1. /6/ Merzbacher, Exercise 7.5, p. 125.

2. A particle is moving in the potential field

\[ U(x) = U_0 \frac{|x|^q}{a^q}, \quad U_0 > 0, \quad q > 0. \]  

   a. /8/ Using the semiclassical approximation find the energy spectrum, the spacing between the nearest levels \( s = E_{n+1} - E_n \) in the region of validity of the approximation and the level density \( \rho(E) \) as a function of the parameter \( q \). Does the spacing \( s \) increase or decrease with the increase of \( n \)?

   b. /8/ For a semiclassical wave function \( \psi_n(x) \) calculate expectation values of potential energy, \( \langle n|U|n \rangle \), and kinetic energy, \( \langle n|K|n \rangle \), and check the virial theorem /Merzbacher, eq. (3.89)/.

3. /8/ Find in the semiclassical approximation the transmission coefficient through the “semicircular” barrier \( (U_0 > 0) \)

\[ U(x) = \begin{cases} U_0 \left(1 - \frac{x^2}{a^2}\right), & |x| < a, \\ 0, & |x| > a. \end{cases} \]  

Discuss the criteria of validity of the result.