Solution

Consider an electron around a nucleus that has two protons, like an ionized Helium atom.

1. **Compare the "effective Bohr radius" $a_{0,He}$ with the usual Bohr radius for hydrogen, a_0:**

   a. $a_{0,He} > a_0$

   b. $a_{0,He} = a_0$

   c. $a_{0,He} < a_0$

Look at how a_0 depends on the charge:

$$a_0 \equiv \frac{\hbar^2}{m\kappa e^2} \rightarrow a_{0,He} \equiv \frac{\hbar^2}{m\kappa(2e)e} = \frac{a_0}{2}$$

This should make sense:
more charge → stronger attraction
→ electron sits closer to the nucleus

2. **What is the ratio of ground state energies $E_{0,He}/E_{0,H}$?**

   a. $E_{0,He}/E_{0,H} = 1$

   b. $E_{0,He}/E_{0,H} = 2$

   c. $E_{0,He}/E_{0,H} = 4$