(6.10) A γ-line at 0.146 MeV is assigned to a +4 to +0 rotational level change in ^{238}Pu. (a) What should the energy of the +2 and +6 rotational levels be? Compare with the measured values of 0.044 and 0.304 MeV. (b) If ^{238}Pu is considered to be a homogenous sphere, what will its apparent radius be? Compare with that obtained using relation (4.14)

E_{rot}=((***h***/2*π)^2/(2*I_{rot}))*n_r*(n_r+1). Hence I_{rot}=((***h***/2*π)^2/(2*E_{rot}))*n_r*(n_r+1)

(a).

$$MeV := 10^6 \cdot 1.602177 \cdot 10^{-19} \cdot joule$$

$$h := 6.626076 \cdot 10^{-34} \cdot joule \cdot sec \qquad E_{rot} := 0.146 \cdot MeV \qquad n_r := 4$$

$$I_{rot} := \frac{\left(\frac{h}{2 \cdot \pi}\right)^2}{2 \cdot E_{rot}} \cdot n_r \cdot (n_r + 1) \qquad I_{rot} = 4.754 \cdot 10^{-54} \cdot kg \cdot m^2$$

$$A := 238 \qquad Z := 94 \qquad N := A - Z$$

$$n := 0, 2 .. 6$$

$$E_n := \frac{\left(\frac{h}{2 \cdot \pi}\right)^2}{2 \cdot I_{rot}} \cdot n \cdot (n + 1) \qquad E\gamma_n := \frac{E_n}{1.602177 \cdot 10^{-19}} \cdot 10^{-6}$$

E_n	n	$E\gamma_n$	
$0 \cdot kg \cdot m^2 \cdot sec^{-2}$	0	$0 \cdot kg \cdot m^2 \cdot sec^{-2}$	
$7.018 \cdot 10^{-15} \cdot kg \cdot m^2 \cdot sec^{-2}$	2	$0.044 \cdot kg \cdot m^2 \cdot sec^{-2}$	+2 level 0.044 MeV
$2.339 \cdot 10^{-14} \cdot kg \cdot m^2 \cdot sec^{-2}$	4	$0.146 \cdot kg \cdot m^2 \cdot sec^{-2}$	+4 level 0.146 MeV
$4.912 \cdot 10^{-14} \cdot kg \cdot m^2 \cdot sec^{-2}$	6	$0.307 \cdot kg \cdot m^2 \cdot sec^{-2}$	+6 level 0.307 MeV

(b) eqn (3.29): $I_{rot}=m*r^2$, hence r=sqrt(I_{rot}/m)

$$u := 1.660540 \cdot 10^{-27} \cdot kg$$

$$m_{238Pu} := A \cdot u \qquad r_{238Pu} := \sqrt{\frac{I_{rot}}{m_{238Pu}}} \qquad r_{238Pu} = 3.468 \cdot 10^{-15} \cdot m$$

Compare with result from 4.14: $r=r_0*A^{1/3}$

$$r_0 := 1.4 \cdot 10^{-15} \cdot m$$

$$r_A := r_0 \cdot A^{\frac{1}{3}} \qquad r_A = 8.676 \cdot 10^{-15} \cdot m$$