1. **Well**. Consider a spherically symmetric flat potential well,

\[ V(r) = \begin{cases} -V_0 & r \leq r_0 \\ 0 & r > r_0 \end{cases} \]

where \( V_0 \) and \( r_0 \) are positive real constants.

(a) Find the differential scattering cross section for this potential in Born approximation and in the limit of low energy, \( E = \frac{\hbar^2 k^2}{2m} \), such that \( kr_0 \ll 1 \).

(b) Find the \( s \)-wave phase shift \( \delta_0 \) produced by this potential. To simplify the calculation, consider the low energy limit, and assume the scattering potential is weak, so that

\[
(mV_0)^{1/2}r_0 \ll \hbar. \tag{1}
\]

The first step is to find the solution to the one-dimensional Schrödinger equation for the \( s \)-wave radial wave function at \( r < r_0 \) with the right boundary condition at \( r = 0 \). The matching condition at \( r = r_0 \) gives an equation for the phase shift, \( \delta_0 \).

(c) Find the low energy scattering cross section from the phase shift found in part b). The result should agree with what you found in part a)!

2. Griffiths Problem 11-8.