Useful Formulae:

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

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

Decay: $N = N_0 e^{\frac{-t}{\tau}}$

Basic Physics: $v = \frac{d}{t}$ $A_{circle} = \pi r^2$

Wein's Law: $\lambda_{MAX} T = 2.897 \times 10^{-3} mK$

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

Power: $P = \frac{E}{t}$

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

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

Saturated Gain: $g_{sat} = \frac{g_0}{1 + \frac{2\rho}{\rho_{sat}}}$ $g_{sat} = \frac{g_0}{\sqrt{1 + \frac{2\rho}{\rho_{sat}}}}$

Snell's Law: $(\frac{\sin\theta_1}{\sin\theta_2}) = \frac{n_2}{n_1}$

Gain Coefficient: $g = \Delta N \times \sigma_0$

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

Atomic Mass: $M(g) = \frac{amu(g/mol)}{N_a(mol^{-1})}$

Cavity Optics: $g = 1 - \frac{L}{r}$

Threshold Gain: *(Simplified)* $g_{th} = \gamma + \frac{1}{2x}\ln(\frac{1}{R_1 R_2})$

Optical Density: $OD = -\log_{10}(\frac{P_{OUT}}{P_{IN}})$

Interferometer Mode Spacing: $FSR = \frac{c}{2nt}$

Etalon Angle: *(Small Angle approx)* $N\lambda = 2nt\cos(\frac{\theta}{n})$

Half-wave Voltage: $\frac{V_{\frac{1}{2}-\lambda_1}}{V_{\frac{1}{2}-\lambda_2}} = \frac{\lambda_1}{\lambda_2}$

Bragg Diffraction: $\theta_B = \frac{\lambda f}{2v}$

Acoustic Wavelength: $\Lambda = \frac{v_{acoustic}}{f}$

Constants and Conversions:

1eV = $1.602E^{-19}$J
k = Boltzmann's constant ($1.38 * 10^{-23}$ J/K)
σ = Stefan-Boltzmann constant ($5.67*10^{-8}$ $Wm^{-2}K^{-4}$)
N_a (Avogadro's number) = $6.02*10^{23}$ atoms/molecules
Indices of Refraction: Quartz = 1.46, Glass = 1.51
Acoustic Speed: Quartz = 3760 m/s

0ºC = 273.15 K
h = Planck's constant ($6.626 * 10^{-34}$ Js)
c= Speed of Light ($3*10^8$ m/s)
ε_0 = permittivity ($8.85*10^{-12}$ F/m)
Dilated Pupil = $0.4cm^2$

Atomic masses: Neon = 20 amu, Argon = 38 amu, Helium = 4 amu, Cadmium=112 amu,
CO_2 = 44 amu, Krypton = 83.8 amu