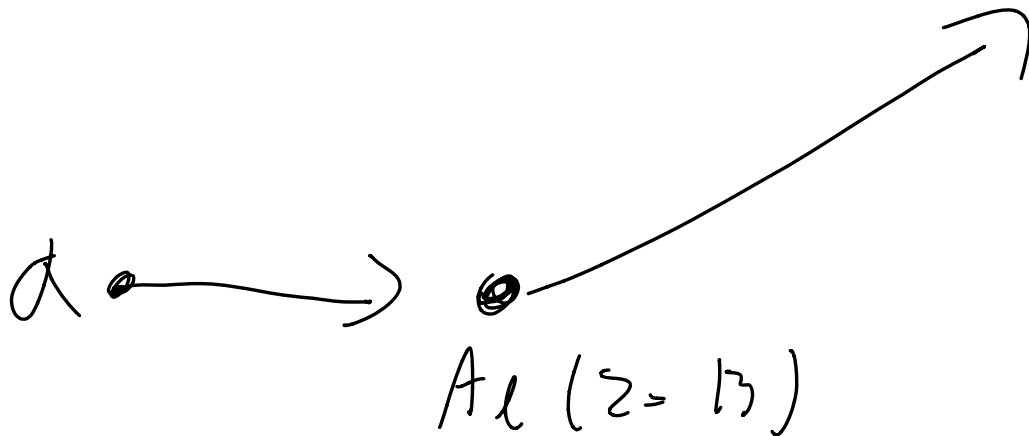


## Section B: Modern Physics

- 6) The Rutherford scattering cross-section formula for charged particles makes two basic assumptions: 1) the interaction is mediated by long-range Coulomb forces and 2) the particles are point particles. Departure from the point-particle form is an indicator of nuclear structure for low energy projectiles that do not have sufficient energy to penetrate the Coulomb barrier. Consider an alpha particle that collides head-on with an Aluminum ( $Z = 13$ ) target and thus scatters at large angle. With this information estimate the radius of the Aluminum nucleus for an alpha particle with a  $KE = 7.7 \text{ MeV}$  initially very far away from the target.



Estimate  $r_{Al}$  given  $KE_{\alpha} = 7.7 \text{ MeV}$

$$PE = k \frac{(2e)(13e)}{r_A} = KE$$

$$r_A = \frac{26 ke^2}{KE}$$

$$r_A = \frac{26 (14.4 \cancel{\text{eV}} \text{\AA}^2) \cancel{\text{e}^2}}{7.7 \times 10^4 \cancel{\text{eV}}}$$

$$= \frac{26(14.4)}{7.7} \times 10^{-6} \text{\AA}$$

$$= 48.62 \times 10^{-6} \text{\AA}$$

$$= 4.86 \times 10^{-5} (\times 10^{-10} \text{m})$$

$$= 4.86 \times 10^{-15} \text{m}$$

$$= 4.86 \text{ fm}$$