Useful Equations and Constants:

$$\overline{u^2} = \frac{3k_BT}{m} \qquad \bar{u} = \sqrt{\frac{8k_BT}{\pi m}} \qquad u_{mp} = \sqrt{\frac{2k_BT}{m}}$$

$$\bar{\varepsilon} = \frac{3}{2}k_BT \qquad \left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

$$\lambda = \frac{V}{\sqrt{2}\pi d^2 N} \qquad \frac{dN}{N} = 4\pi\left(\frac{m}{2\pi k_BT}\right)^{3/2} e^{-mu^2/2k_BT}u^2\,du$$

$$Z = \frac{PV}{nRT} = \frac{PV_m}{RT} \qquad \left(P_r + \frac{3}{V_r^2}\right)\left(V_r - \frac{1}{3}\right) = \frac{8}{3}T_r \qquad P_t = \frac{RT}{V}\sum_i n_i$$

$$\Delta U = q + w \qquad w = -\int_{V_i}^{V_f} P_{ext}\,dV \qquad \Delta H_m(T_2) = \Delta H_m(T_1) + \int_{T_1}^{T_2} \Delta C_p\,dT$$

$$w = -P_{ext}\Delta V \qquad w = -nRT\ln\left(\frac{V_2}{V_1}\right) \qquad H = U + PV$$

$$\Delta H = \Delta U + \Delta(PV) \qquad \Delta H = \Delta U + \Delta nRT \qquad \Delta U = nC_{V,m}(T_2 - T_1)$$

$$\Delta H = nC_{P,m}(T_2 - T_1) \qquad \frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} \qquad \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^{\gamma}$$

$$\gamma = \frac{C_{p,m}}{C_{v,m}} \qquad C_{P,m} - C_{V,m} = R \qquad \Delta U = -n^2 a\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$$

$$w = -nRT\ln\left(\frac{V_2 - nb}{V_1 - nb}\right) - n^2 a\left(\frac{1}{V_2} - \frac{1}{V_1}\right) \qquad \eta = \frac{T_h - T_c}{T_h}$$

$$\Delta S = nR\ln\frac{V_f}{V_i} \qquad \Delta S = nR\ln\frac{P_i}{P_f} \qquad \Delta S = nC_{P,m}\ln\frac{T_f}{T_i}$$

$$\Delta S = nC_{V,m}\ln\frac{T_f}{T_i} \qquad \Delta S = -R(x_1\ln x_1 + x_2\ln x_2) \qquad G = H - TS$$

$\Delta G = \Delta H - T\Delta S$ $\Delta S = n_1 R \ln\left(\frac{V_1 + V_2}{V_1}\right) + n_2 R \ln\left(\frac{V_1 + V_2}{V_2}\right)$

$A = U - TS$ $\Delta A = \Delta U - T\Delta S$ $\left(\frac{\partial U}{\partial V}\right)_T = -P + T\left(\frac{\partial P}{\partial T}\right)_V$

$\left(\frac{\partial H}{\partial P}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_P$ $RT \ln\frac{f}{P} = \int_0^P \left(V_m - \frac{RT}{P'}\right) dP'$

L = 6.022×10^{23} mol^{-1}
R = 8.3145 J K^{-1} mol^{-1} = 0.082057 atm dm^3 K^{-1} mol^{-1} = 1.98719 cal K^{-1} mol^{-1}
k_B = 1.381×10^{-23} J K^{-1}

1 atm = 101325 Pa, 1 bar = 100000 Pa
1 m^3 = 1000 liter = 1000 dm^3
1 W = 1 J s^{-1}
1 horsepower = 745.6 W

Thermodynamic data for organic compounds (all values are for 298.15 K and 1 bar)

	$\Delta_f H^o$ / kJ mol^{-1}	S^o / JK^{-1} mol^{-1}	$C_{P,m}$ / JK^{-1} mol^{-1}
$H_2(g)$	0	130.68	28.82
$N_2(g)$	0	191.61	29.13
$O_2(g)$	0	205.14	29.34
$CO(g)$	–110.53	197.67	29.14
$CO_2(g)$	–393.51	213.74	37.11
$H_2O(l)$	–285.83	69.91	75.29
$H_2O(g)$	–241.82	188.83	33.58
C(*graphite*)	0	5.74	8.527
$C_2H_5OH(s)$	–277.69	160.7	111.5
$C_6H_5OH(s)$	–165.47	144.0	221.2