3.012 Bonding-Structure: Recitation 3

1 Spherical Harmonics, Y_{lm}

Problem I

Identify the spherical harmonics in Figures 1, 2. Indicate the corresponding spectroscopic notation (if known).

Give the general relations to determine the number of vertical nodal planes and the total number of angular nodal surfaces.

$$Y_{lm} : \begin{cases} \text{number of vertical nodal planes} & : \quad \_\_\_ \\ + \text{ number of other nodal surfaces} & : \quad \_\_\_ \\ \hline \text{total number of nodal surfaces} & : \quad \_\_\_ \end{cases}$$

2 Radial Function, R_{nl}

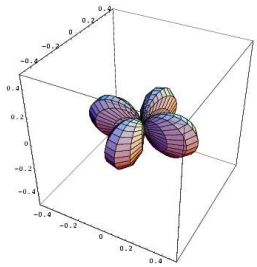
Problem II

Identify the radial functions in Figure 3.

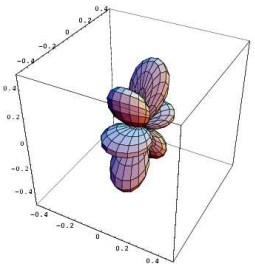
Give a relation for the total number of radial nodal spheres and the rule to determine the behaviour of the radial function when r goes to zero ($R_{nl}(r) \propto r^{\alpha}$).

$$R_{nl} : \begin{cases} \text{total number of nodes } (r = 0 \text{ no taken into account}) & : \quad \_\_\_ \\ \text{behaviour at the origin} & : \quad R_{nl}(r) \text{ behaves as } r^{\_\_} \end{cases}$$

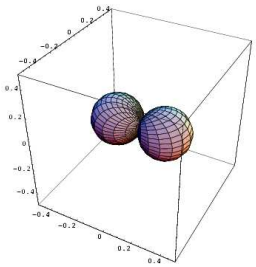
What is the total number of nodal surfaces (radial and angular) for the wavefunction $Y_{nlm}(r, \theta, \phi) = R_{nl}(r)Y_{lm}(\theta, \phi)$?



