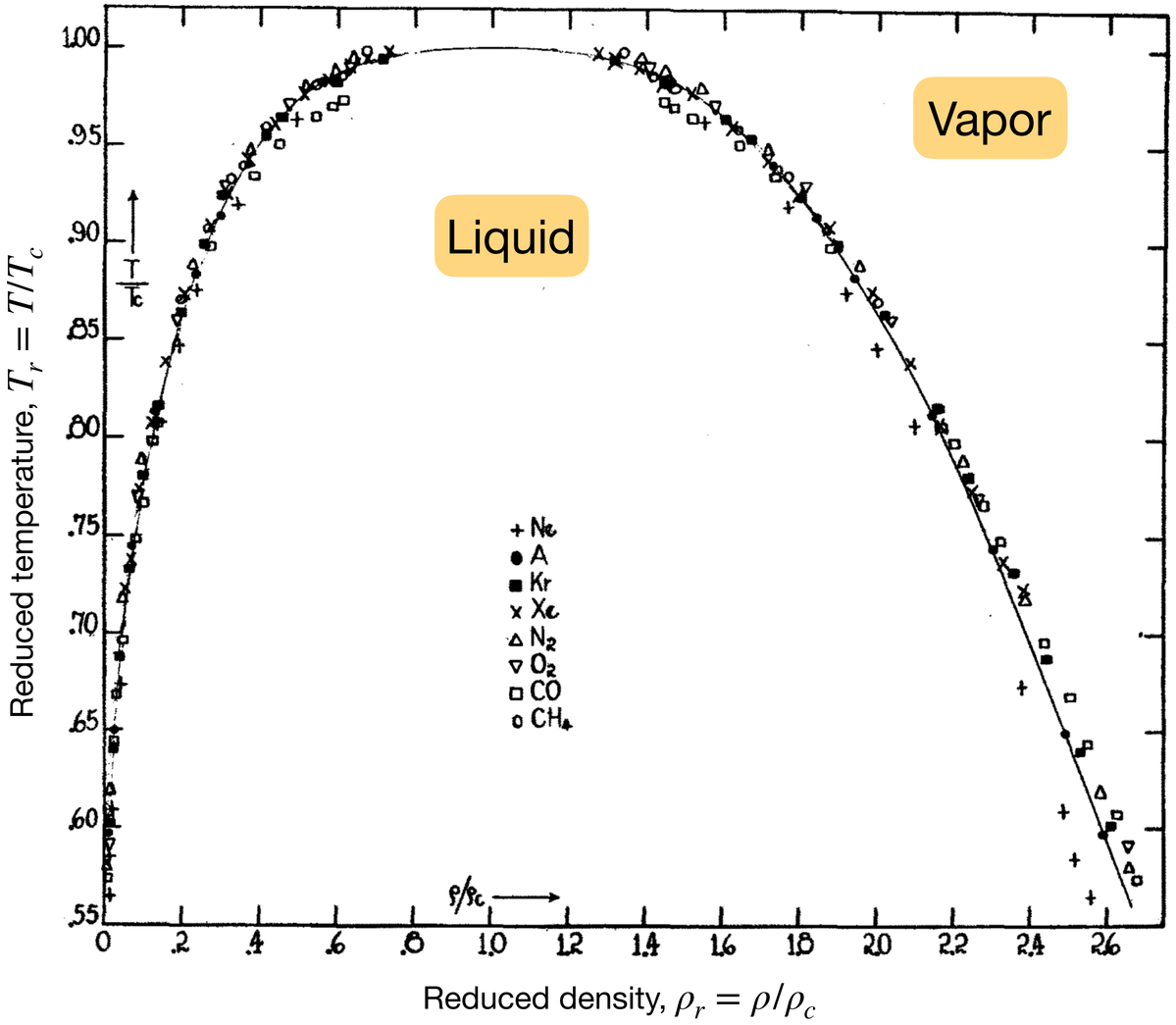
Lecture 6: Transport Coefficients

Corresponding States

