Handout 7:

Summary of key ideas in thermodynamics

U	$dU = TdS - pdV$
$H = U + pV$	$dH = TdS + Vdp$
$F = U - TS$	$dF = -SdT - pdV$
$G = H - TS$	$dG = -SdT + Vdp$

Toolkit for thermodynamic manipulations

* $f = f(x,y) \Rightarrow df = \left(\frac{\partial f}{\partial x}\right)_y dx + \left(\frac{\partial f}{\partial y}\right)_x dy$
* use a Maxwell relation e.g. $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$
* use $\left(\frac{\partial x}{\partial y}\right)_z = \left[\left(\frac{\partial y}{\partial x}\right)_z\right]^{-1}$
* use $\left(\frac{\partial x}{\partial y}\right)_z = -\left(\frac{\partial x}{\partial z}\right)_y \left(\frac{\partial z}{\partial y}\right)_x$ — DON'T FORGET
* identify a heat capacity e.g. $\frac{C_V}{T} = \left(\frac{\partial S}{\partial T}\right)_V$
* identify a "generalized susceptibility"

e.g. $\beta_p = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p$, $\kappa_T = -\frac{1}{V}\left(\frac{\partial V}{\partial p}\right)_T$, etc

β_p: isobaric expansivity; κ_T: isothermal compressibility

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