Phy 360 Mid Term 2 October 15, 2008

On my honor I have neither given nor received any aid on the examination

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

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

$u_x = (u_x' - v)/(1 - vu_x'/c^2)$

$h = 4 \times 10^{-15}\ eV \cdot s$

$\hbar c = 197.33\ eV \cdot nm$

$hc = 1239.8\ eV \cdot nm$

$\lambda' - \lambda_0 = \frac{h}{m_e c}(1 - \cos\theta)$

$h = 6.6 \times 10^{-34}\ J \cdot s$

$m_e = 0.5\ MeV/c^2$

$a_0 = 0.5\ \text{Å} = 0.05\ nm$

$E_0 = -13.6\ eV$

$E = \gamma m_0 c^2$

$E^2 = p^2c^2 + m_0^2c^4$

$KE_{max} = h\nu - \phi$

$p = \gamma m_0 v$

$c = 3 \times 10^8\ m/s$

$u(\lambda) = \frac{8\pi hc\, d\lambda}{\lambda^5(e^{hc/\lambda k_B T} - 1)}$

$E = \frac{3}{2} k_B T$

$\lambda = h/p$

$k_B = 9 \times 10^{-5}\ eV/^\circ K$

1) The work function for Molybdenum is 4.22eV
   (a) What is the minimum frequency of the light that will eject an electron?
   (b) Will yellow light (560 nm) cause an electron to be ejected?
   (c) What would the stopping voltage be for ~~blue~~ (~~440~~ nm) light?
   uv (200nm)

2) (a)What is the DeBroglie wavelength of a ping-pong ball (m=2g) moving at 5 m/s? (b) How fast would it need to move to have a wavelength of 1mm?

3) (a) Determine the three lowest energy levels in a Bohr hydrogen atom.

   (b) What are the possible energy transitions between these levels?

   (c) What are the possible wavelengths of light that might be emitted due to these transitions?

4) Consider the collisions of two identical particles, each of mass mo. In experiment A, a particle moving at 0.9c strikes a stationary particle.
   (a) What is the total KE before the collision?
   (b) In experiment B, both particles are moving at a speed u (relative to the lab), directly toward one another. If the total kinetic energy before the collision in experiment B is the same as that in experiment A, what is u?
   (c) In both experiments the particles stick together. Find the mass of the resulting single particle in each experiment. In which is more of the initial KE converted to mass?

Physics 360 Mid Term 2 October 11, 2006

1) The work function for Cesium is 2.0 eV.

(a) find the threshold frequency and wavelength for the photoelectric effect

(b) Find the maximum KE of the ejected electron if the incident light is 300 nm.

2) X-rays of wavelength 0.200 nm are scattered from a block of carbon. If the scattered radiation is detected at 90 deg from the incident beam, find

(a) the Compton shift $\Delta\lambda$

(b) the kinetic energy imparted to the recoiling electron

3) A hydrogen atom absorbs a photon to make the transition from n=1 to n=3 level. What was the frequency and wavelength of the photon? What is the recoil momentum and energy of the atom? What wavelengths of photons can be released as the atom transitions back to the n=1 level?

4) Suppose Fuzzy, a quantum mechanical duck lives in a world in which h=2 J s
Fuzzy has a mass of 2.0 kg and is initially known to be within a region 1.0 m wide.
(a) what is the minimum uncertainty in his speed?
(b) assuming this uncertainty in speed is to prevail for 5 s, determine the uncertainty in his position after this time.

Physics 360 Mid Term 2 October 10, 2007

1) The work function for Potassium is 2.2 eV.
   (a) Find the maximum KE of the ejected electron if the incident light is 350 nm.
   (b) The cutoff wavelength

2) In a Compton scattering event the scattered photon has an energy of 120 keV and the recoiling electron has an energy of 40 keV. Find the (a) wavelength of the incident photon, (b) the angle θ at which the photon is scattered, and (c) the recoil angle, ϕ, of the electron.

3) A photon is emitted from a hydrogen atom that undergoes an electronic transition from the state n=3 to the state n=2. Calculate (a) the energy, (b) the wavelength, and (c) the frequency of the emitted photon.

4) At what wavelength does the human body emit the maximum electromagnetic radiation? What would the work function of a detector for this radiation have to be? For a bonus 5 pts…what could be a possible problem for this detector?