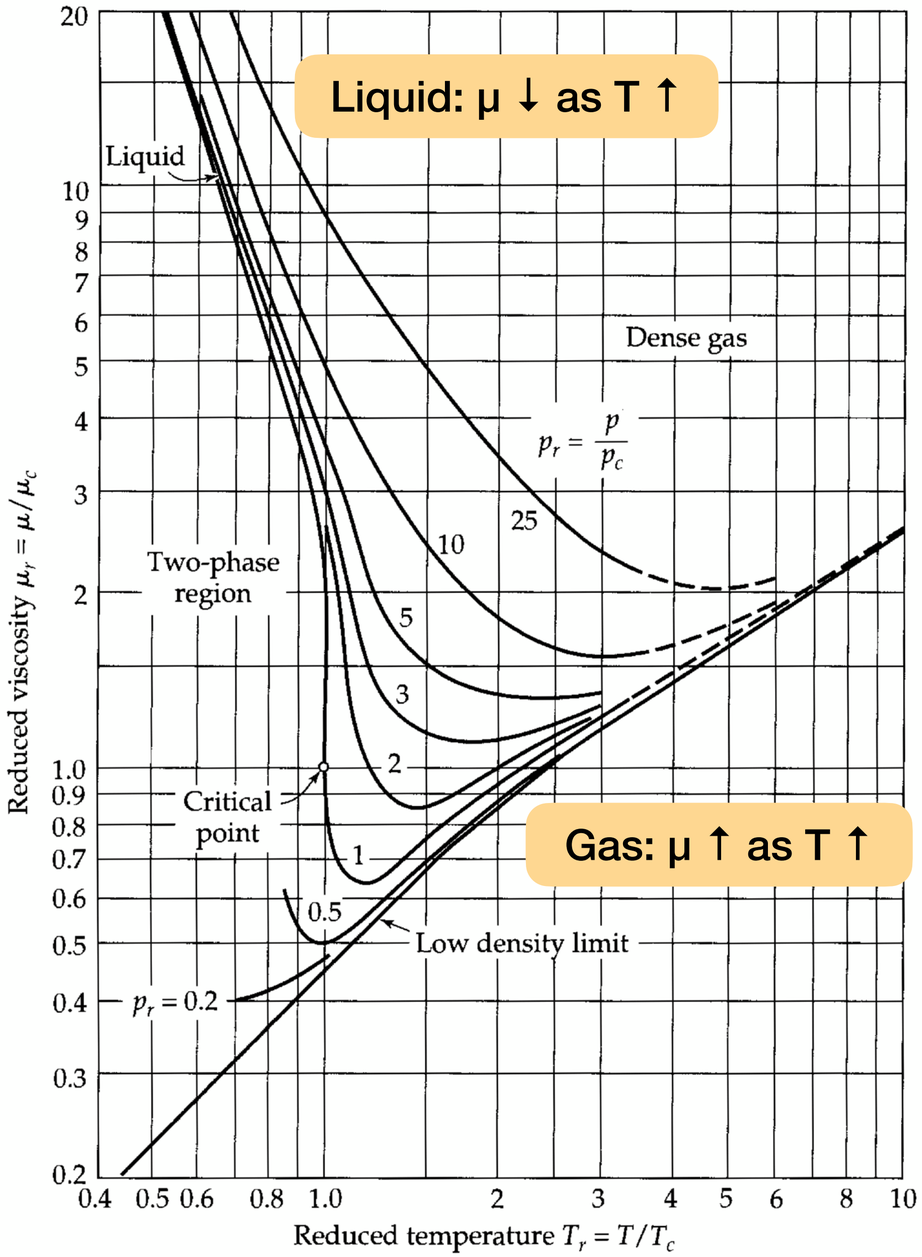
Chemical Engineering 533: Transport Phenomena

