Physics 202 • Exam Information Sheet

$\mathbf{F}_q = k\,q\,Q\,\hat{r}/r^2$

$\mathbf{E}(r) = k\,Q\,\hat{r}/r^2$

$\hat{r} = \vec{r}\,/\,|\vec{r}\,|$

Note: $\vec{r}$, $\hat{r}$ point towards location of interest

$k = 9.0 \times 10^9$ N·m^2/C^2

$\mathbf{F}_q = q\,\mathbf{E}$

$\phi_E = EA = Q_{\mathrm{enc}}/\epsilon_o$

$\mathbf{E}_x = -\Delta V/\Delta x$

$q_e = -1.6 \times 10^{-19}$ C, $q_p = |q_e|$

$m_e = 9.1 \times 10^{-31}$ kg

$E = \sigma/\epsilon_o$

eV $= 1.6 \times 10^{-19}$ J

$\epsilon_o = 8.9 \times 10^{-12}$ C^2/N·m^2

$k = 1/(4\pi\epsilon_o)$

$\mathbf{F} = m\,\mathbf{a}$

$K = \frac{1}{2}\,m\,v^2$, $p = mv$

$U = k\,q\,Q/r$

$V(r) = U/q = k\,Q/r$

$C = Q/V$

$V = |\mathbf{E}|\,d$

$C_{||} = \epsilon_o\,\kappa\,A/d$

$U = \frac{1}{2}\,C\,V^2$

$1/C_{\mathrm{ser}} = 1/C_1 + 1/C_2 + \cdots$

$C_{\mathrm{par}} = C_1 + C_2 + \cdots$

$\mathcal{U}_E = \frac{1}{2}\,\epsilon_o\,\mathbf{E}^2$

$\sigma = Q/A$

$V = i\,R$

$P = i^2\,R = i\,V = V^2/R$

$R = \rho L/A$

$R = R_o[1 + \alpha(T - T_o)]$

$R_{\mathrm{ser}} = R_1 + R_2 + \cdots$

$1/R_{\mathrm{par}} = 1/R_1 + 1/R_2 + \cdots$

$Q_{\mathrm{char}} = VC\,[1 - e^{-t/RC}]$

$Q_{\mathrm{dischar}} = Q_o\,e^{-t/RC}$

$V_{\mathrm{char}} = V\,[1 - e^{-t/RC}]$

$V_{\mathrm{dischar}} = V_o\,e^{-t/RC}$

$\Sigma\,V_{\mathrm{loop}} = 0$

$\Sigma\,i_{\mathrm{in}} = \Sigma\,i_{\mathrm{out}}$

$\mathbf{v} = \Delta x/\Delta t = \mathbf{v_o} + \mathbf{a}\,t$

$\mathbf{x} = \mathbf{x_o} + \mathbf{v_o}\,t + \frac{1}{2}\mathbf{a}\,t^2 = \mathbf{v}_{\mathrm{ave}}\,\Delta t$

$\mathbf{v_f}^2 = \mathbf{v_o}^2 + 2\,\mathbf{a}\,(\mathbf{x_f} - \mathbf{x_o})$

$\mathbf{v}_{\mathrm{ave}} = \frac{1}{2}(\mathbf{v_f} + \mathbf{v_o})$

$\cos\theta =$ adj / hyp

$\tan\theta =$ opp / adj

$\sin\theta =$ opp / hyp

$C_{\mathrm{circle}} = 2\pi R$

$V_{\mathrm{sphere}} = \frac{4}{3}\,\pi R^3$

$A_{\mathrm{sphere}} = 4\pi R^2$

$A_{\mathrm{circle}} = \pi R^2$

$\phi_B = BA\cos\theta$

$F = qvB\sin\theta$

$F_{\mathrm{rad}} = mv^2/r$

$F = i\ell B\sin\theta$

$\tau = NBA\,i\sin\phi$

$\mathcal{E} = -N\Delta\phi_B/\Delta t = vB\ell$

$\Sigma\, B_{||}\,\Delta\ell = \mu_o\, i_{\rm enc}$

$\mu_o = 4\pi \times 10^{-7}$ T·m/A

$c = 2.998 \times 10^8$ m/s

$B = \mu_o i/(2\pi d)$, long wire

$B = \mu_o Ni/(2r)$, loop(s)

$B = \mu_o Ni/\ell$, solenoid

$L = \mu_o n^2 A\ell$, $n = N/\ell$

$P_{\rm ave} = i^2_{\rm rms}R$

$V(t) = NBA\,\omega\sin(\omega t) = V_{\rm max}\sin(\omega t)$

$V_{\rm rms} = V_{\rm max}/\sqrt{2}$

$\mathcal{E}_{\rm ind} = -L\,\Delta i/\Delta t$

$W = \frac{1}{2}\,L\,i^2$

$V_2 = V_1 N_2/N_1$

$i_2 = i_1 N_1/N_2$

$R_1 = R_2(N_1/N_2)^2$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$V_{\rm o\ rms} = i_{\rm rms}Z,\ R = Z\cos\phi$

