TABLE OF CONSTANTS

CONSTANT	SYMBOL	VALUE
speed of light in a vacuum	c	3.00×10^{8} m s^{-1}
gravitational constant	G	6.673×10^{-11} N m^{2} kg^{-2}
orbital constant	$G M_E$	3.986×10^{14} m^{3} s^{-2}
standard gravitational acceleration	g	9.81 m s^{-1}
Planck's constant	h	6.626×10^{-34} J s
Boltzmann's constant	k	1.381×10^{-23} J K^{-1}
first radiation constant	c_1	1.191×10^{-16} W m^{2} sr^{-1}
second radiation constant	c_2	1.439×10^{-2} m K
Stefan-Boltzmann constant	σ	5.670×10^{-8} W m^{-2} K^{-4}
Wien's displacement law constant	none	2.8979×10^{-3} m K
Avogadro's number	N_A	6.022×10^{23} molecules mole^{-1}
Dobson unit	DU	1 DU = 2.687×10^{16} molecules/cm^{2}
molar gas constant	R	8.3143 J mole^{-1} K^{-1}
angular velocity of Earth	$d\Omega_E / dt$	7.292×10^{-5} rad s^{-1}
solar day	T_{solar}	86,400 s
sidereal day	$T_{sidereal}$	86,164.1 s
mean radius of Earth	R_E	6.371×10^{6} m = 6371 km
mass of Earth	M_E	5.9737×10^{24} kg
standard pressure	p_o	1013.25 mbar = 1.01325×10^{5} N m^{-2}
standard temperature	T_o	273.15 K
scale height of Earth's atmosphere	$H = RT/Mg$	~ 7 km
radius of Sun (visible disk)	R_{sun}	6.96×10^{8} m
mean Earth-Sun distance	d_{sun}	1.50×10^{11} m
solar constant	S_{sun}	1368 W m^{-2}
molecular mass of CO_2	M	44 g/mole=7.3065×10^{-26} kg/molecule
molecular mass of H_2O	M	18 g/mole=2.9890×10^{-26} kg/molecule
molecular mass of O_2	M	32 g/mole=5.3138×10^{-26} kg/molecule

LIST OF EQUATIONS

$$F = \frac{Gm_1 m_2}{r^2} \qquad T = 2\pi\sqrt{\frac{r^3}{Gm_E}} \qquad v = \sqrt{Gm_E\left(\frac{2}{r} - \frac{1}{a}\right)} \qquad r = \frac{a(1-\varepsilon^2)}{1+\varepsilon\cos\theta}$$

$$M = e - \varepsilon \sin e = n(t - t_p) \qquad \cos\theta = \frac{\cos e - \varepsilon}{1 - \varepsilon\cos e} \qquad \cos e = \frac{\cos\theta + \varepsilon}{1+\varepsilon\cos\theta} \qquad \tilde{T} = \frac{2\pi}{\bar{n} + \frac{d\omega}{dt}}$$

$$LT = UT + \frac{\psi}{15^\circ} \qquad ECT = UT + \frac{\psi_N}{15^\circ} = 12 + \frac{\Delta\psi}{15^\circ} \qquad \vec{\mathbf{S}} = c^2\varepsilon_0 \vec{\mathbf{E}} \times \vec{\mathbf{H}}$$

$$I = \int_0^\infty I_\lambda d\lambda = \int_0^\infty I_\nu d\nu = \int_0^\infty I_{\bar{\nu}} d\bar{\nu} \qquad B_\lambda = \frac{2hc^2\lambda^{-5}}{\exp\left(\frac{hc}{\lambda kT}\right) - 1} = \frac{c_1\lambda^{-5}}{\exp\left(\frac{c_2}{\lambda T}\right) - 1}$$

$$\lambda_{\max}(\mu m) = \frac{2897.9}{T(K)} \qquad M_{BB} = \sigma T^4 \qquad B_\lambda \cong \frac{c_1 T}{c_2 \lambda^4} \qquad \alpha_\lambda + R_\lambda + \tau_\lambda = 1 \qquad \alpha_\lambda = \varepsilon_\lambda$$

$$dI_\lambda = -\sigma_a(\lambda) I_\lambda ds = -\rho k_a(\lambda) I_\lambda ds = -k_a(\lambda) I_\lambda du$$

$$\tau_\lambda(z_1, z_2) = \exp\left[-\int_{z_1}^{z_2} \frac{k_a(\lambda)\rho}{\mu} dz\right] = \exp\left[-\int_{u_1}^{u_2} k_a(\lambda) du\right]$$

$$\frac{\mu}{\rho k_e(\lambda)} \frac{dI_\lambda}{dz} = -I_\lambda(\theta, \phi) + \tilde{\alpha}_\lambda B_\lambda(T) + \tilde{\omega}_\lambda < I_\lambda' > \qquad < I_\lambda' > = \frac{1}{4\pi} \int_0^{2\pi} \int_{-1}^{1} I_\lambda(\mu', \phi') p(\psi_S) d\mu' d\phi'$$

$$\tilde{\alpha}_\lambda = \frac{\sigma_a(\lambda)}{\sigma_e(\lambda)} \qquad \tilde{\omega}_\lambda = \frac{\sigma_s(\lambda)}{\sigma_e(\lambda)} \qquad \frac{\mu}{\rho k_e(\lambda)} \frac{dI_\lambda}{dz} = -I_\lambda(\mu, \phi) + B_\lambda(T)$$

$$k_a^L = \frac{S}{\pi} \frac{\alpha_L}{(\bar{\nu} - \bar{\nu}_o)^2 + \alpha_L^2} \qquad \alpha_L(T, p) = \alpha_L(T_o, p_o) \frac{p}{p_o} \sqrt{\frac{T_o}{T}}$$

$$k_a^D = \frac{S}{\alpha_D \sqrt{\pi}} \exp\left[-\frac{(\bar{\nu} - \bar{\nu}_o)^2}{\alpha_D^2}\right] \qquad \alpha_D(T, \bar{\nu}_o) = \sqrt{\frac{2kT}{M}} \frac{\bar{\nu}_o}{c}$$

$$\chi = \frac{2\pi r}{\lambda} \qquad Q_s = \frac{k_s}{\pi r^2} \qquad \sigma_s = \int_0^\infty \pi r^2 Q_s N(r) dr \qquad \sigma_s(\lambda) \cong \frac{8\pi^3}{3\lambda^4} \frac{\left[n_o(\lambda)^2 - 1\right]^2}{N_s^2} f(\delta)$$

$$m = n - i\, n' \qquad I_r(\theta_r, \varphi_r) = \int_0^{2\pi} \int_0^{\pi/2} I_i(\theta_i, \varphi_i) \gamma_r(\theta_r, \varphi_r; \theta_i, \varphi_i) \cos\theta_i \sin\theta_i d\theta_i d\varphi_i$$

$$\gamma_r(\theta_r, \phi_r; \theta_{sun}, \phi_{sun}) = \frac{I_r(\theta_r, \phi_r)}{I_{sun}\Omega_{sun} \cos\theta_{sun}} = \frac{I_r}{E_{sun}}$$

$$A = \frac{M}{E} = \int_0^{2\pi} \gamma_r(\theta_r, \varphi_r; \theta_{sun}, \varphi_{sun}) \cos\theta_r d\Omega_r$$