

Formulas:

$T_3 = 273.16K = 0.01^\circ C$; water freezes/boils at $T = 0^\circ C = 32^\circ F / T = 100^\circ C = 212^\circ F$

$1cal = 4.1868J$; $N_A = 6.02 \times 10^{23}$

Thermal expansion: $\Delta L = L\alpha\Delta T$; $\Delta V = V\beta\Delta T$; $\beta = 3\alpha$

Heat capacity and specific heat: $Q = C\Delta T$; $Q = cm\Delta T$

Heat of vaporization, fusion: $Q = L_V m$; $Q = L_F m$

First law of thermodynamics: $\Delta E_{int} = Q - W$; $dE_{int} = dQ - dW$; $W = \int_{V_i}^{V_f} p dV$ work

Conduction: $P_{cond} = \frac{Q}{t} = kA \frac{T_H - T_L}{L}$; $R = \frac{L}{k}$ k,R=thermal conductivity, resistance

Radiation: $P_{rad} = \sigma \epsilon A T^4$; $\sigma = 5.67 \times 10^{-8} W / m^2 K^4$ $\epsilon = 1$ for black body

Ideal gas: $PV = nRT = NkT = nN_A kT$; $R = 8.31 J/molK$; $k = 1.38 \times 10^{-23} J / K$

Pressure: $P = \frac{Nm}{3V} (v^2)_{avg}$ Kinetic energy: $K_{avg} = \frac{1}{2} m (v^2)_{avg} = \frac{3}{2} kT$

Internal energy: $E_{int} = NK_{avg}$; $C_V = \frac{3}{2} R$ for monoatomic gas; $C_P = C_V + R$

C_V, C_P = molar heat capacity at constant volume, pressure

$C_V = \frac{f}{2} R$ for polyatomic gases with f degrees of freedom per molecule

Adiabatic expansion of ideal gas: $PV^\gamma = const$, $TV^{\gamma-1} = const$; $\gamma = C_P / C_V$