Problem # 1

Find the differential cross section in the first Born approximation for the elastic scattering of a particle of mass $m$, which is initially traveling along the $z$-axis from a non-spherical double delta potential $V(\vec{r}) = V_0 \delta(\vec{r} - a\vec{k}) + V_0 \delta(\vec{r} + a\vec{k})$, where $\vec{k}$ is the unit vector along the $z$-axis.

Problem 2.

Consider the scattering of particle of mass $m$ from a hard sphere potential: $V(r) = \infty$ for $r < a$ and $V(r) = 0$ for $r > a$.

a) Calculate the total cross section in the low energy limit. Find a numerical estimate for the cross section in the case of scattering 5 keV protons from a hard sphere of radius $a = 6$ fm.

b) Calculate the total cross section in the high-energy limit; find a numerical estimate for the cross section for the case of 700 MeV protons with $a = 6$ fm.