**PHYS-201 Equation Sheet for Midterm Exam #3**
(11/29/2012, MAIN AUDITORIUM, 8:00-8:50 am)

**Blackbody Radiation**

$$\mathcal{P} = \sigma A e T^4 \qquad \sigma = 5.7\times10^{-8}\mathrm{Wm^{-2}K^{-4}}$$

$$\lambda_{max}T = 2.898\times10^{-3}\mathrm{m\cdot K} \qquad E_n = nhf$$

$$e = 1\,(\text{emissivity of the blackbody}) \qquad h = 6.626\times10^{-34}\mathrm{J\cdot s}$$

**Photoelectric Effect**

$$K_{max} = hf - \Phi = e\Delta V_S \qquad \lambda_c = \frac{c}{f_c} = \frac{hc}{\Phi}$$

$$e = 1.602\times10^{-19}\,\mathrm{As} \qquad hc = 1240\mathrm{eV\cdot nm}$$

$$\hbar = \frac{h}{2\pi} = 1.055\times10^{-34}\mathrm{J\cdot s} \qquad c = 2.998\times10^{8}\mathrm{ms^{-1}}$$

$$1\ \mathrm{eV} = 1.602\times10^{-19}\ \mathrm{J}$$

**Discrete Spectra of Atomic Gases: Rydberg Formula**

$$\frac{1}{\lambda} = R_H\left(\frac{1}{2^2}-\frac{1}{n^2}\right) \quad (n = 3,4,5,...) \qquad R_H = 1.097\times10^{7}\mathrm{m^{-1}}$$

$$E_i - E_f = hf$$

**Bohr Model of the Hydrogen Atom**

$$E = V + K = -\frac{k_e e^2}{2r} \qquad m_e v_n r_n = n\hbar \quad (n = 1,2,3,...)$$

$$r_n = n^2\,a_0 \qquad E_n = -\frac{k_e e^2}{2a_0 n^2} \quad (n = 1,2,3,...)$$

$$k_e = \frac{1}{4\pi\epsilon_0} = 8.988\times10^{9}\mathrm{N\cdot m^2(As)^{-2}} \qquad e = 1.602\times10^{-19}\mathrm{As}$$

$$a_0 = \frac{\hbar^2}{m_e k_e e^2} = 5.292\times10^{-11}\mathrm{m} \qquad m_e = 9.109\times10^{-31}kg = 0.511\,\mathrm{MeV}\cdot c^{-2}$$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_f^2}-\frac{1}{n_i^2}\right) \qquad (n_f = 1:\mathrm{Lyman}, 2:\mathrm{Balmer}, 3:\mathrm{Paschen})$$

**Special Theory of Relativity**

$$
\begin{aligned}
\Delta t &= \frac{\Delta t_p}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma \Delta t_p & L &= L_p \left(1 - \frac{v^2}{c^2}\right)^{1/2} = \frac{L_p}{\gamma} \\
x' &= \gamma\,(x - vt) & x &= \gamma\left(x' + vt'\right) \\
y' &= y & y &= y' \\
z' &= z & z &= z' \\
t' &= \gamma\left(t - \frac{vx}{c^2}\right) & t &= \gamma\left(t' + \frac{vx'}{c^2}\right) \\
u'_x &= \frac{u_x - v}{1 - \frac{u_x v}{c^2}} & u_x &= \frac{u'_x + v}{1 + \frac{u'_x v}{c^2}} \\
u'_y &= \frac{u_y}{\gamma\left(1 - \frac{u_x v}{c^2}\right)} & u_y &= \frac{u'_y}{\gamma\left(1 + \frac{u'_x v}{c^2}\right)} \\
u'_z &= \frac{u_z}{\gamma\left(1 - \frac{u_x v}{c^2}\right)} & u_z &= \frac{u'_z}{\gamma\left(1 + \frac{u'_x v}{c^2}\right)} \\
\vec{\mathbf{p}} &= \frac{m\vec{\mathbf{u}}}{\sqrt{1 - \frac{u^2}{c^2}}} = \gamma\, m\vec{\mathbf{u}} & E &= E_R + K \\
E_R &= mc^2 & K &= (\gamma - 1)\, mc^2 \\
E &= \gamma\, mc^2 & E^2 &= p^2 c^2 + \left(mc^2\right)^2
\end{aligned}
$$