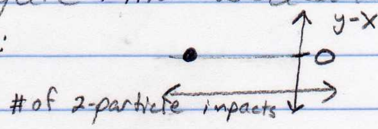
Ch14 C 10, 24, 29, 33
P 2, 5

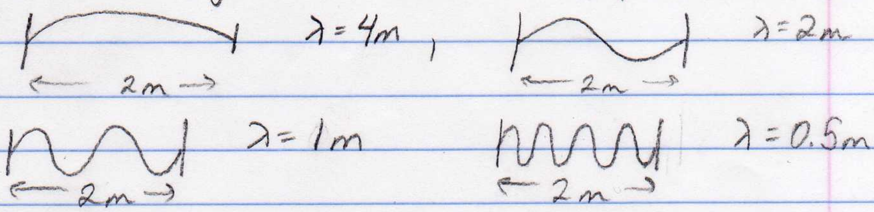
Physics 107
Homework #8
11/15/06

C 10. If the photons behaved like ordinary Newtonian particles, the particles would hit the screen at equal distances from the midpoint. This would give $y-x=0$ for all the particles. So the graph in figure 14.12 would look like a single dot out from $y-x=0$:



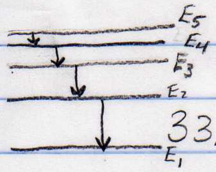
24. length = 2m A standing wave can be setup in increments of $\frac{1}{2}\lambda$.

examples:



So the string can vibrate with a standing wave of 0.5m wavelength, but not wavelengths of 2.1m or 1.9m.

29. Yes, the atom would have more mass in the excited state. In the excited state, the atom has more energy. We know by $E=mc^2$ that energy is related directly to mass. So with higher energy, the atom also has more mass.



33. The energy change between E_2 and E_1 is the greatest. Photon energy is directly related to its frequency ($E=hf$), so the transition E_2 to E_1 gives photons with highest frequency. The transition E_5 to E_4 has the lowest energy change so gives photons with the lowest frequency and longest wavelength ($c=\lambda f$).

P 2. $m = 1.7\times10^{-27}\,kg$ $\quad \Delta v = 1\,m/s$ $\quad \Delta p = m(\Delta v) = (1.7\times10^{-27}\,kg)(1\,m/s) = 1.7\times10^{-27}\,kg\,m/s$

$\Delta x\,\Delta p > h/4\pi$ $\quad \Delta x > h/(4\pi\Delta p) = (6.626\times10^{-34}\,Js)/(4\pi(1.7\times10^{-27}\,kg\,m/s))$

$\Delta x > 3.1\times10^{-8}\,m = \underline{3.1\times10^{-6}\,mm}$

or

$\Delta x \sim \frac{h}{m\Delta v} = (6.626\times10^{-34}\,J\cdot s)/(1.7\times10^{-27}\,kg\,m/s) = 3.9\times10^{-7}\,m = \underline{3.9\times10^{-4}\,mm}$

5. $E_{photon} = E_3 - E_2 = 3\times10^{-19}\,J = hf$ $\quad f = \frac{3\times10^{-19}\,J}{6.626\times10^{-34}\,J/s} = \underline{4.5\times10^{14}\,Hz}$

This is in the visible region of the electromagnetic spectrum.