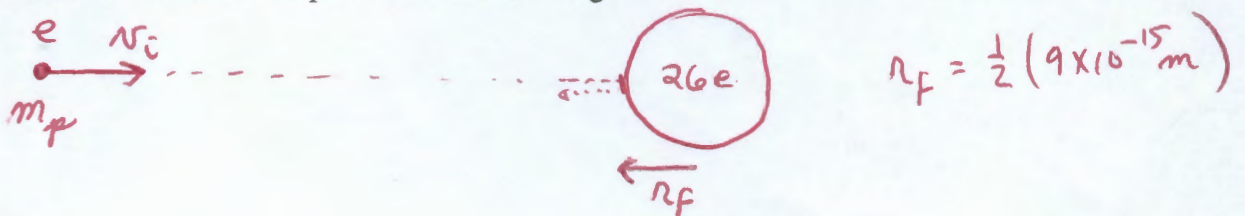


5. (20 pts.) A proton is fired from far away toward the nucleus of an iron atom. Iron is element number 26, and the diameter of the nucleus is  $9.0 \times 10^{-15}$  m. What initial speed does the proton need to have to just reach the surface of the nucleus? Assume the nucleus remains at rest. The mass of the proton is  $1.67 \times 10^{-27}$  kg.

Name: SOLUTIONS

If any question is unclear, *please* ask immediately. Be sure to show your work **clearly** and **draw a box around your answer**. Partial credit may be given for work *if* it can be understood.

1. (20 pts.) A proton is fired from far away toward the nucleus of an iron atom. Iron is element number 26, and the diameter of the nucleus is  $9.0 \times 10^{-15}$  m. What initial speed does the proton need to have to just reach the surface of the nucleus? Assume the nucleus remains at rest. The mass of the proton is  $1.67 \times 10^{-27}$  kg.



Energy Conservation

$$K_i + U_i = K_f + U_f$$

$$\frac{1}{2} m_p v_i^2 + 0 = 0 + \frac{1}{4\pi\epsilon_0} \frac{(e)(26e)}{r_f}, \quad r_f = 4.5 \times 10^{-15} \text{ m}$$

$$v_i = \sqrt{\frac{2}{m_p} \frac{26e^2}{4\pi\epsilon_0 r_f}} = \boxed{4.00 \times 10^7 \text{ m/s}}$$

[This is very similar to problem 29.56]