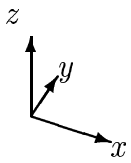
(a) $\mathrm{Re}(Y_{l=2,m=\_\_})$

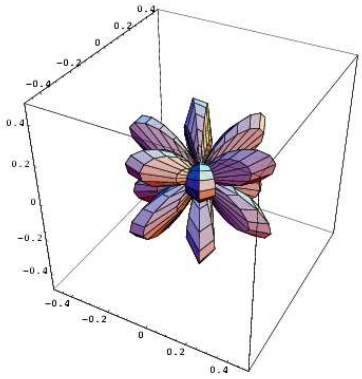


(b) $\mathrm{Im}(Y_{l=\_\_,m=1})$

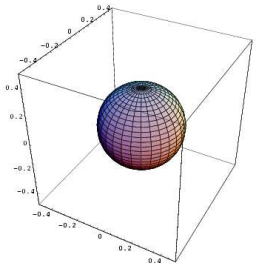


(c) $\mathrm{Re}(Y_{l=\_\_,m=\_\_})$

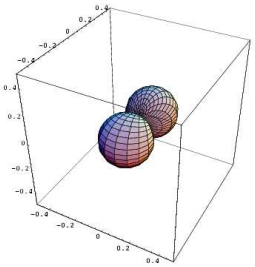




(d) $\mathrm{Re}(Y_{l=\_\_,m=\_\_})$

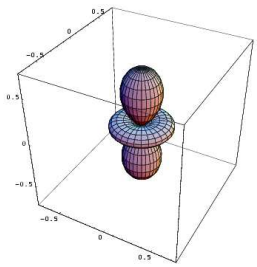


(e) $\_\_(Y_{l=\_\_,m=\_\_})$

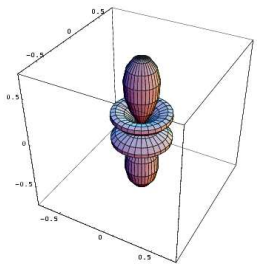


(f) $\_\_(Y_{l=1,m=1})$

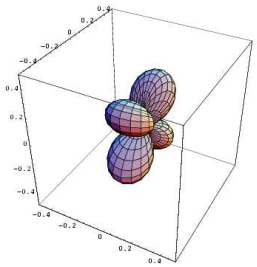
Figure 1: Spherical Harmonics

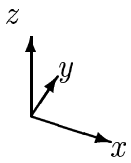


(a) $Y_{l=0,m=0}$

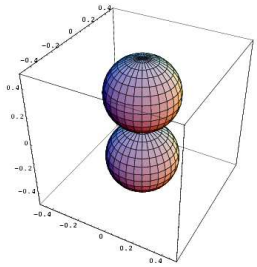


(b) $Y_{l=3,m=0}$

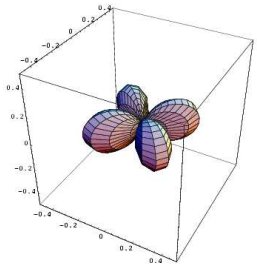




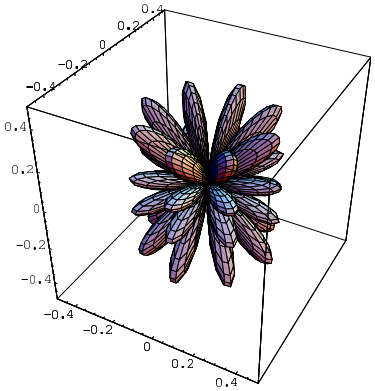
(c) $Y_{l=1,m=1}$



(d) $Y_{l=2,m=2}$

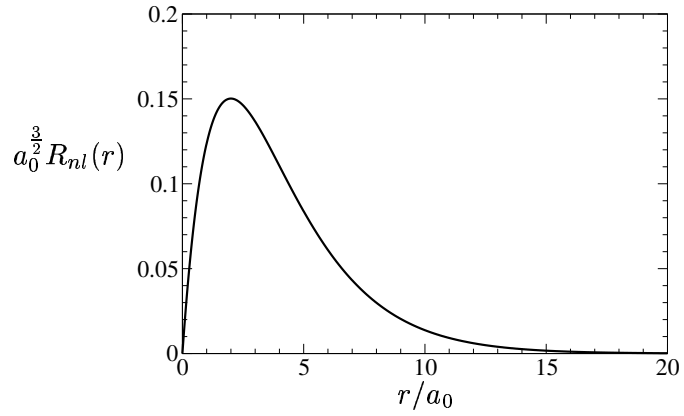


(e) $Y_{l=2,m=1}$

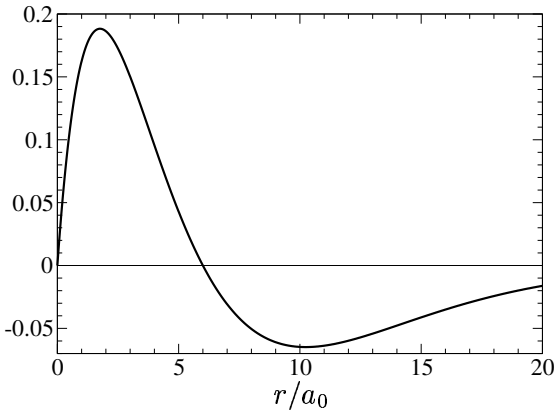


(f) $Y_{l=3,m=3}$

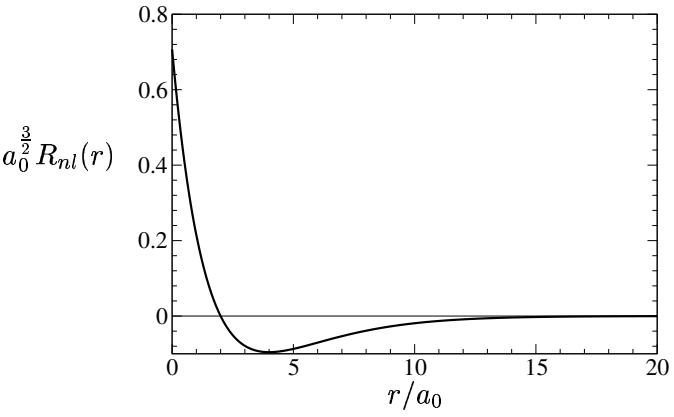
Figure 2: Spherical Harmonics



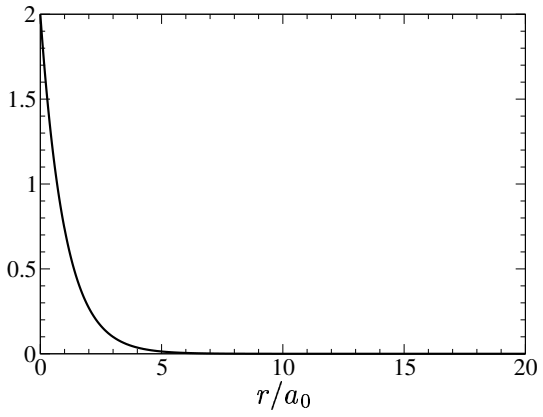
(a) $R_{n=2,l=\_\_}$



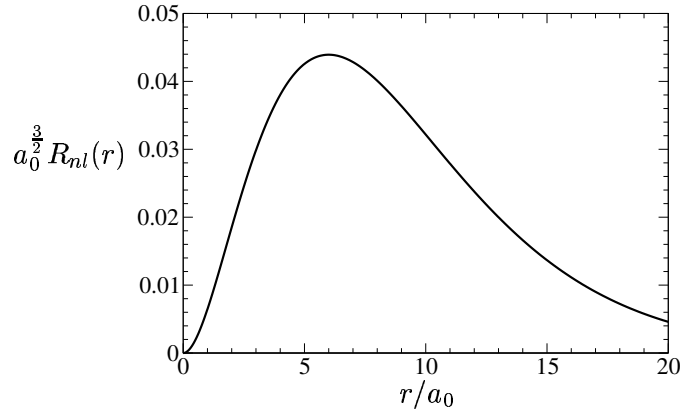
(b) $R_{n=\_\_,l=1}$



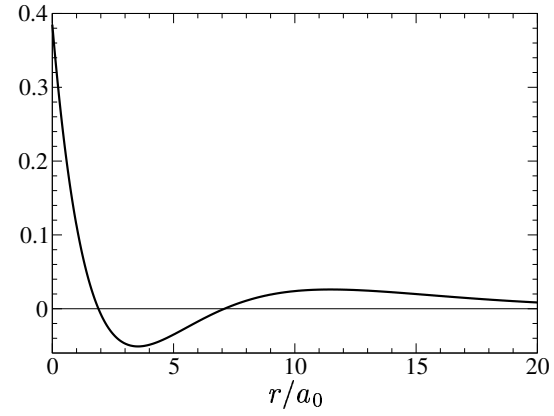
(c) $R_{n=\_\_,l=0}$



(d) $R_{n=\_\_\_,l=\_\_}$



(e) $R_{n=\_\_\_,l=\_\_}$



(f) $R_{n=\_\_,l=\_\_\_}$

Figure 3: Radial Functions