

**Homework Assignment #6**  
(40 points)**Due Friday, May 7**  
(at 5:00 pm)

6.1 (10 points) Consider scattering from a localized central potential  $V(r)$ . *Derive* a condition for the validity of the Born approximation. Explain clearly the steps in your derivation, and discuss the physical meaning of your condition. (Hint: Derive an approximate expression for the scattered wave within the scattering region—in particular, at  $\mathbf{r} = 0$ —and then require that the scattered wave be small relative to the unscattered wave.)

6.2 (10 points) Consider scattering from a spherical square well of depth  $V_0$  and radius  $r_0$ , i.e.,

$$V(r) = \begin{cases} -V_0, & r < r_0, \\ 0, & r > r_0. \end{cases}$$

*Find* the differential and total cross sections in the Born approximation. Discuss the low- and high-energy limits of your expression for the total cross section.

6.3 (10 points) *Obtain* the differential and total cross sections in the Born approximation for scattering from the potential

$$V(r) = V_0 e^{-\alpha r}.$$

6.4 (10 points) Challenge problem.