Answer on Question #65292, Physics Electric Circuits

An alpha particle (mass of 6.64 × 10−27 kg, charge of +2e - or twice the fundamental unit of charge) is shot with an initial velocity of 2.00×107 m/s directly at a gold nucleus (charge of +79e, and assumed to remain stationary so you will not need its mass). If you assume that the alpha particle was initially very far from the gold nucleus, there is no potential energy associated with the alpha particle - gold nucleus system. If the alpha particle is fired directly at the gold nucleus, it will get close to the gold nucleus before being repelled. How close to the gold nucleus will the alpha particle get (note that at its closest, the alpha particle will have v = 0 m/s)?

Solution:

Data:

$m = 6.64 * 10^{-27}, q = 2e = 3.2 * 10^{-19}C$

$v_0 = 2 * 10^7 \frac{m}{s}$; $v_{final} = 0$

$Q = 79e = 126.4 * 10^{-19}C$

According to the law of conversation of energy: $E_0 = E_{final}$;

$$E_0 = E_{kin} = \frac{m * v_0{}^2}{2};\ E_{final} = E_{pot,electrical} = \frac{kqQ}{r_{min}{}^2};$$

$$\frac{m*v_0{}^2}{2} = \frac{kqQ}{r_{min}{}^2};\ \Rightarrow r_{min} = \frac{1}{v_0}\sqrt{\frac{2kqQ}{m}} = \frac{1}{2*10^7}\sqrt{\frac{2*9*10^9*3.2*10^{-19}*126.4*10^{-19}}{6.64*10^{-27}}} = 16.56 * 10^{-8}m = 165.6\ nm$$

Answer: $165.6\ nm$