PHYS 2D
PROBLEM SESSION

2012/5/03

- Quiz 2 regrade request: before quiz 3
- Quiz 2 still being graded

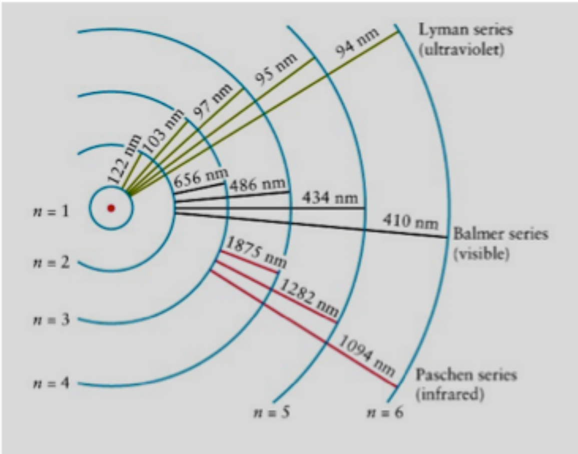
- Solution has lots of typesetting errors
- Number is usually correct
- Let Dr. Sutterly or me know if you find serious/ conceptual errors

4.3, 4.7, 4.8

- Do them!
- Questions?

4.13

- Lyman emission spectra: hydrogen goes from state $n_i=n$ to $n_f=1$, $n_i=2, 3, 4, \ldots, \infty$



- $E_{photon}=hc/\lambda=E_i-E_f$
- $1/\lambda=R(1/n_f^2-1/n_i^2)=R(1/1^2-1/n^2)$
- $n_i>n_f=1$, A series of emission lines corresponds to a set of n_i
- Different n_f give different series
- Lyman: $n_f=1$, Balmer: $n_f=2$, Paschen: $n_f=3$

4.14

- Radius of the 1st, 2nd, 3rd Bohr orbit of hydrogen
  - $r=n^2\hbar^2/m_e ke^2=n^2a_0=0.0529n^2$ nm
  - $r_1=0.0529$ nm
  - $r_2=0.2116$ nm
  - $r_3=0.4761$ nm
- Speed of electron in these orbits
  - $K=m_e v^2/2=-E=13.6/n^2$ eV, $v= (2*13.6eV/m_e)^{1/2}/n$
  - $v_1=2.19*10^6$ m/s$=0.00726c$
  - $v_2=0.00364c=v_1/2$, $v_3=v_1/3$
- $v<<c$

4.15

- Energy level of He+ ion
- Same as hydrogen, except Z=2
- $E=-13.6*Z^2/n^2$ eV
- Everything is 4 times that of hydrogen

4.23

- Hydrogen in state $n=1$
- $r=0.0529$ nm
- $p=m_e v$, v calculated in 4.14
- $L=m_e vr=n\hbar=\hbar$
- $K=m_e v^2/2$
- $U=-ke^2/r$
- Circular motion, centripetal force $m_e v^2/r=ke^2/r^2$
- $U=-2K$
- $E=U+K=-K=-13.6$ eV

4.32

- Mass of proton is not infinite
- Must consider the motion of proton
- Done by simply using reduced mass μ instead of m_e
- $\mu = m_e M/(m_e+M)$, M: mass of nucleus
- $a_0 \sim 1/m_e$, $E \sim 1/a_0$, so $E' = E*\mu/m_e$
- $\lambda \sim 1/E$, $\lambda' = \lambda * m_e/\mu$
- Using m_e: 656.1469 nm
- Hydrogen: 656.4691 nm
- Deuterium: 656.2925 nm
- Tritium: 656.2325 nm