

2. Scattering from a spherical potential:

- (a) Calculate the differential cross-section, $d\sigma/d\Omega$, for a particle of mass m scattering from a spherical potential $V(r) = V_0 e^{-(r/a)^2}$ using the first-order Born approximation. You may need the integral

$$\int_0^\infty \sin r e^{-(r/b)^2} r dr = \frac{\sqrt{\pi}}{4} b^3 e^{-b^2/4}.$$

- (b) Calculate the total cross-section. It may be helpful to use the representation $|\vec{k} - \vec{k}'| = 2|\vec{k}| \sin(\theta/2)$, where θ is the angle between \vec{k} and \vec{k}' .
- (c) What are the conditions on V_0 , a and/or k for the first-order Born approximation to be valid?