1. Apply Bohr-Sommerfeld quantization condition (BSQC) to obtain:
   (i) Bohr’s postulate, (ii) energy levels of a particle in an infinite 1-dimensional well,  
   (iii) energy levels of a simple harmonic oscillator.

2. Obtain the differential cross section $\sigma(\theta)$ using Born approximation, for the shielded 
   Coulomb potential of the form, 
   $$V(r) = -\alpha \frac{e^{-r/a}}{r},$$
   where $\alpha$ and $a$ are constants ($a$ is related to the range of the potential).

3. Obtain the $s$-wave phase shift and hence the total scattering cross section for very 
   low energy ($E$) scattering (small $E$ implies $ka \ll 1$ where $k = \sqrt{2mE/\hbar}$) using the 
   method of phase shifts for the following potential. 
   $$V(r) = \begin{cases} 
   -V_0 & \text{for } r \leq a \\
   0 & \text{for } r > a 
   \end{cases}$$
   where $a$ is some range of the potential.

4. Calculate the total cross section in the low energy limit using the method of partial 
   waves for a hard sphere potential of the form, 
   $$V(r) = \begin{cases} 
   \infty & \text{for } r \leq a \\
   0 & \text{for } r > a 
   \end{cases}$$
   where $a$ is some range of the potential. Explain clearly why does one need to consider 
   a few number of partial waves for low incident energies.

5. For a potential profile $V(x)$ as shown below ($E$ being the energy of the particle),
   ![Potential Profile](image)
   (i) Write down the wavefunctions in all the 3 regions.
   (ii) Hence find the transmission coefficient.