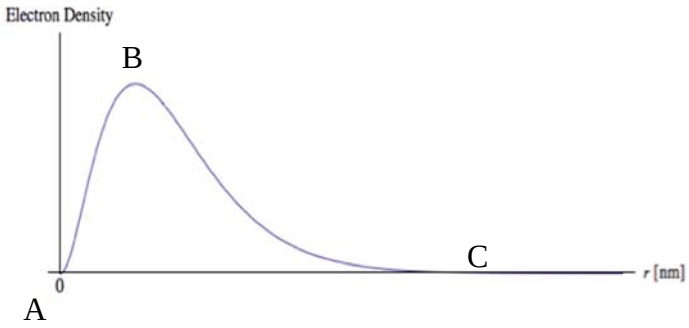
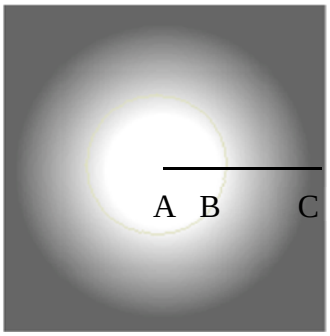
17. Electron Density: Electron Waves

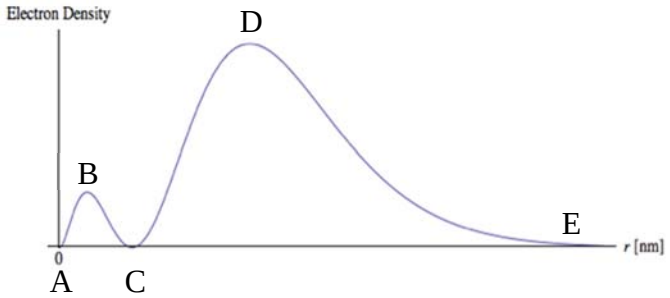
In addition to three-dimensional images of electron clouds, the energy densities of these waves are often shown using one-dimensional graphs. The graph below (left) shows a one-dimensional representation of a 1s orbital electron wave next to the three-dimensional cross section (right). The energy density is plotted along the y-axis, while the distance from the nucleus is plotted on the x-axis. When the distance is zero (at the center of the tree-dimensional electron wave), the energy is zero because of the absence of an electron due to the presence of the nucleus. As the distance increases away from the nucleus, the energy density decreases asymptotically to zero because of the attraction between the nucleus and the electron.

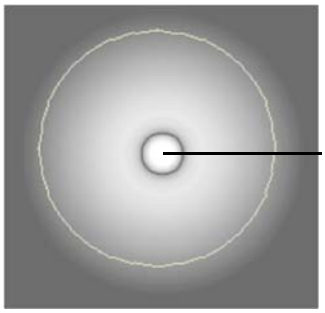




As we increase the energy of the electron wave, the shape of the wave becomes more complex. Below are the energy density graph and the three-dimensional cross section of a 2s orbital.

1) Label the locations in the cross section that correspond with "A", "B", "C", "D", and "E" in the graph. A horizontal distance axis has been provided for you.



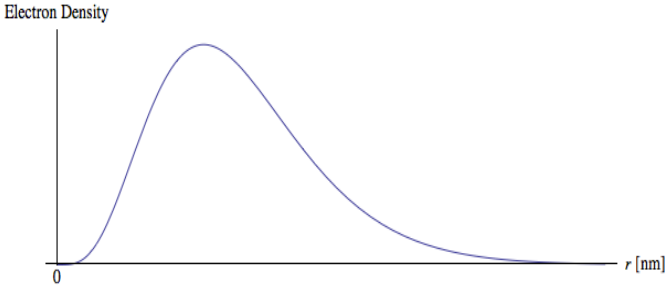


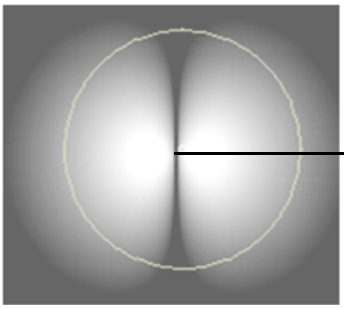
2) On the graph of the 2s orbital above, indicate the location(s) of the nodal plane(s).

3) On the graph of the 2s orbital above, indicate the location(s) and number of loops.

4) Are all of the radial loops and nodal planes of the three-dimensional orbital represented in this graph? Explain.

Below are the energy density graph and the three-dimensional cross section of a 2px orbital.





5) On the graph of the 2px orbital above, indicate the location of the nodal plane.

6) On the graph of the 2px orbital above, indicate the location(s) and number of loops.

7) Are all of the radial loops and nodal planes of the three-dimensional orbital represented in this graph? Explain.