Good afternoon students myself, Miss Avinanti Gaonkar from

Government college quepem. I'm going to deal with quantum

chemistry. My module name is probability distribution

functions, nodal properties .My module number is 32.
Outline of my module will be.

Radial probability distribution function angular probability

distribution function and learning outcomes will be

students will able to sketch probability distribution curves

and shapes of various orbital.

Total wave function is given as sum

Of radial wave function, and angular wave function.
radial wave function, it depends on distance ‘r’ from the nucleus

and it gives size of the orbital, whereas angular

wave function it depends on direction and it gives shapes

of the orbitals.
Now table one. It gives radial wave functions for

Various orbital, for example1S, 2P, 3P orbital radial

Wave function is given here.

Table two gives angular wave function for various orbital

having different quantum numbers that is ‘l ‘& ‘m’ . Here ‘l’ is azimuthal

quantum number and ‘m’ is magnetic quantum number.

Now suppose if we plot graph of probability density against

Distance ‘r’ from the nucleus, then we will get nature of the

graph as shown in figure one. Now here ‘R’ square is the

probability density and small ’ r’ is the distance from nucleus.

Now this applies for 1S, 2S and 3 S orbital. Now from this

graph you can see that

probability density is maximum at ‘r’ = 0

that is at nucleus probability density equals to

zero, which cannot be true because probability of finding

an electron at nucleus should be 0,

So this function is made meaningful by considering

radial probability.

Now radial probability is the probability of finding an

electron between distance r and r +dr.

Figure 2. it gives the shell of thickness dr

around a nucleus. Here radial probability equals to

probability density into volume of shell dV of thickness dr.
Now

dV equals to volume of shell of radius r + dr minus volume of

shell of radius’ r’.
So it will be equals to dV equals to four Pi

by three r plus dr the whole cube, minus four Pi by three ‘r’ cube. So if

you simplify you will get equation 2, so
dV equals to Four Pi by three bracket r cube plus dr Cube plus three r ^2 +

3 r dr square bracket close minus four Pi by three into r cube.

Now, since the r is very small, the r square, and r cubed from equation to can be neglected. So you will be left with final equation dV equals to four π ‘r’ square dr.

Therefore, Radial probability will be equals to probability density into four π r square dr. And radial probability distribution curves can be obtained by plotting.

Radial probability against distance ‘r’ from nucleus. Figure 3 gives the radial probability distribution curves for various orbital 1s, 2s, 3s, 2p, 3p and 3d orbital.

In this graph, number of minimums which are there It indicates the number of nodes here, now. Node is the region where probability of finding an electron is 0. Now for .1s’ orbital here there is no node. Means zero node here. If you see 2s orbital, one node is present one Minimum. For 3s orbital two nodes.

For 2p Orbital 0 node for 3p 1 node and for 3d orbital 0 node.

The distance of highest peak gives the radius of maximum probability. That is R Max, which means at this radius probability of finding an electron will be maximum. So at

‘R’ Max probability of finding an electron will be maximum. Now

the number of nodes can be given as n - l -- 1.

In this radial wave functions it gives size of the orbital an it

is dependent on quantum number n and l. where ‘n’ is principle quantum

number l is as a azimuthal quantam number .

angular wavefunction gives Shapes of the orbital and it is dependent

on quantum number ‘m’ and ‘l’ where ‘m’ is magnetic quantum number,

and ‘l’ is azimuthal quantum number. Now Figure 4 it shows

the shapes of the orbital.

Shapes of 1s, 2 s and 3 s orbital are given here. Now S

orbital is spherical in shape. Now if you see 1S orbital there is

zero node here for 2 S orbital, one node is present for 3s orbital there are two

nodes. Figure 5 gives shapes of your’ p’ orbitals. There are

total 3 ‘p’ orbital p_x ,p_y, p_z orbital.

And ‘p’ orbitals are dumb bell in

shape. For 2p orbital, there is zero node and for 3p.

One node for 4px 2 nodes. Figure 6 gives shapes of the d

orbital. There are total 5d orbital, dxy dxz, dyz, d x2-y2 and dz^2

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These ‘d ‘orbitals are

double dumb bell in shape.

Thank you.