

$$\frac{1}{2}m_e v_t^2 = \frac{3}{2}k_B T \quad (1)$$

$$\frac{d\mathbf{v}}{dt}m_e = -e\mathbf{E}, \quad (2)$$

$$\mathbf{v}(t) = \frac{-e\mathbf{E}t}{m_e}. \quad (3)$$

$$\bar{\mathbf{v}} = \frac{-e\mathbf{E}\tau}{m_e}. \quad (4)$$

$$n|\bar{\mathbf{v}}|A. \quad (5)$$

$$-en|\bar{\mathbf{v}}|A. \quad (6)$$

$$\mathbf{j} = n\bar{\mathbf{v}}(-e), \quad (7)$$

$$\mathbf{j} = \frac{ne^2\tau}{m_e}\mathbf{E} = \sigma\mathbf{E} = \frac{\mathbf{E}}{\rho}, \quad (8)$$

$$\sigma = \frac{ne^2\tau}{m_e}, \quad (9)$$

$$\rho = \frac{m_e}{ne^2\tau}. \quad (10)$$

$$\mu = \frac{e\tau}{m_e}, \quad (11)$$

$$\sigma = n\mu e \quad \rho = \frac{1}{n\mu e} \quad (12)$$

$$E_H = E_y = R_H j_x B_z, \quad (13)$$

$$eE_H = eB_z v_x. \quad (14)$$

$$R_H = \frac{E_H}{j_x B_z} = \frac{E_H}{(-e)nv_x B_z}, \quad (15)$$

$$R_H = \frac{v_x B_z}{-env_x B_z} = \frac{-1}{ne}. \quad (16)$$

$$R_H = \frac{1}{pe}, \quad (17)$$

$$\mathbf{E}(z, t) = \mathbf{E}_0 e^{i(kz - \omega t)} \quad (18)$$

$$k = \frac{2\pi N}{\lambda_0} \quad (19)$$

$$N = \sqrt{\epsilon} = \sqrt{\epsilon_r + i\epsilon_i}. \quad (20)$$

$$\mathbf{E}(z, t) = \mathbf{E}_0 e^{i(\frac{2\pi N}{\lambda_0} z - \omega t)} = \mathbf{E}_0 e^{i(\frac{\omega\sqrt{\epsilon}}{c} z - \omega t)}. \quad (21)$$

$$m_e \frac{d^2 x(t)}{dt^2} = -eE(t). \quad (22)$$

$$x = \frac{eE}{m_e\omega^2}. \quad (23)$$

$$P = -nex = -\frac{ne^2E}{m_e\omega^2} \quad (24)$$

$$D = \epsilon\epsilon_0E = \epsilon_0E + P, \quad (25)$$

$$\epsilon = 1 + \frac{P}{\epsilon_0E}. \quad (26)$$

$$\epsilon = 1 - \frac{ne^2}{\epsilon_0m_e\omega^2} = 1 - \frac{\omega_P^2}{\omega^2} \quad (27)$$

$$\omega_P^2 = \frac{ne^2}{m_e\epsilon_0}. \quad (28)$$

$$\frac{\kappa}{\sigma} = LT, \quad (29)$$

$$\frac{\kappa}{\sigma} = \frac{3}{2} \frac{k_B^2}{e^2} T = LT, \quad (30)$$