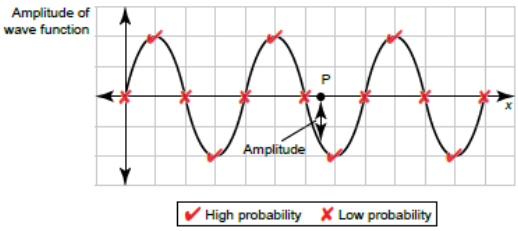
Beyond Bohr: A Quantum Approach to the Atom

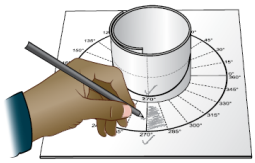
Orbital Shapes

You might be used to thinking of electrons as particles, but electrons exhibit many wave-like properties. We can model electrons using wave functions, as shown in the graph on the right. In this section, you will use wave templates to model atomic orbitals. Each wave template represents a different wave function.



1. Each member of your group will be given a different template. On your template, use a check mark (✓) to indicate each location where the probability of detecting an electron is the highest and an X to mark the location where the probability of detecting an electron is lowest.

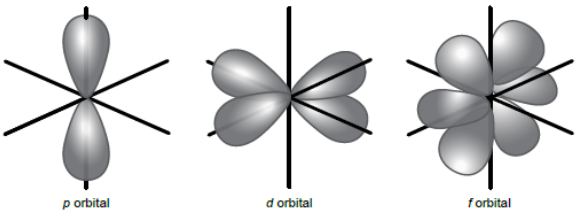
2. Bend the template so that it forms a cylinder. Slide both ends of the template until the 0° and 360° marks meet. Fasten the ends of the template together using a paper clip or some tape. How many wavelengths fit around the circle?



3. Centre the cylinder on the Circular graph. Make sure that the 0° mark on Wave Template matches up with the 0° mark on the Circular Graph. Draw an X on the edge of the circle at every angle where there's an X on Wave Template. Repeat this process for all the check marks (✓) on Wave Template.

4. On the Circular Graph, colour in the segment to the left and the right of each check mark. What do the coloured regions represent?

5. Compare the patterns made by each of your group members. Compare the patterns you made on the circular graphs to the images of the *p*, *d*, and *f* orbitals below. Keep in mind that we are modelling 3-D orbitals with 2-D graphs. Which pattern best matches each orbital?



6. Shade Circular Graph D to represent an orbital where there's an equal probability of detecting the electron at every angle. What type of orbital does it correspond to?