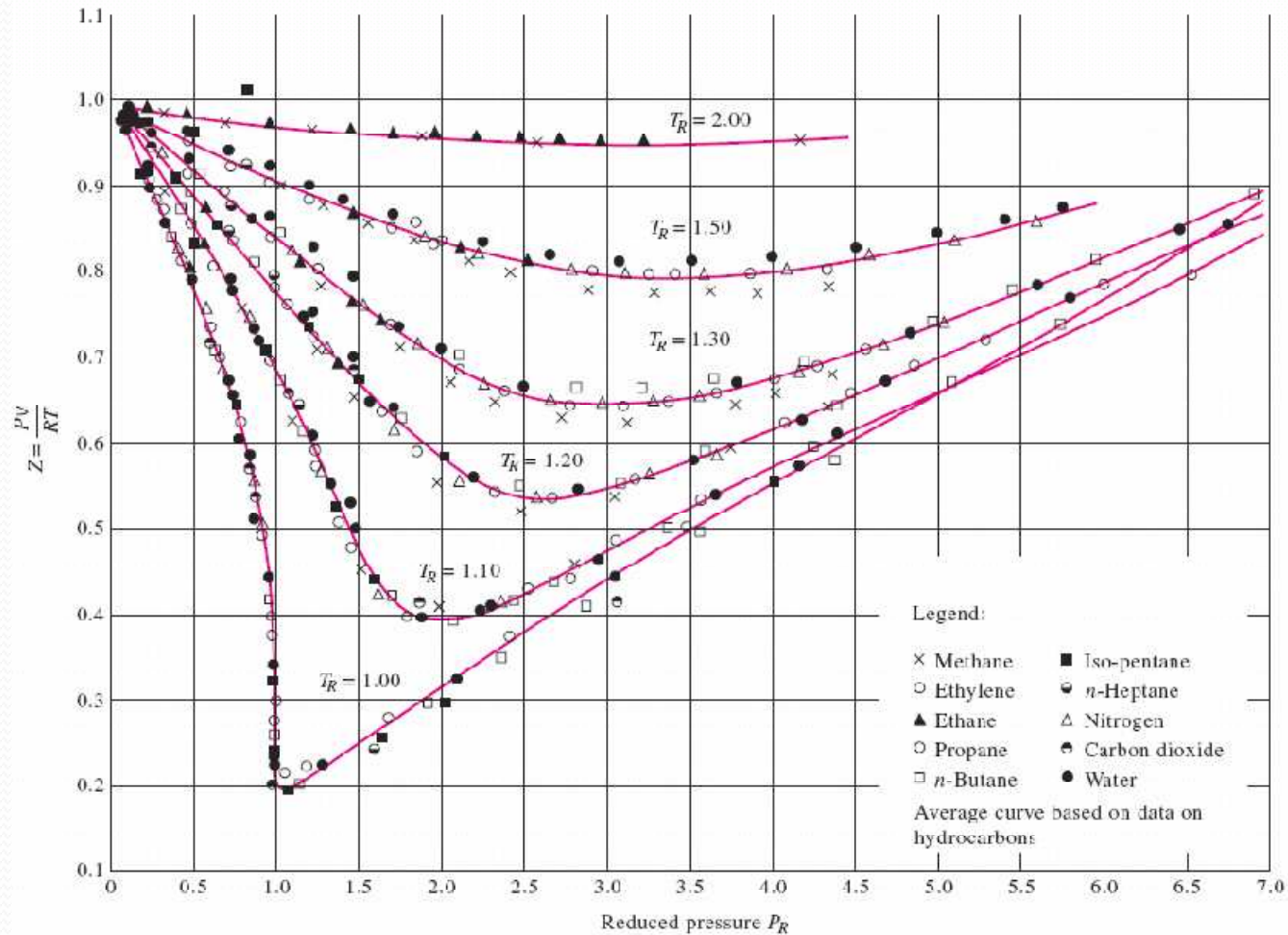


# COEFICIENTE DE COMPRESIBILIDAD

$$Z = \frac{PV}{RT}$$

$$Z = \frac{V_{\text{actual}}}{V_{\text{ideal}}}$$

