Cohesive forces:

$V + dV$: $\quad U' = U + \left(\frac{\partial U}{\partial V}\right)\Big|_T dV$

$T + dT$: $\quad U' = U + \frac{\partial U}{\partial T}\Big|_V dT$

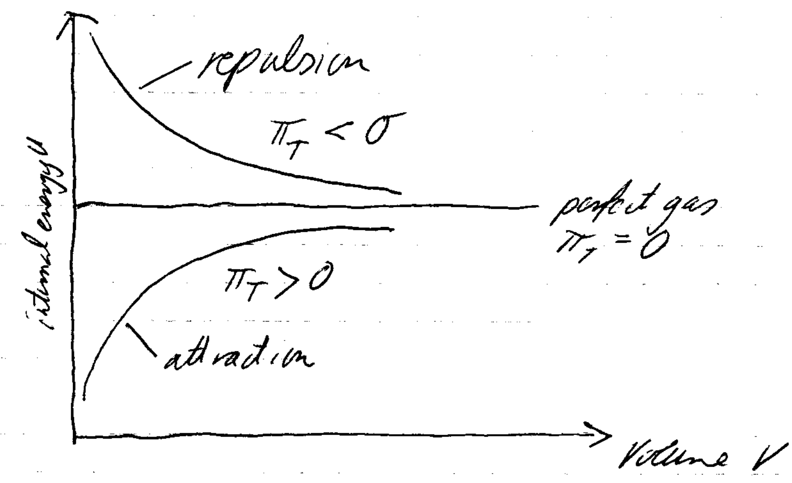
both: $\quad U' = U + \frac{\partial U}{\partial V}\Big|_T dV + \frac{\partial U}{\partial T}\Big|_V dT$

$$dU = \frac{\partial U}{\partial V}\Big|_T dV + \frac{\partial U}{\partial T}\Big|_V dT$$

$$= \frac{\partial U}{\partial V}\Big|_T dV + C_V \, dT$$

"internal pressure": $\pi_T = \frac{\partial U}{\partial V}\Big|_T$

$$dU = \pi_T \, dV + C_V \, dT$$



$$\frac{\partial U}{\partial T}\Big|_p = \pi_T \frac{\partial V}{\partial T}\Big|_p + C_V$$

expansion coefficient α: $\quad \alpha = \frac{1}{V} \cdot \frac{\partial V}{\partial T}\Big|_p$

$$\Rightarrow \boxed{\frac{\partial U}{\partial T}\Big|_p = \alpha \pi_T V + C_V}$$

further relations:

$$\boxed{\left.\frac{\partial H}{\partial T}\right|_V = \left(1 - \frac{\alpha \mu}{\kappa_T}\right) c_p}$$

with $\kappa_T = -\frac{1}{V}\left.\frac{\partial V}{\partial p}\right|_T$ isothermal compressibility

$\mu = \left.\frac{\partial T}{\partial p}\right|_H$ Joule-Thompson coefficient

$\kappa_T = \frac{1}{p}$ (perfect gas)

$$\boxed{c_p - c_V = \frac{\alpha^2 T V}{\kappa_T}}$$

potential exercises:

3.9, 3.11, 3.13

potential problems:

3.1, 3.23, 3.19