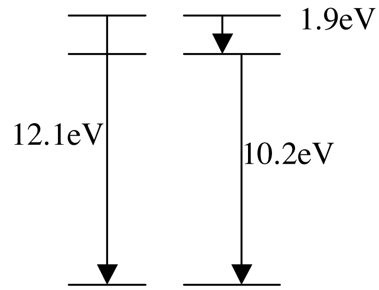
CHAPTER-4 HOMEWORK

#11- $\Delta E_{32} = 13.6$ eV (1/4 – 1/9) = 1.89 eV → 1240/1.89 nm = <u>656.1 nm</u>
$\Delta E_{42} = 13.6$ eV (1/4 – 1/16) = 2.55 eV → 1240/2.55 nm = <u>486.3 nm</u>
$\Delta E_{52} = 13.6$ eV (1/4 – 1/25) = 2.85 eV → 1240/2.85 nm = <u>434.2 nm</u>

#18- (a) $\Delta E_{13} = 13.6$ eV (1 – 1/9) = <u>12.1 eV</u>

(b) $\Delta E_{31} = 12.1$ eV
$\Delta E_{32} = 13.6$ eV (1/4 – 1/9) = <u>1.9 eV</u>
$\Delta E_{21} = 13.6$ eV (1 – 1/4) = <u>10.2 eV</u>



 # 25- (a) $\Delta E_{43} = 13.6$ eV (1/9 – 1/16) = 0.661 eV
$f = E/h$ = (0.661 eV /4.136 x10^{-19} eV-s = <u>1.6 x 10^{14} Hz</u>

(b) $T = 2\pi r / v$ → $f = v / 2\pi r$

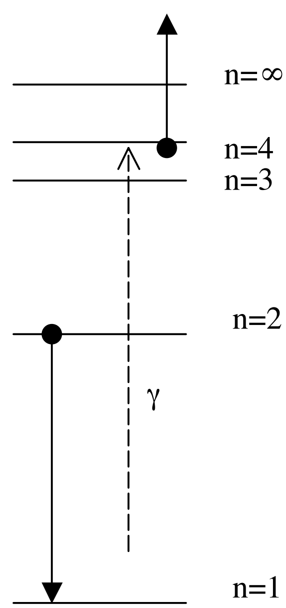
$r_n = n^2 a_o$ and $m v r = n h$ → $v_n = n h / m r_n$

<u>n=4</u> r = 16 ao v = 4 h / 16 m ao
f_4 = [4 h / 16 m ao] / 2 π [16 ao] = 1.03 x 10^{14} Hz

<u>n=3</u> r = 9 ao v = 3 h / 9 m ao
f_3 = [3 h / 9 m ao] / 2 π [9 ao] = 2.44 x 10^{14} Hz

$f_3 - f_4$ <u>= 1.4 x 10^{14} Hz</u> about halfway between the two frequencies of revolution.

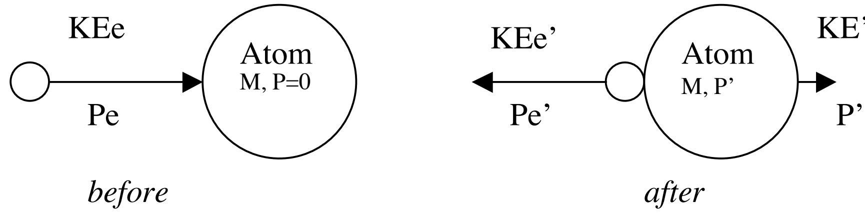
#28- The kinetic energy of the n=4 electron will be the energy of the emitted 2->1 photon minus the ionization energy of the n=4 electron. (Zcr = 24) .



n=2→1 photon
$\Delta E_{12} = (24)^2$ (1-1/4) eV = <u>5.875 keV</u>

Ionization energy of n=4 electron
$I_4 = \Delta E_{4\infty} = (24)^2 (1/4-1/\infty)$ eV = <u>1.958 keV</u>
ΔE_{12} photon is absorbed by the n=4 electron
<u>KEe</u> = $\Delta E_{12} - I_4$ = 5.875 keV - 1.958 keV = <u>3.917 eV</u>

#38-



$Ee + EA' = Ee' + EA$	conservation of energy
$Pe + 0 = -Pe' + P'$	conservation of momentum
$KEe + mc^2 + Mc^2 = KEe' + mc^2 + KE' + Mc^2$	masses cancel
$KEe = KEe' + KE'$	
$\Delta KEe = KE' = P'^2 / 2M = (Pe+Pe')^2/2M$	using $Pe + 0 = -Pe' + P'$
$\Delta KEe \sim (2Pe)^2 /2M$	assuming $Pe \sim Pe'$!!
$\Delta KEe \sim 4 Pe^2 / 2M = 2 (Pe^2 /2m)2m / M$	$KEe = (Pe^2 /2m)$
$\mathbf{\Delta KEe / KEe = 4m/M}$	*QED*