$$V_R = \frac{V_{\text{actual}}}{RT_{\text{cr}}/P_{\text{cr}}}$$

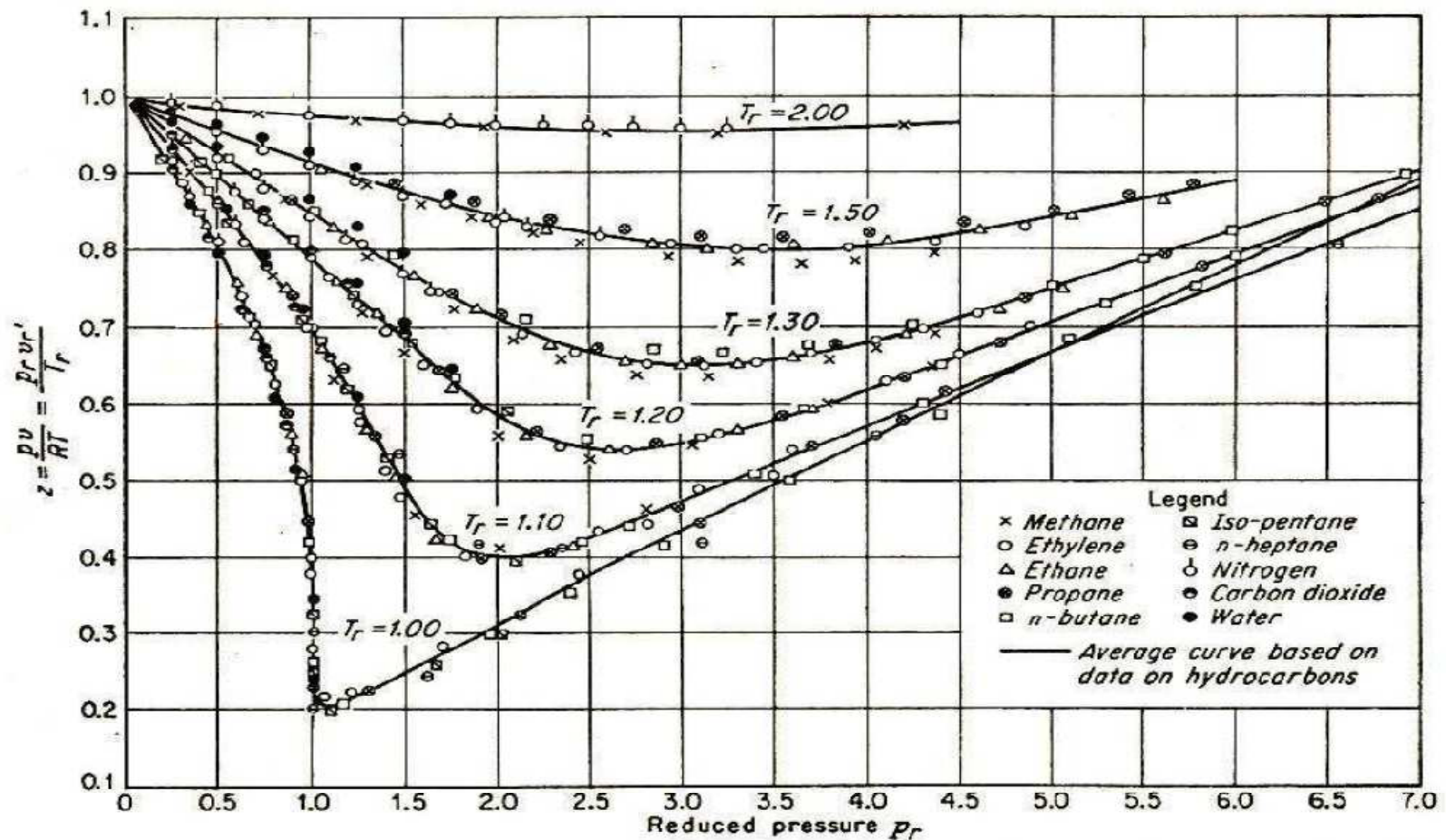


# Conclusión

De la carta de compresibilidad se observa:

