Physics 102—Our Basic Equations

\[ r_x = r \cos \theta \quad r_y = r \sin \theta \quad r = \sqrt{r_x^2 + r_y^2} \quad \theta_{\text{CALC}} = \arctan \frac{r_y}{r_x} \quad \theta_{\text{REAL}} = \theta_{\text{CALC}} \text{ in 1 \& 4} \quad \theta_{\text{REAL}} = \theta_{\text{CALC}} + 180^\circ \text{ in 2 \& 3} \]

\[ v_f = v_i + a \Delta t \quad x_f = x_i + v_i \Delta t + \frac{1}{2} a_x (\Delta t)^2 \quad v_f^2 = v_i^2 + 2a \Delta s \quad s_f = s_i + \frac{1}{2} (v_i + v_f) \Delta t \quad \theta = \frac{s}{r} \quad \omega = \frac{v_{\text{ang}}}{r} \quad \Sigma \vec{F} = m \vec{a} \]

\[ \Sigma \vec{F} = m \vec{a} \quad F_g = w = mg \quad W = \vec{F} \cdot \Delta \vec{r} = F \Delta r \cos \theta \quad KE = \frac{1}{2} mv^2 \quad \vec{p} = m \vec{v} \quad W_{\text{net}} = \Delta KE = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \]

\[ \overline{P}_{\text{av}} = \frac{W}{\Delta t} = \overline{F} \cdot \overline{v} \quad a_c = \frac{v^2}{r} = r \omega^2 \quad F_g = G \frac{m_1 m_2}{r^2} \quad x = A \cos(\omega t + \phi) \quad \omega = \sqrt{k/m} = 2\pi f = \frac{2\pi}{T} \quad y = A \sin \left[ \frac{2\pi}{\lambda} (x - vt) \right] \]

\[ v = \frac{\lambda}{T} = f \lambda \quad k = \frac{2\pi}{\lambda} \omega = \frac{2\pi}{T} = 2\pi f \quad f' = f \left( \frac{v + v_o}{v - v_s} \right) \] The equations from Phys 102 start below.

\[ \overline{F} = k \frac{|q_1| |q_2|}{r^2} \quad \overline{E} = \frac{\overline{F}}{q_o} = k \frac{|q|}{r^2} \quad W = qE_x \Delta x = \Delta KE = -\Delta PE \quad \Delta V = -E_x \Delta x \quad \Delta V = k \frac{q}{r} \quad PE = qV_i = k \frac{q^2}{r} \quad W = -q(V_s - V_a) \]

\[ C = \frac{Q}{\Delta V} \quad C = \varepsilon_0 \frac{A}{d} \quad C_p = C_1 + C_2 + \ldots \quad \frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots \quad C = kC_0 = k \frac{\varepsilon_0 A}{d} \quad PE_c = \frac{1}{2} Q \Delta V = \frac{1}{2} C (\Delta V)^2 = \frac{Q^2}{2C} \quad C = k\varepsilon_0 \frac{A}{d} \]

\[ I = \frac{\Delta Q}{\Delta t} \quad \Delta V = IR \quad R = \rho \frac{l}{A} \quad \rho = \rho_o \left[ 1 + \alpha (T - T_o) \right] \quad R = R_0 \left[ 1 + \alpha (T - T_o) \right] \quad P = I \Delta V \quad P = I^2 R = \frac{\Delta V^2}{R} \quad \Delta V = \varepsilon - Ir \]

\[ \varepsilon = IR + I r \quad R_{\text{s}} = R_1 + R_2 + \ldots \quad R_{\text{r}} = \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \quad q = Q \left( 1 - e^{-\gamma t} \right) \quad \tau = RC \]

\begin{align*}
\text{Coulomb constant} & \quad k_e & \quad 8.988 \times 10^9 \text{N} \cdot \text{m}^2/\text{C}^2 & \quad \text{Acc. of gravity} & \quad g & \quad 9.807 \text{ m/s}^2 \\
\text{electron charge} & \quad \bar{e} & \quad 1.602 \times 10^{-19} \text{ C} & \quad \text{Planck's constant} & \quad \hbar & \quad 6.626 \times 10^{-34} \text{ J} \cdot \text{s} \\
\text{permittivity of vac} & \quad \varepsilon_0 & \quad 8.854 \times 10^{-12} \text{ F/m} & \quad \text{Avogadro's number} & \quad N_A & \quad 6.022 \times 10^{23} /\text{mol} \\
\text{permeability of vac} & \quad \mu_0 & \quad 4\pi \times 10^{-7} \text{ N/A}^2 & \quad \text{Boltzmann constant} & \quad k & \quad 1.381 \times 10^{-23} \text{ J/K} \\
\text{mass of electron} & \quad m_e & \quad 9.109 \times 10^{-31} \text{ kg} & \quad \text{Stephan-Boltzman constant} & \quad \sigma & \quad 5.671 \times 10^{-8} \text{ W/(m}^2\cdot\text{K}^4) \\
\text{mass of proton} & \quad m_p & \quad 1.673 \times 10^{-27} \text{ kg} & \quad \text{Rydberg constant} & \quad R_\infty & \quad 1.097 \times 10^7 /\text{m} \\
\text{mass of neutron} & \quad m_n & \quad 1.675 \times 10^{-27} \text{ kg} & \quad \text{Wein's constant} & \quad b & \quad 2.898 \times 10^3 \text{ m} \cdot \text{K} \\
\text{speed of light} & \quad c & \quad 2.998 \times 10^8 \text{ m/s} & \quad \text{Std. atmosphere} & \quad 1.013 \times 10^5 \text{ Pa} 
\end{align*}