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 9.0×10^{-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 1.67×10^{-27} kg.

Physics 132-01 (8 am)
October 21, 2005
Test 2

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 9.0×10^{-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 1.67×10^{-27} kg.

$r_f = \frac{1}{2}(9\times10^{-15}\text{ m})$

Energy Conservation

$K_i + U_i = K_f + U_f$

$\frac{1}{2}m_p v_i^2 + 0 = 0 + \frac{1}{4\pi\epsilon_0}\frac{(e)(26e)}{r_f}$, $r_f = 4.5\times10^{-15}$ m

$$v_i = \sqrt{\frac{2}{m_p}\frac{26e^2}{4\pi\epsilon_0 r_f}} = \boxed{4.00\times10^7 \text{ m/s}}$$

[This is very similar to problem 29.56]