Answer on Question #54469 – Chemistry – General chemistry

Question:

Using the Bohr Model, n=1 level in Li 2+ and Be 3+ in n=1 level. If the value of R is the same, by what factor do the two energies differ? (Round answer to nearest hundredth)

Solution

The difference is the nuclear charge.

For n=1 level in Li 2+

$$E_n\left(Li_{2+}\right)=\frac{R_E Z}{n^2}=\frac{R_E\cdot 2}{1^2}=2R_E \tag{1}$$

where $R=\frac{\left(4\pi\varepsilon_0\right)^2 me^4}{2\hbar^2}=13.6eV$ is the energy Rydberg constant

For Be 3+ in n=1 level

$$E_n\left(Be_{2+}\right)=\frac{R_E Z}{n^2}=\frac{R_E\cdot 3}{1^2}=3R_E \tag{2}$$

So, $E_n\left(Be_{2+}\right)/E_n\left(Li_{2+}\right)=1.5$