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Midterm #2 Preparation

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Problem P5 – Scattering in a Regularized Coulomb Potential

[Goldstein 3.35] One way to regularize the diverging Rutherford cross section is to inmpose a cutoff on the repulsive Coulomb potential. To this end, we can define

$$V(r) = \begin{cases} \frac{\kappa}{r} - \frac{\kappa}{a} & \text{for} \quad r \leq a\,, \\ 0 & \text{for} \quad r > a\,, \end{cases} \qquad \kappa > 0\,. \tag{1}$$

Obtain closed-form expressions for the scattering angle θ and the differential cross section. What is the total cross section for the regularized potential?

Hint: The scattering angle and differential cross section are conveniently expressed in terms of a parameter that measures the distance of closest approach in terms of a.