finally the α-particle touches the surface of the nucleus and stops there momentarily $\Rightarrow K_f = 0$

$\Rightarrow \quad K_i = U_f$

The α-particle has a charge $2e$ and the nucleus has a charge Ze.

$$K_\alpha = \frac{k(Ze)(2e)}{r}$$

$$\Rightarrow r = \frac{k(Ze)(2e)}{K} = \frac{9\times10^{9}\times 29\times 2\times(1.6\times10^{-19})^2}{13.9\times1.6\times10^{-19}\times1\times10^{6}}$$

$$\boxed{r = 6.0\times10^{-15}\text{ m}}$$

Pb# 14

a) For hydrogen atom $r_n = a_0 n^2 \quad n = 1, 2, 3, 4, \ldots$

$a_0 = 0.0529$ nm (Bohr radius)

First orbit $r_1 = a_0 = \boxed{0.0529\text{ nm}}$

2nd orbit $r_2 = 4a_0 = \boxed{0.2116\text{ nm}}$

3rd orbit $r_3 = 9a_0 = \boxed{0.4761\text{ nm}}$

b) $$\frac{ke^2}{2r} = \frac{1}{2}m_e v^2 \Rightarrow v_n = \sqrt{\frac{ke^2}{m_e r_n}} = \frac{1}{n}\sqrt{\frac{ke^2}{m_e a_0}} \quad n = 1, 2, \ldots$$

First orbit $v_1 = \sqrt{\dfrac{ke^2}{m_e a_0}} = \boxed{2.19\times10^{6}\text{ m/s}}$

2nd orbit $v_2 = \dfrac{v_1}{n} = \dfrac{v_1}{2} = \boxed{1.09\times10^{6}\text{ m/s}}$

3rd orbit $v_3 = \dfrac{v_1}{3} = \boxed{0.73\times10^{6}\text{ m/s}}$