PHYS-201 Equation Sheet for Midterm Exam #3
(05/31/2012, MAIN AUDITORIUM, 8:00-8:50 am)

Blackbody Radiation

$$\mathcal{P} = \sigma A e T^4 \qquad \sigma = 5.7 \times 10^{-8} \mathrm{Wm^{-2}K^{-4}}$$
$$\lambda_{max} T = 2.898 \times 10^{-3} \mathrm{m \cdot K} \qquad E_n = nhf$$
$$e = 1\,(\text{emissivity of the blackbody}) \qquad h = 6.626 \times 10^{-34} \mathrm{J \cdot s}$$

Photoelectric Effect

$$K_{max} = hf - \Phi = e\Delta V_S \qquad \lambda_c = \frac{c}{f_c} = \frac{hc}{\Phi}$$
$$e = 1.602 \times 10^{-19}\,\mathrm{As} \qquad hc = 1240 \mathrm{eV \cdot nm}$$
$$\hbar = \frac{h}{2\pi} = 1.055 \times 10^{-34} \mathrm{J \cdot s} \qquad c = 2.998 \times 10^{8} \mathrm{ms^{-1}}$$
$$1\ \mathrm{eV} = 1.602 \times 10^{-19}\ \mathrm{J}$$

Discrete Spectra of Atomic Gases: Rydberg Formula

$$\frac{1}{\lambda} = R_H \left(\frac{1}{2^2} - \frac{1}{n^2} \right) \quad (n = 3, 4, 5, ...) \qquad R_H = 1.097 \times 10^{7} \mathrm{m^{-1}}$$
$$E_i - E_f = hf$$

Bohr Model of the Hydrogen Atom

$$E = V + K = -\frac{k_e e^2}{2r} \qquad m_e v_n r_n = n\hbar \quad (n = 1, 2, 3, ...)$$
$$r_n = n^2\, a_0 \qquad E_n = -\frac{k_e e^2}{2 a_0 n^2} \quad (n = 1, 2, 3, ...)$$
$$k_e = \frac{1}{4\pi\epsilon_0} = 8.988 \times 10^{9} \mathrm{N \cdot m^2 (As)^{-2}} \qquad e = 1.602 \times 10^{-19} \mathrm{As}$$
$$a_0 = \frac{\hbar^2}{m_e k_e e^2} = 5.292 \times 10^{-11} \mathrm{m} \qquad m_e = 9.109 \times 10^{-31} kg = 0.511\, \mathrm{MeV} \cdot c^{-2}$$
$$\frac{1}{\lambda} = R_H \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) \qquad (n_f = 1 : \text{Lyman}, 2 : \text{Balmer}, 3 : \text{Paschen})$$

Special Theory of Relativity

$$\Delta t = \frac{\Delta t_p}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma \Delta t_p \qquad L = L_p \left(1 - \frac{v^2}{c^2}\right)^{1/2} = \frac{L_p}{\gamma}$$

$$x' = \gamma (x - vt) \qquad x = \gamma \left(x' + vt'\right)$$

$$y' = y \qquad y = y'$$

$$z' = z \qquad z = z'$$

$$t' = \gamma \left(t - \frac{vx}{c^2}\right) \qquad t = \gamma \left(t' + \frac{vx'}{c^2}\right)$$

$$u'_x = \frac{u_x - v}{1 - \frac{u_x v}{c^2}} \qquad u_x = \frac{u'_x + v}{1 + \frac{u'_x v}{c^2}}$$

$$u'_y = \frac{u_y}{\gamma \left(1 - \frac{u_x v}{c^2}\right)} \qquad u_y = \frac{u'_y}{\gamma \left(1 + \frac{u'_x v}{c^2}\right)}$$

$$u'_z = \frac{u_z}{\gamma \left(1 - \frac{u_x v}{c^2}\right)} \qquad u_z = \frac{u'_z}{\gamma \left(1 + \frac{u'_x v}{c^2}\right)}$$

$$\vec{\mathbf{p}} = \frac{m\vec{\mathbf{u}}}{\sqrt{1 - \frac{u^2}{c^2}}} = \gamma\, m\vec{\mathbf{u}} \qquad E = E_R + K$$

$$E_R = mc^2 \qquad K = (\gamma - 1)\, mc^2$$

$$E = \gamma\, mc^2 \qquad E^2 = p^2c^2 + \left(mc^2\right)^2$$