Thermodynamic Corresponding States



Guggenheim, J. Chem. Phys., 1945

Viscosity

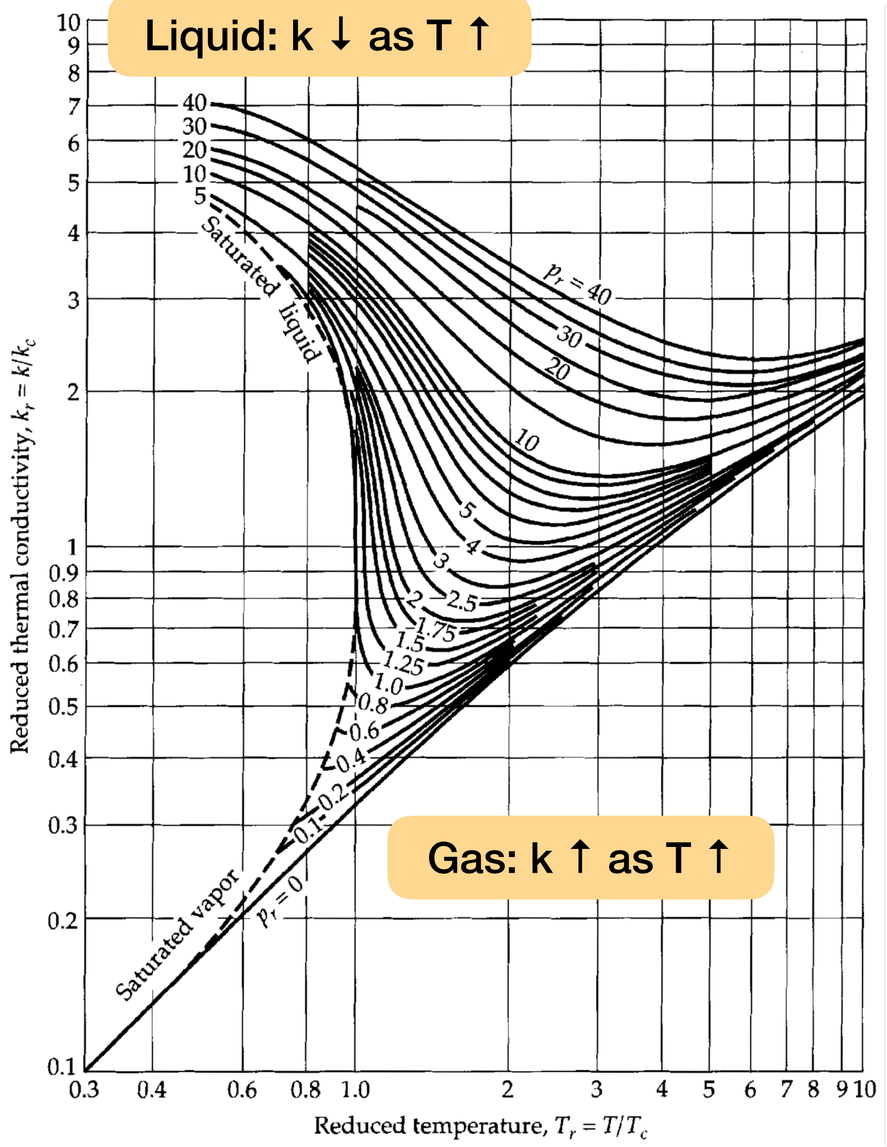


The viscosity of liquids and gases are not very sensitive to pressure, except around the critical point.

Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd Ed. 2002

Thermal Conductivity

Liquid: k ↓ as T ↑

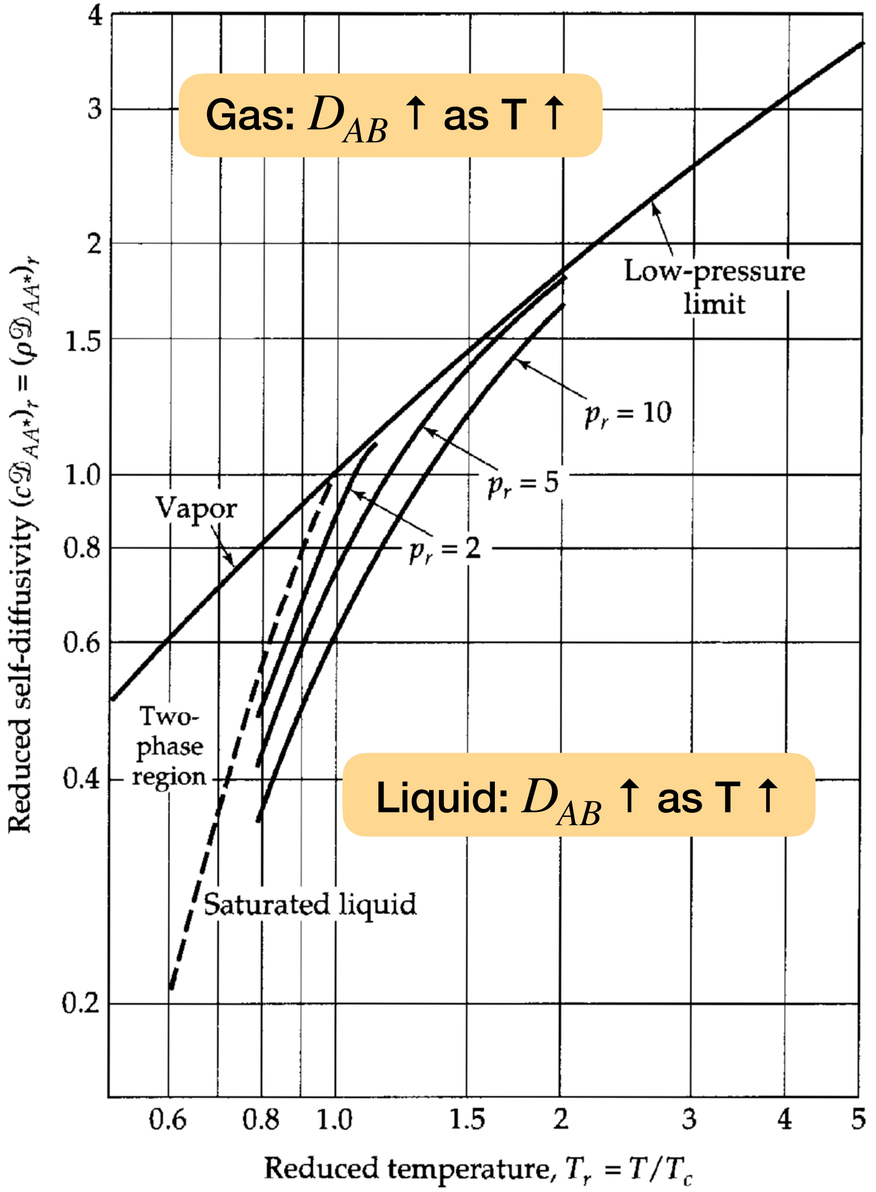


Gas: k ↑ as T ↑

Again, the thermal conductivity of liquids and gases are not very sensitive to pressure, except around the critical point.

Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd Ed. 2002

Diffusivity



Again, the diffusivity of liquids and gases are not very sensitive to pressure, except around the critical point.

Diffusivity breaks the trend from the previous two cases.

Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd Ed. 2002

Correlations for getting transport coefficients

Procedure A

- Use a known (or predicted) viscosity (conductivity/diffusivity) at known T and P and find it on the chart. Then compute critical viscosity (conductivity/diffusivity) and use chart.

Procedure B

- Use correlations below to find the critical viscosity (conductivity/diffusivity) and then use the chart to find your desired transport coefficient.

$$\mu_c = 7.70 M^{1/2} p_c^{2/3} T_c^{-1/6} \qquad \mu_c = 61.6 (M T_c)^{1/2} \tilde{V}_c^{-2/3}$$

$$\left(c\mathscr{D}_{AB}\right)_c = 2.96 \times 10^{-6} \left(\frac{1}{M_A} + \frac{1}{M_B}\right)^{1/2} \frac{\left(p_{c,A} p_{c,B}\right)^{1/3}}{\left(T_{c,A} T_{c,B}\right)^{1/12}}$$

- μ in micropoise
- $\mathscr{D}_{AB}$ in cm²/s
- p_c in atm
- T_c in K
- $\tilde{V}_c$ in cm³/g-mole
- c in g-mole/cm³

Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd Ed. 2002