The fundamental equations of thermodynamics

Definitions:	$H = U + PV$	$A = U - TS$	$G = H - TS$
Properties of matter:	$C_v = \left(\frac{\partial U}{\partial T}\right)_V$	$C_p = \left(\frac{\partial H}{\partial T}\right)_P$	$\mu = \left(\frac{\partial T}{\partial P}\right)_H$
	$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$	$\kappa_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$	$\kappa_S = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_S$

Basic equations	Maxwell relationships	Working equations
(a) $dU = T\,dS - P\,dV$	$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$	$dU = C_v\,dT + \left[T\left(\frac{\partial P}{\partial T}\right)_V - P\right]dV$
(b) $dA = -S\,dT - P\,dV$	$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$	$dS = \frac{C_v}{T}\,dT + \left(\frac{\partial P}{\partial T}\right)_V dV$
(c) $dH = T\,dS + V\,dP$	$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$	$dH = C_p\,dT + \left[V - T\left(\frac{\partial V}{\partial T}\right)_P\right]dP$
(d) $dG = -S\,dT + V\,dP$	$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$	$dS = \frac{C_p}{T}\,dT - \left(\frac{\partial V}{\partial T}\right)_P dP$

Some derived relationships:

$C_v = T\left(\frac{\partial S}{\partial T}\right)_V$	$\left(\frac{\partial G}{\partial T}\right)_P = -S$	$\left(\frac{\partial G}{\partial P}\right)_T = V$
$C_p = T\left(\frac{\partial S}{\partial T}\right)_P$	$\left(\frac{\partial A}{\partial T}\right)_V = -S$	$\left(\frac{\partial A}{\partial V}\right)_T = -P$