上海科技大学
ShanghaiTech University

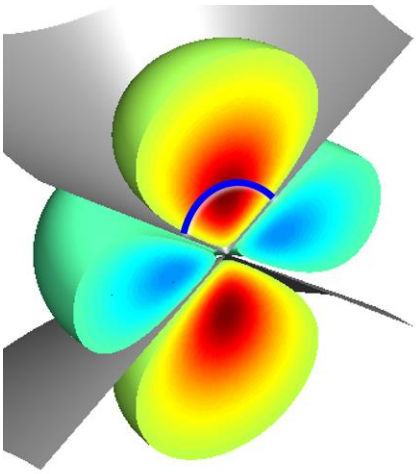
General Chemistry I, Fall 2024
Problem Set 3

This set consists of 4 problems and the total points is 4.

1. (1.5 point) (a) See the attached figure, it represents the $3d_{z2}$ orbital, what is the n and l quantum number of it?

(b) Use n and l quantum number to calculate (instead of counting), how many nodes can be found in $3d_{z2}$ orbital? How many radial nodes? How many angular nodes?

(c) According to the angle part $Y_{dz2} = (5/16\pi)^{1/2} (3\cos^2\theta - 1)$, find out the cone angle (in degrees) of the nodal planes.



2. (0.6 pt) What is the maximum number of electrons (in a single atom) that can be associated with each of the following combinations of quantum numbers?

(a) n = 2

(b) n = 3, l = 2

(c) n = 2, l = 0, m = 0

(d) n = 6, l = 3, m = -3, ms = -½

3. (1.2 pt) Does each of the following set of quantum numbers describe a possible atomic orbital? If so, give the label for this orbital. If not, explain why an electron with that set of quantum numbers isn't possible.

(a) n = 4, l = 3, m = -3

(b) n = 1, l = 0, m = 0

(c) n = 0, l = 0, m = 0

(d) n = 2, l = 3, m = 0

(e) n = 3, l = -2, m = 3

(f) n = 4, l =3, m = -4

4. (0.7 pt) Ionization is a process that involves the removal of electron present in an orbit to outside the atom (n = ∞).

(a) Calculate the ionization energy (I) required to ionize 1 mole H atom at ground state (using quantum mechanics)

(b) Calculate the first ionization energy (I) required to ionize 1 mole He^+ at ground state (using quantum mechanics)