2. Let the negative charge on the sphere be $-q$. Then the potential energy between the sphere and either of the protons is

$$U_{\mathrm{e}} = -\frac{1}{4\pi\varepsilon_0}\frac{qe}{R_{\mathrm{eq}}/2}$$

The total energy of the system includes the repulsion of the protons and the attraction of the negative sphere for each of the protons:

$$E = U_{\mathrm{p}} + 2U_{\mathrm{e}} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{R_{\mathrm{eq}}} - 2\frac{1}{4\pi\varepsilon_0}\frac{qe}{R_{\mathrm{eq}}/2} = \frac{1}{4\pi\varepsilon_0}\frac{e}{R_{\mathrm{eq}}}(e-4q)$$

Inserting the value of R_{eq} = 0.106 nm and $E = -B = -2.7$ eV, we can solve to find

$$q = 0.30e$$

This quantity of charge is roughly consistent with the fraction of ψ^2 that appears between the two protons in Figure 9.3*a*.