

PHYS-201 Equation Sheet for Midterm Exam #3

(26 May 2011, MAIN AUDITORIUM, 8:00-8:50 am)

Blackbody Radiation

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

Photoelectric Effect

$$\begin{aligned} K_{max} &= h f - \Phi = e \Delta V_S & \lambda_c &= \frac{c}{f_c} = \frac{h c}{\Phi} \\ e &= 1.602 \times 10^{-19} \text{As} & h c &= 1240 \text{eV} \cdot \text{nm} \\ \hbar &= \frac{h}{2\pi} = 1.055 \times 10^{-34} \text{J} \cdot \text{s} & c &= 2.998 \times 10^8 \text{ms}^{-1} \\ 1 \text{ eV} &= 1.602 \times 10^{-19} \text{J} \end{aligned}$$

Discrete Spectra of Atomic Gases: Rydberg Formula

$$\begin{aligned} \frac{1}{\lambda} &= R_H \left(\frac{1}{2^2} - \frac{1}{n^2} \right) \quad (n = 3, 4, 5, \dots) & R_H &= 1.097 \times 10^7 \text{m}^{-1} \\ E_i - E_f &= h f \end{aligned}$$

Bohr Model of the Hydrogen Atom

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

Special Theory of Relativity

$$\Delta t = \frac{\Delta t_p}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma \Delta t_p$$

$$x' = \gamma(x - vt)$$

$$y' = y$$

$$z' = z$$

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

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

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

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

$$\vec{p} = \frac{m\vec{u}}{\sqrt{1 - \frac{u^2}{c^2}}} = \gamma m\vec{u}$$

$$E_R = mc^2$$

$$E = \gamma mc^2$$

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

$$x = \gamma(x' + vt')$$

$$y = y'$$

$$z = z'$$

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

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

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

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

$$E = E_R + K$$

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

$$E^2 = p^2 c^2 + (mc^2)^2$$