1. Problem 3-11 Wong’s text book
2. Calculate the s-wave phase shift of a slow neutron scattered by an attractive spherical potential of depth \( V_0 \) and width \( W \). Obtain the scattering length “a” and the effective range in terms of \( V_0 \) and the width \( W \).

3. Show that the amplitude for a low energy nucleon-nucleon elastic scattering process is:

\[
f(\theta) = \frac{1}{k} \sum_{l=0}^{\infty} (2l + 1) e^{il\delta} \sin \delta_l P_l(\cos \theta)
\]

4. Using the Fermi gas model, which assumes that the nucleus is a sphere \( R = R_0 A^{1/3}, \ R_0 = 1.2 \text{fm} \) and solving the Schrödinger equation one gets that the number of states up to a momentum \( P \) is

\[
\frac{4\pi P^3 V}{3(2\pi \hbar)^3}
\]

a) What is the energy \( E_F \) of the Fermi level for a nucleus with equal number of protons and neutrons
b) What is the total kinetic energy of \(^{16}\text{O} \) (Z=8)?

Hint: the average kinetic energy:

\[
\langle E \rangle = \frac{\int_0^P E p^2 dp \int_0^\pi \sin \theta d\theta \int_0^{2\pi} d\phi}{\int_0^P p^2 dp \int_0^\pi \sin \theta d\theta \int_0^{2\pi} d\phi}
\]