

3. Elastic Scattering

Problems

3.1. Find expressions for the intensities $I(\mathbf{r}) = |\psi(\mathbf{r})|^2$ of the wave functions below.

(\mathbf{k} , \mathbf{K} , and \mathbf{r} are real):

a) $\psi(\mathbf{r}) = Ae^{2\pi i \mathbf{k} \cdot \mathbf{r} + i\phi}$, (A , ϕ real)

b) $\psi(\mathbf{r}) = i \cdot \cos(\theta) \cdot \frac{e^{2\pi i k r}}{r}$, [θ is real]

c) $\psi(\mathbf{r}) = e^{2\pi i \mathbf{k} \cdot \mathbf{r}} e^{-\mathbf{K} \cdot \mathbf{r}/2}$

d) $\psi(\mathbf{r}) = \frac{2}{5} \cdot e^{2\pi i \mathbf{k} \cdot \mathbf{r}} + i \cdot \frac{\sqrt{21}}{5} \cdot e^{-2\pi i \mathbf{k} \cdot \mathbf{r}}$

3.2. The following problems involve cross sections for some object at scattering angle θ ($0 \leq \theta \leq \pi$):

a) Given $d\sigma/d\Omega = A \cdot \cos^4 \theta$, find an expression for $\sigma_{\leq}(\theta)$.

b) Given $\sigma_{\leq}(\theta) = \sigma_{tot} \cdot [1 - \cos(\theta/2)]$, find an expression for $d\sigma/d\Omega$.