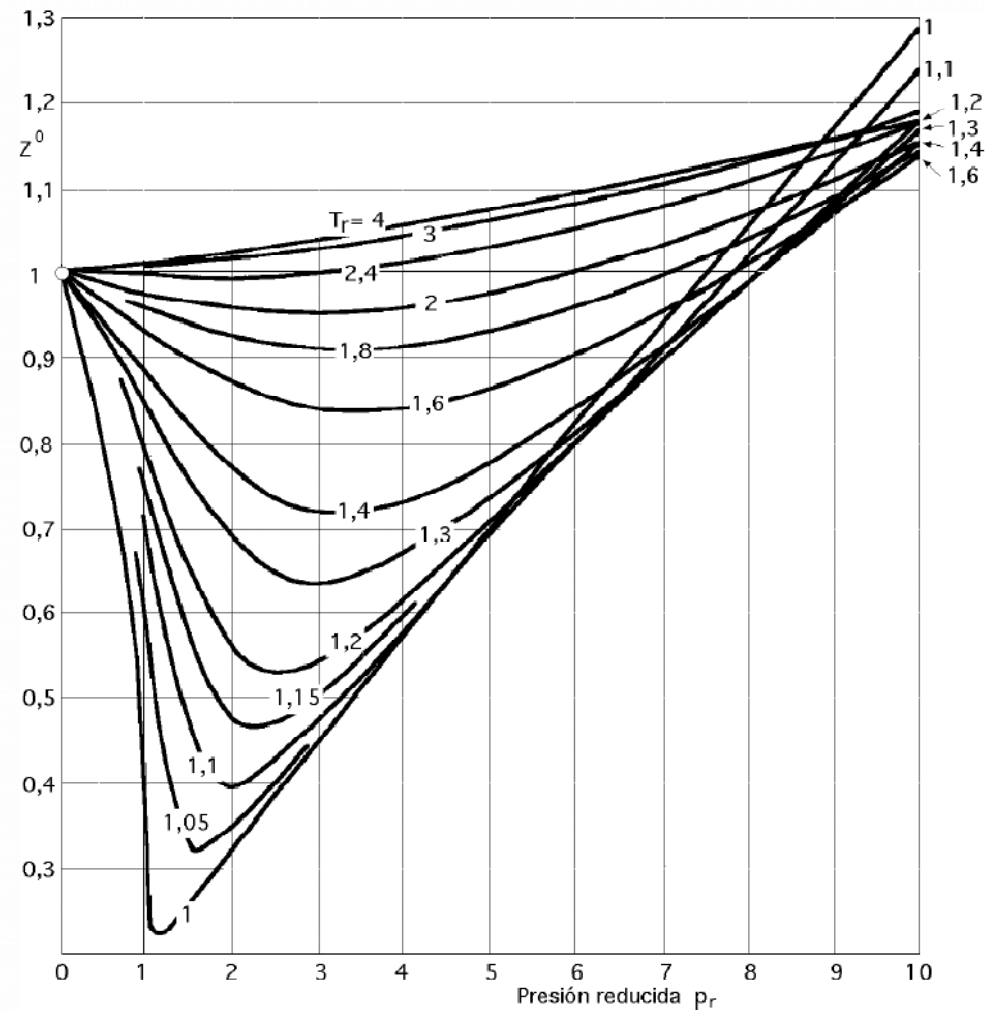
- 1.- A presiones muy bajas ( $PR \ll 1$ ), los gases se comportan como un gas ideal sin considerar las temperaturas .
- 2.- A temperaturas altas ( $TR > 2$ ) ,es posible que los gases se comporten como un gas ideal sin considerar la presión excepto cuando  $PR \ll 1$ .
- 3.- La desviación de un gas respecto al comportamiento de un gas ideal es mayor cerca del punto crítico .

