# Physics 222, Exam 2 Formula Sheet

Numericals:

$c = 2.998 \times 10^{8}$ m s$^{-1}$
$e = 1.602 \times 10^{-19}$ C (electron charge)
$N_A = 6.02 \times 10^{23}$ mol$^{-1}$
$m_e = 9.1095 \times 10^{-31}$ kg (electron)
$m_p = 1.6726 \times 10^{-27}$ kg (proton)
$\varepsilon_o = 8.85 \times 10^{-12}$ C$^2$ J$^{-1}$ m$^{-1}$
1 Å $= 1 \times 10^{-10}$ m
1 eV $= 1.602 \times 10^{-19}$ J
1 cal $= 4.186$ J
$u = 1.6605 \times 10^{-27}$ kg

$$1/4\pi\varepsilon_o = 8.99\times10^{9}\,\mathrm{N\cdot m^2\cdot C^{-2}}$$
$$R_H = 1.09678\times10^{7}\,\mathrm{m^{-1}}$$
$$\sigma = 5.67\times10^{-8}\,\mathrm{W/(m^2K^4)}$$
$$k = 1.38\times10^{-23}\ \mathrm{J/K}$$
$$\lambda_c = 2.426\times10^{-12}\,\mathrm{m}$$
$$h = 6.626\times10^{-34}\,\mathrm{J\cdot s}$$
$$h = 4.1357\times10^{-15}\,\mathrm{eV\cdot s}$$
$$\hbar = 1.055\times10^{-34}\,\mathrm{J\cdot s}$$
$$\hbar = 6.5821\times10^{-16}\,\mathrm{eV\cdot s}$$
$$\alpha = \frac{e^2}{4\pi\varepsilon_o\hbar c} \cong 1/137$$
$$a_o = \frac{4\pi\varepsilon_o\hbar^2}{me^2} = 5.29\times10^{-11}\,\mathrm{m}$$
$$E_o = 13.606\ \mathrm{eV}$$

Formulas:

*Binomial expansion, n ≠ integer OK*:

$$(x+y)^n \cong x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + \ldots$$

(*note that* 2! = 1×2, 3! = 1×2×3, *etc.*)

*or*, $$(1\pm x)^n \cong 1 \pm nx + \frac{n(n-1)}{2}x^2 + \ldots$$

$F = dp/dt$
$\vec{p} = m\vec{u}$
$f = c/\lambda$

$$x' = x - vt$$
$$y' = y$$
$$z' = z$$

$$x' = \gamma(x - vt)$$
$$y' = y$$
$$z' = z$$
$$t' = \gamma\left(t - vx/c^2\right)$$
$$\gamma = \frac{1}{\sqrt{\left(1 - v^2/c^2\right)}}$$
$$L = L_o/\gamma$$
$$T = \gamma T_o$$

$$u_x = dx/dt = \frac{u_x' + v}{1 + u_x'v/c^2}$$
$$u_y = dy/dt = \frac{u_y'}{\gamma(1 + u_x'v/c^2)}$$
$$u_z = dz/dt = \frac{u_z'}{\gamma(1 + u_x'v/c^2)}$$
$$m = m_o\gamma = \frac{m_o}{\sqrt{1 - u^2/c^2}}$$
$$E = mc^2 = \frac{m_oc^2}{\sqrt{1 - u^2/c^2}}$$
$$E = \sqrt{p^2c^2 + m_o^2c^4}$$
$$E = pc$$

$$f = f_o\frac{\sqrt{1+\beta}}{\sqrt{1-\beta}}$$
$$\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$$
$$U = \frac{Q^2}{4\pi\varepsilon_o r}$$
$$I = \varepsilon\sigma T^4$$
$$\lambda_{\max}T = 2.90\times10^{-3}\,\mathrm{m\cdot K}$$

$$\frac{dI}{d\lambda} = \frac{2\pi c^2 h}{\lambda^5} \frac{1}{e^{hc/\lambda kT} - 1}$$

$$E = hf$$

$$K = hf - \phi$$

$$\frac{h}{m_o c}(1 - \cos\theta) = (\lambda' - \lambda)$$

$$N(\theta) = \frac{N_i nt}{16}\left(\frac{e^2}{4\pi\varepsilon_o}\right)^2 \frac{Z_1^2 Z_2^2}{r^2 K^2 \sin^4(\theta/2)}$$

$$L = n\hbar$$

$$E = \frac{Z^2 me^4}{n^2 \cdot 2(4\pi\varepsilon_o\hbar)^2} = \frac{Z^2}{n^2} E_o$$

$$v_n = \frac{n\hbar}{mr_n}$$

$$r_n = (n^2 / Z) a_o$$

$$K = \tfrac{1}{2}|U|$$

$$\frac{1}{\lambda} = R_H\left(1/n_1^2 - 1/n_2^2\right)$$

$$\mu = mM/(m + M)$$

$$f_{K_\alpha} = \frac{3cR}{4}(Z - 1)^2$$