University of Hyderabad

School of Physics

Jul 2010 - Dec 2010 | Time : 1hr
M.Sc. III-Semester | Quantum Mechanics-II | MM : 20

Session V:Tutorial Born Approximation

[1] Calculate the differential cross section in Born approximation for scattering of particle of mass μ from a δ function potential given by

$$V(\vec{r}) = g\delta^3(\vec{r})$$

[2] A nucleon is scattered from a heavy nucleus. The effect of the nucleus can be represented by a square well potential

$$V(r) = \begin{cases} -V_0 & r < R \\ 0 & r > R \end{cases}$$

Compute the differential cross section in teh Born approximation.

[3] Classically the total cross section for scattering from a hard sphere of radius R is πR^2. What happens if you try to compute the quantum mechanical cross section using Born approximation? Discuss and give your comments.

[4] Compute the differential cross section in first Born approximation for the gaussian potential

$$V(r) = -V_0 \exp(-r^2/a^2)$$

and show that the total cross section is given by

$$\sigma_t = V_0^2 \left(\pi^2 \mu^2 a^4 / 2\hbar^4 k^2 \right) \left(1 - \exp(-2a^2 k^2) \right)$$

Verify that the total cross section has correct dimension of area

Date : Aug 16,2010