# Carta de compresibilidad



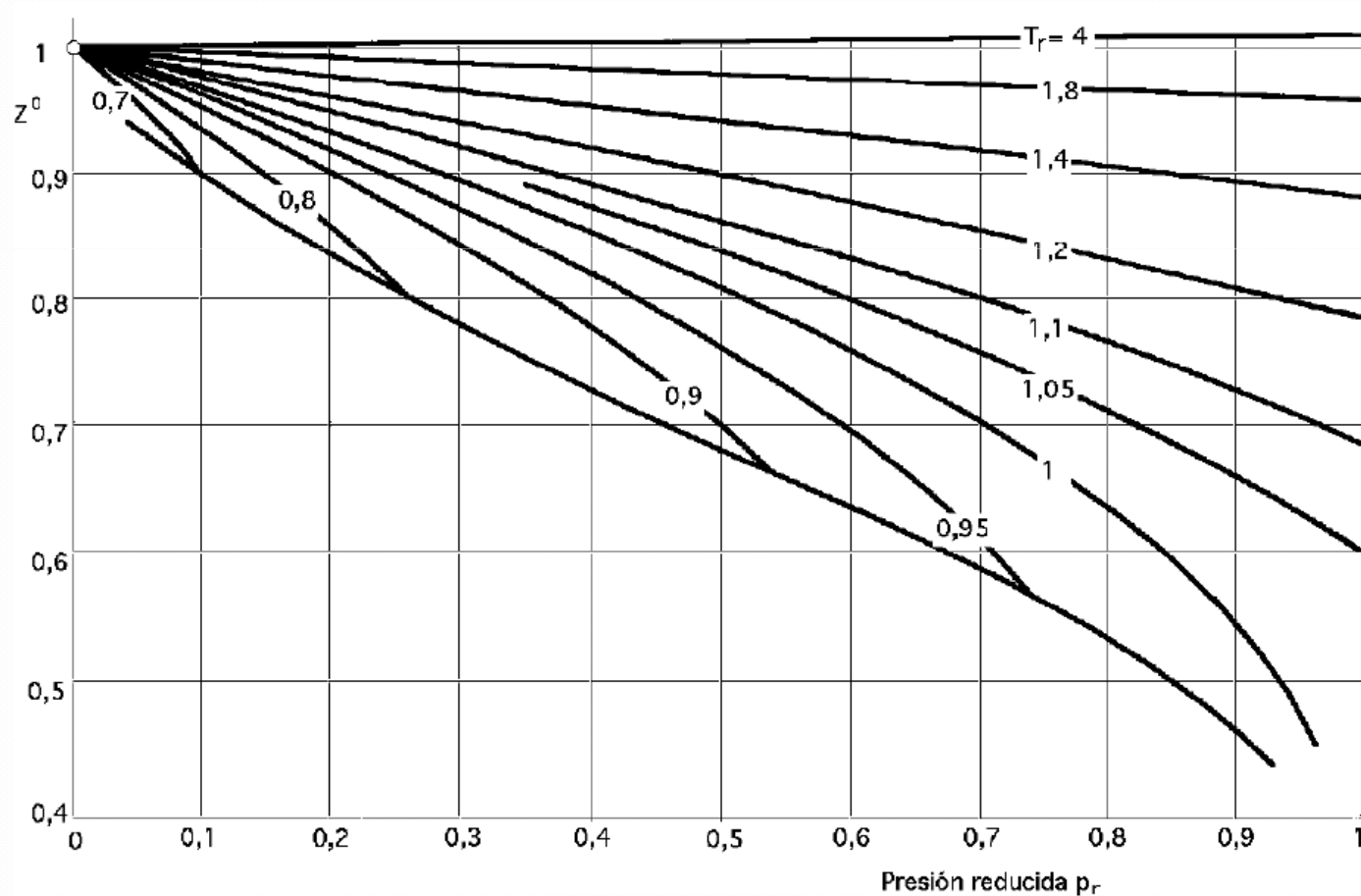
# Carta de compresibilidad generalizada

presiones reducidas mayor que 1



# Carta de compresibilidad generalizada

presiones reducidas menor que 1





**FIN**