$P_{\rm ave} = V^2_{\rm o\ rms}\cos\phi/Z = V_{\rm o\ rms}i_{\rm rms}\cos\phi$

$\tan\phi = (X_L - X_C)/R$

$\arctan(0) = 0°$

$\arctan(-\infty) = -90°$

$f_{\rm reson} = 1/(\,2\pi\sqrt{LC}\,)$

$\omega = 2\pi f = 2\pi/T$

$X_C = 1/(2\pi f C)$

$X_L = 2\pi f L$

$f_{\rm obs} = f_{\rm src}(1 \pm |u|/c)$, "+" if objects are closing, "−" if objects are separating

$S_{\rm out} = S_{\rm in}\cos^2\theta$ (polarized)

$S_{\rm out} = \frac{1}{2}S_{\rm in}$ (unpolarized)

$c = f_{\rm vac}\lambda_{\rm vac} = 1/\sqrt{\epsilon_o\mu_o}$

$\mathcal{U}_B = \frac{1}{2}\,\mathbf{B}^2/\mu_o$

$\mathcal{U}_{\rm total} = \epsilon_o\mathbf{E}^2 = \mathbf{B}^2/\mu_o$

$S = c\,\mathcal{U}_{\rm total}$

$\theta_{\rm incid} = \theta_{\rm reflect}$

$f = R/2$ (concave)

$f = -R/2$ (convex)

for θ small: $\sin\theta \approx \theta \approx \tan\theta$

$1/d_o + 1/d_i = 1/f$

$m = -d_i/d_o = h_i/h_o$

$n_\alpha = c/v_\alpha$

$f = v_\alpha/\lambda_\alpha =$ constant

$n_1\sin\theta_1 = n_2\sin\theta_2$

$d' = d\ n_{\rm viewer}/n_{\rm object}$

$\theta_{1\,\rm crit} = \arcsin(n_2/n_1)$

$\theta_{\rm Brew} = \arctan(n_2/n_1)$

$m\lambda = d\sin\theta$ (bright fringes)

$(m + \frac{1}{2})\lambda = d\sin\theta$ (dark fringes)

constructive, 2 180°-Δ's: $2t = m\,\lambda_{\rm above}/n_{\rm below}, \quad m = 1, 2, 3, \ldots$

constructive, 1 180°-Δ: $2t = (m + \frac{1}{2})\,\lambda_{\rm above}/n_{\rm below}, \quad m = 0, 1, 2, \ldots$

destructive, 2 180°-Δ's: $2t = (m + \frac{1}{2})\lambda_{\rm above}/n_{\rm below}, \quad m = 0, 1, 2, \ldots$

destructive, 1 180°-Δ: $2t = m\,\lambda_{\rm above}/n_{\rm below}, \quad m = 1, 2, 3, \ldots$

$\theta_{\rm min} = 1.22\,\lambda/D$ (circular)

$\theta_{\rm min} = \lambda/W$ (rectangular)

$y_{\text{central width}} = 2\lambda L/\sqrt{W^2 - \lambda^2}$

$h = 6.63 \times 10^{-34}$ J·s

Mirrors:

$f > 0$: concave

$f < 0$: convex

$d_{o,i} > 0$: front (real)

$d_{o,i} < 0$: behind (virtual)

$m > 0$: upright

$m < 0$: inverted

Lenses:

$f > 0$: converging

$f < 0$: diverging

$d_o > 0$: left

$d_o < 0$: right

$d_i > 0$: right (real)

$d_i < 0$: left (virtual)

$m > 0$: upright

$m < 0$: inverted

$\Delta t = \Delta t_o/\sqrt{1 - v^2/c^2}$

$L = L_o\sqrt{1 - v^2/c^2}$

$p = mv/\sqrt{1 - v^2/c^2}$

$E_{\text{rest}} = mc^2$

$K = mc^2/\sqrt{1 - v^2/c^2} - mc^2$

$E_\gamma = hf = hc/\lambda$

$p_\gamma = h/\lambda$

$E_\gamma = p_\gamma\, c$

$E_\gamma = K_e + W$

$\Delta\lambda = \lambda' - \lambda = h(1 - \cos\theta)/(mc)$

$\lambda_{\text{Compton}} = h/(mc)$

$\lambda_{\text{DeB}} = h/p$

$\Delta p\, \Delta x \geq h/(4\pi)$

$R = 1.10 \times 10^7$ 1/m

$r_n = n^2\,(5.3 \times 10^{-11})$ m

$E_n = (-2.2 \times 10^{-18})/n^2$ J

$E_n = -13.6$ eV$/n^2$

DeBroglie: $2\pi\, r = n\lambda$

$E_\gamma = 13.6\,\text{eV}\ (1/n_f^2 - 1/n_i^2)$ (emission)

$E_\gamma = 13.6\,\text{eV}\ (1/n_i^2 - 1/n_f^2)$ (absorption)

Quantum Numbers:

$n = 1, 2, 3, \ldots$ (Energy Q #), $E_n = -13.6$ eV$/n^2$

$\ell = 1, 2, 3, \ldots (n-1)$ (Angular Momentum Q #), $|\mathbf{L}| = \sqrt{\ell(\ell+1)}\; h/(2\pi)$

$m_\ell = -\ell, \ldots, -1, 0, 1, \ldots, \ell$ (Magnetic Moment Q #), $L_z = m_\ell\, h/(2\pi)$

$m_s = \frac{1}{2}$ or $-\frac{1}{2}$ (Electron Spin Q #), $S_z = m_s\, h/(2\pi)$