Useful Formulae:

Rayleigh-Jean's Law: Intensity = $(8\pi\nu^2/c^3)$ kT
Planck Radiation Law: $8\pi h\nu^3/kT * (\exp(h\nu/kT)-1)^{-1}$
Wein's Law: λ_{max} T = 2.897*10^{-3} mK
Stefan's Law: $W = \sigma T^4$
Balmer Formula: $\lambda = 364.6\ n^2 / (n^2-4)$
Bohr Radii: $r = n^2 a_0$
Hydrogen Energy: $E = -13.6 / n^2$
Mode Spacing: $\Delta\nu = c/2L$
Rate equations: r = dN/dt = W N
Pumping probability: $W = \sigma I/h\nu$
Level lifetime: $\tau = 1/(\Sigma A)$

Minimum pump energy: $P_{minimum} = dN_{ULL}/dt\ V\ h\nu_{mp}$
Differential solution: $dN_{ULL}/dt = -1/\tau\ N_{ULL}$

Laser Rate Equations: $r_{absorption} = B_{12}N_1\rho$
$r_{stimulated} = B_{21}N_2\rho$
$r_{spontaneous} = A_{21}N_2$
$A_{21} = 1/\tau_{21}$
$r_{stimulated} / r_{spontaneous} = c^3\rho/8\pi h\nu^{3s}$
$r_{stimulated} / r_{absorption} = N_2 / N_1$

Grating Formula: $d\sin\theta = m\lambda$

Thermal Energy: kT

Gain coefficient: $g = \Delta N\ \sigma_0$

Power Gain: $P_{OUT} = P_{IN}\ e^{gx}$

Planck's Relationship: $E = h\nu = \frac{hc}{\lambda}$

Boltzmann's Law: $N = N_0 e^{\frac{-E}{kT}}$

Cavity Radiation: $\rho = \frac{8\pi h\nu^3}{c^3}\frac{1}{e^{\frac{E}{kT}}-1}$

Saturation Intensity: $I_{sat} = \frac{h\nu}{\sigma_0\tau}$

Fresnel equation (at 90 degrees): $R = (\frac{n_1 - n_2}{n_1 + n_2})^2$

Fresnel equation: $R_p = (\frac{n\cos\theta_i - \cos\theta_r}{n\cos\theta_i + \cos\theta_r})^2$

Linewidth: $\Delta\nu = 2\nu_0\sqrt{\frac{2kT\ln(2)}{Mc^2}}$

Snell's Law: $\frac{\sin\theta_i}{n_r} = \frac{\sin\theta_r}{n_i}$

Threshold Gain (simple configuration): $g_{threshold} = \gamma + \frac{1}{2x}\ln(\frac{1}{R_1 R_2})$

Saturated Gain: $g_{sat} = \frac{g_0}{1 + \frac{\rho}{\rho_{sat}}}$

Threshold Temp: $I_{TH} = I_0 e^{\frac{-\Delta T}{T_0}}$

Junction Temp: $T_{Junction} = T_{amb} + R_\theta \times P$

Constants and Conversions:

1eV = 1.602E^{-19}J
k = Boltzmann's constant (1.38 * 10^{-23} J/K)
σ = Stefan-Boltzmann constant (5.67*10^{-8} $Wm^{-2}K^{-4}$)
a_0 = Bohr radius (5.29*10^{-11} m)
1 mole (Avogadro's number) = 6.02*10^{23} atoms/molecules
Indices of Refraction: Quartz = 1.46, Glass = 1.51
Atomic masses: Neon = 20 amu, Argon = 38 amu, Helium = 4 amu, Cadmium=112 amu, CO_2 = 44 amu

0 C = 273.15 K
h = Planck's constant (6.626 * 10^{-34} Js)
c= Speed of Light (3*10^8 m/s)