Key

CH301H: Principles of Chemistry I: Honors
Fall 2016, Unique 50015

Quiz 4, 18 October 2016

An allowed solution to the angular part of the wavefunction is given below:

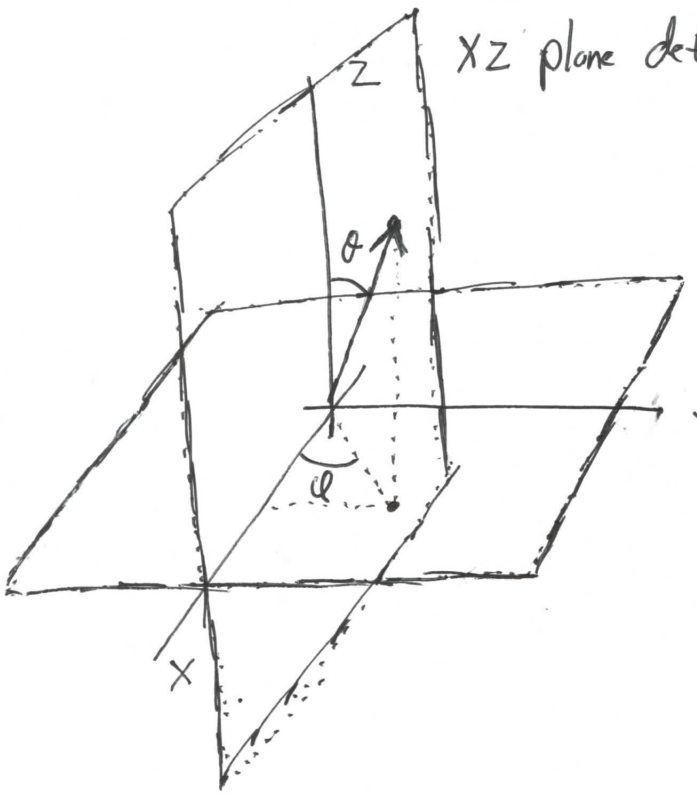
$$Y(\theta, \phi) = \left(\frac{15}{4\pi}\right)^{\frac{1}{2}} \sin\theta \cos\theta \sin\phi$$

a) How many radial nodes does the orbital described by this equation have?
b) How many angular nodes does the orbital described by this equation have?
c) What are the values of *n*, *l*, and *m* for this orbital?
d) Where are the angular nodes defined by this orbital?

EC (not much): What orbital is defined by this wavefunction?

a) This orbital depends only on $l + m$, so there is no information on radial nodes.

b) This question is easiest to answer if d) is already answered:
$Y(\theta, \phi) = 0$ where $\sin\theta = 0$ $(\theta = 0, \pi)$;
$\cos\theta = 0$ $(\theta = \frac{\pi}{2}, \frac{3}{2}\pi)$
$\sin\phi = 0$ $(\phi = 0, \pi)$



xz plane defined by $\theta = 0, \pi$ (z-axis) or $\varphi = 0, \pi$ (x-axis)

← xy plane defined by $\theta = \frac{\pi}{2}, \frac{3\pi}{2}$

So there are 2 angular nodes, $l=2$.

c) The only thing we know is $l=2$.

So the allowed values of n are $n > 2$.

Allowed values of m are $m = -2, -1, 0, +1, +2$

d) xz plane

xy plane See above.

ec) d_{yz} orbital. Bonus EC points if you can draw a good one.