PRACTICE D

De Broglie Waves

1. With what speed would a 50.0 g rock have to be thrown if it were to have a wavelength of 3.32×10^{-34} m?
2. If the de Broglie wavelength of an electron is equal to 5.00×10^{-7} m, how fast is the electron moving?
3. How fast would one have to throw a 0.15 kg baseball if it were to have a wavelength equal to 5.00×10^{-7} m (the same wavelength as the electron in problem 2)?
4. What is the de Broglie wavelength of a 1375 kg car traveling at 43 km/h?
5. A bacterium moving across a Petri dish at 3.5 μm/s has a de Broglie wavelength of 1.9×10^{-13} m. What is the bacterium's mass?

De Broglie waves account for the allowed orbits of Bohr's model

At first, no one could explain why only some orbits were stable. Then, de Broglie saw a connection between his theory of the wave character of matter and the stable orbits in the Bohr model. De Broglie assumed that an electron orbit would be stable only if it contained an integral (whole) number of electron wavelengths, as shown in **Figure 18.** The first orbit contains one wavelength, the second orbit contains two wavelengths, and so on.

De Broglie's hypothesis compares with the example of standing waves on a vibrating string of a given length, as discussed in the chapter "Vibrations and Waves." In this analogy, the circumference of the electron's orbit corresponds to the string's length. So, the condition for an electron orbit is that the circumference must contain an integral multiple of electron wavelengths.

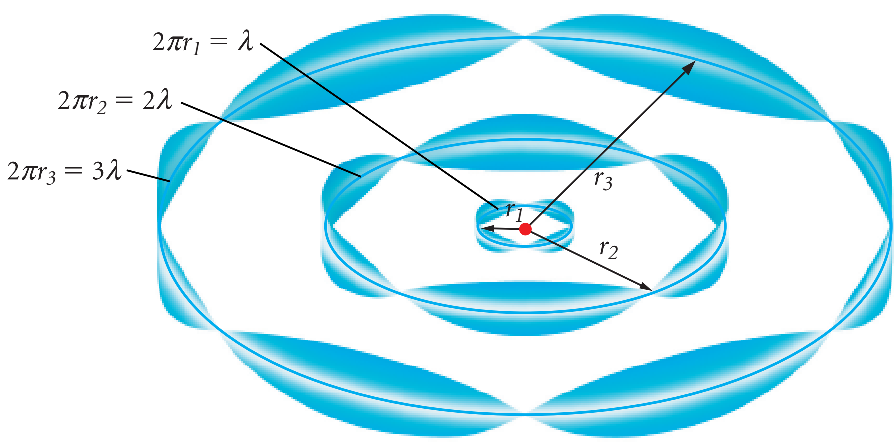

Figure 18
De Broglie's hypothesis that there is always an integral number of electron wavelengths around each circumference explains why only certain orbits are stable.