# PROBLEM SET 3

Physics 215C- Quantum Mechanics, SPRING 2008

(Due Wednesday, April 30.)

1. (Shankar Exercise 19.3.2) Show that if $V(r) = -V_0\,\theta(r_0 - r)$,

$$\frac{d\sigma}{d\Omega} = 4r_0^2\,(\frac{\mu V_0 r_0^2}{\hbar^2})^2\;\frac{(\sin qr_0 - qr_0\cos qr_0)^2}{(qr_0)^6}.$$

   Show that as $kr_0 \to \infty$ the scattering becomes isotropic and,

$$\sigma \approx \frac{16\pi r_0^2}{9}\;(\frac{\mu V_0 r_0^2}{\hbar^2})^2.$$

   (Here and in problem 2, recall that for elastic scattering the magnitude of the incoming and outgoing momenta $k$ is related to the magnitude of the momentum exchanged $q$ by $q^2 = 2k^2(1-\cos\theta)$.

2. (Shankar 19.3.3) Show that for the *Gaussian potential*, $V(r) = V_0\,e^{-r^2/r_0^2}$,

$$\frac{d\sigma}{d\Omega} = \frac{\pi r_0^2}{4}\,(\frac{\mu V_0 r_0^2}{\hbar^2})^2\,e^{-q^2r^2/2}$$
$$\sigma = \frac{\pi^2}{2k^2}\,(\frac{\mu V_0 r_0^2}{\hbar^2})^2\,(1-e^{-2k^2r_0^2}).$$

   Hint: Since $q^2 = 2k^2(1-\cos\theta)$, we have $d(\cos\theta = -d(q^2)/2k^2.)$