

## USEFUL SOLAR NUMBERS (v2.8)

$c =$	2.99E+10	cm/sec	$k_b =$	1.38E-16	erg/K	$G =$	6.67E-8	erg cm g <sup>-2</sup>
$m_e =$	0.911E-27	gm	$m_p =$	1.67E-24	gm	$e =$	4.80E-10	esu

### SOLAR PROPERTIES

Mass .....	$M_\odot$	1.99E+33	gm	Luminosity .....	$L_\odot$	3.83E+33	erg/sec
Radius .....	$R_\odot$	6.96E+10	cm	surface gravity .....	$g_\odot$	2.74E+4	cm/sec <sup>2</sup>
1 AU .....	$D_\odot$	1.50E+13	cm	escape speed .....	$v_\infty$	6.18E+7	cm/sec
Synodic period <sup>†</sup> .....		2.38E+6	sec	Siderial frequency <sup>†</sup> ...	$\Omega_\odot$	2.84E-6	rad/sec

† Equatorial; Synodic/siderial period: 27.56/25.62 days (doppler shift — Snodgrass [1984])

Definitions:  $T = T_6 \times 10^6$  K,  $n_e = n_i = n_9 \times 10^9$  cm<sup>-3</sup>,  $B = B_2 \times 100$ G,  $L = L_9 \times 10^9$  cm

### PLASMA PROPERTIES

		electron	proton	×	units
plasma frequency .....	$\omega_{ps} = \sqrt{4\pi n_s e^2 / m_s}$	1.8E+9	4.2E+7	$n_9^{1/2}$	rad/sec
gyro-frequency .....	$\Omega_s = eB / m_s c$	1.8E+9	.96E+6	$B_2$	rad/sec
Coulomb logarithm ..	$\ln \Lambda$	18 + ln( $T_6^{3/2} n_9^{-1/2}$ )			—
thermal speed .....	$v_s = \sqrt{k_b T_s / m_s}$	3.9E+8	.91E+7	$T_6^{1/2}$	cm/sec
gyro-radius .....	$\rho_s = v_s / \Omega_s$	0.22	9.5	$T_6^{1/2} B_2^{-1}$	cm
plasma skin depth ...	$d_s = c / \omega_{ps}$	17	718	$n_9^{-1/2}$	cm
Debye length .....	$\lambda_s = v_s / \omega_{ps}$	0.22	0.22	$T_6^{1/2} n_9^{-1/2}$	cm
collision time .....	$\tau_s = 0.30 (m_s^2 / e^4) v_s^3 / n \ln \Lambda$	1.5E-2	.93 <sup>†</sup>	$T_6^{3/2} n_9^{-1}$	sec
collision frequency ...	$\nu_s = 1 / \tau_s$	65	1.08	$T_6^{-3/2} n_9$	Hz
e/i thermal time .....	$\tau_{ei} = 0.5 (m_i / m_e) \tau_e$		14	$T_6^{3/2} n_9^{-1}$	sec
mean-free path .....	$\ell_s = v_s \tau_s$	5.9E+6	8.4E+6	$T_6^2 n_9^{-1}$	cm
Stopping column .....	$N = E^2 / 6\pi e^4 \ln \Lambda$	1.4E+17		$E_{\text{keV}}^2$	cm <sup>-2</sup>

†  $\tau_i = \sqrt{2} \sqrt{m_i / m_e} \tau_e$

### MHD PROPERTIES

			×	units
Alfvén speed .....	$v_A = B / \sqrt{4\pi \rho}$	6.9E+8	$B_2 n_9^{-1/2}$	cm/sec
sound speed .....	$c_s = \sqrt{2\gamma k_b T / m_p}$	1.7E+7	$T_6^{1/2}$	cm/sec
plasma $\beta$ .....	$\beta = 8\pi p / B^2$	6.9E-4	$T_6 n_9 / B_2^2$	—
scale height .....	$H_p = 2k_b T / m_p g_\odot$	6.0E+9	$T_6$	cm
electric conductivity <sup>†</sup> .....	$\sigma = 0.16 \omega_e^2 \tau_e$	7.8E+15	$T_6^{3/2}$	sec <sup>-1</sup>
thermal conductivity <sup>†</sup> .....	$\kappa = 3.2 k_b n_e v_e^2 \tau_e$	1.0E+9	$T_6^{5/2}$	erg (cm s K) <sup>-1</sup>
Spitzer current (cgs) .....	$I_{\text{sp}} / c = \eta \sqrt{\rho / 4\pi}$	1.4E-4	$T_6^{-3/2} n_9^{1/2}$	G cm
(MKS) .....	$I_{\text{sp}} = \eta \sqrt{\rho / \mu_0}$	1.4E-3	$T_6^{-3/2} n_9^{1/2}$	Amps
Dreicer field (cgs) .....	$E_D = e \ln \Lambda / \lambda_D^2$	1.8E-7	$n_9 / T_6$	G
(MKS) .....	$E_D = e \ln \Lambda / 4\pi \epsilon_0 \lambda_D^2$	5.9E-3	$n_9 / T_6$	Volts/m
conductive time .....	$\tau_{\text{cond}} = 2n_e k_b L^2 / \kappa$	270	$n_9 T_6^{-5/2} L_9^2$	sec
radiative time <sup>o</sup> .....	$\tau_{\text{rad}} = 2k_b T / n_e \Lambda(T)$	2.3E+3	$T_6^{3/2} / n_9$	sec
RTV cooling time <sup>o</sup> .....	$\tau_{\text{RTV}} = 2.5 k_b L T^{-1/2} / \sqrt{\kappa_0 \Lambda_0}$	1.0E+3	$L_9 T_6^{-1/2}$	sec
RTV pressure <sup>o</sup> .....	$p = 2.0 k_b \sqrt{\kappa_0 / \Lambda_0} T^3 / L$	0.82	$T_6^3 / L_9$	erg cm <sup>-3</sup>
<b>diffusion coefficients</b>				
viscosity <sup>†</sup> .....	$\nu = 0.96 v_i^2 \tau_i$	7.3E+13	$T_6^{5/2} n_9^{-1}$	cm <sup>2</sup> /sec
magnetized viscosity <sup>‡</sup> .....	$\nu_\perp = 0.3 \rho_i^2 / \tau_i$	29	$T_6^{-1/2} n_9 B_2^{-2}$	cm <sup>2</sup> /sec
thermal conductivity <sup>†</sup> .....	$\tilde{\kappa} = (\gamma - 1) \kappa / 2k_b n_e$	2.5E+15	$T_6^{5/2} n_9^{-1}$	cm <sup>2</sup> /sec
resistivity <sup>†</sup> .....	$\eta = c^2 / 4\pi \sigma$	.92E+4	$T_6^{-3/2}$	cm <sup>2</sup> /sec

† Component  $\parallel$  to  $\mathbf{B}$ ;  $\sigma_\perp = 0.51\sigma$  and  $\eta_\perp = 1.96\eta$  ‡ Coupling rate-of-strain & stress  $\perp$  to  $\mathbf{B}$

o  $\Lambda(T) = \Lambda_0 T^{-1/2} = 1.2 \times 10^{-22} T_6^{-1/2}$  erg cm<sup>3</sup>/s good for 300,000 K  $< T < 30$  MK.