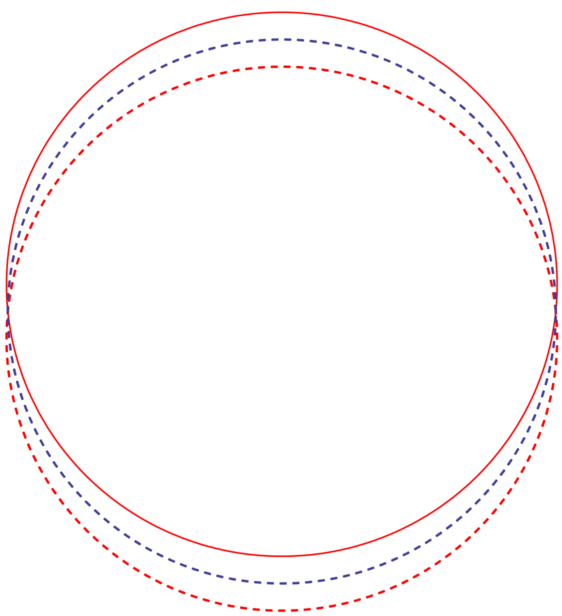
Teacher notes
Topic E

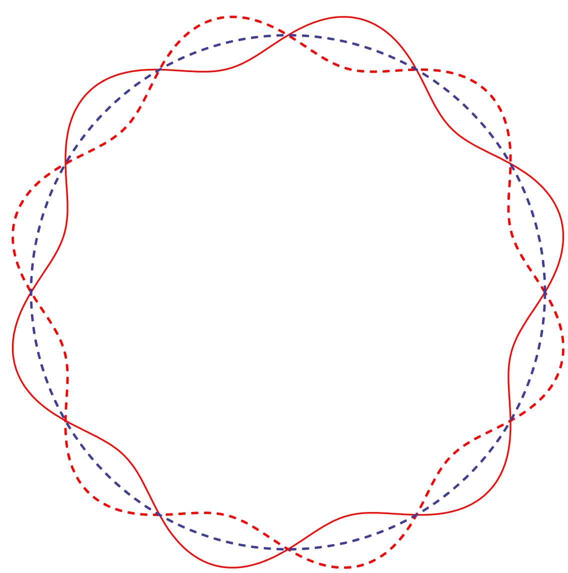
Bohr's condition and de Broglie's hypothesis

Bohr's condition of angular momentum quantization, $mvr = n\frac{h}{2\pi}$, can be connected to de Broglie's hypothesis that a particle of momentum *p* has wavelength $\lambda = \frac{h}{p}$.

The quantization condition can be rewritten as $pr = n\frac{h}{2\pi}$, i.e. $2\pi r = n\frac{h}{p} = n\lambda$. In other words that the wavelength of the electron fits exactly an integer number *n* on the circumference of the orbit (shown in the dashed blue line).



$n = 1$



$n = 6$

This is reminiscent of standing waves. The electron wave is a standing wave on the circumference. Standing waves do not transfer energy and this is a very loose way of explaining why the electron in the energy levels of hydrogen does not radiate.

Conversely, the de Broglie condition that the wavelength of the electron fits exactly an integer number *n* on the circumference of the orbit may be used to provide a justification of the Bohr condition of quantized angular momentum.