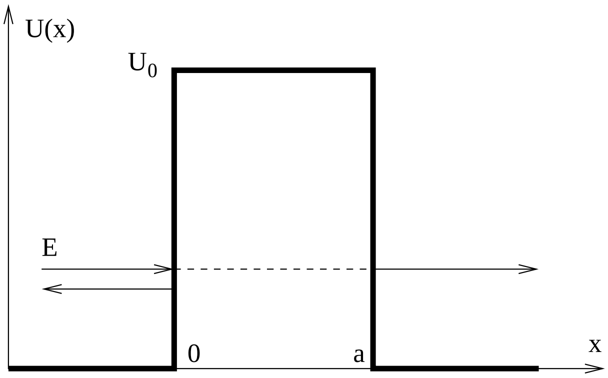
Problem Set 3.

Quasiclassical tunneling.

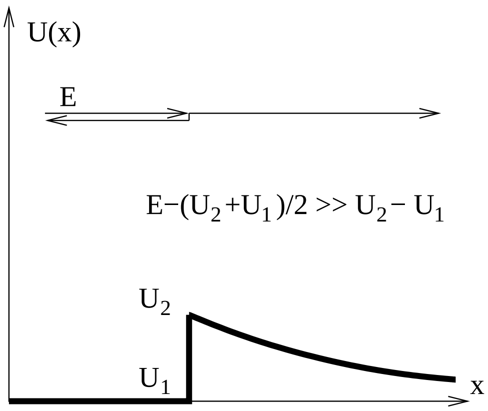
Problem 3.1

For the rectangular potential barrier (Fig. 1), find the tunneling coefficient in the quasiclassical approximation (including the pre-exponential factor). What are the conditions of applicability of the quasiclassical approximation?



Problem 3.2

Consider a fast one-dimensional particle scattering on a barrier with a discontinuity at point $x = 0$ (Fig. 2). In the quasiclassial approximation (what are the conditions of its applicability?), find the reflection and transmission coefficients.



Problem 3.3

Consider a particle of mass m moving in the one-dimensional sinusoidal potential $U(x) = U_0 \cos(2\pi x/a)$. When U_0 is big (compared to what?), the tunneling through the potential maxima may be described in the quasiclassical approximation. In this limit, find the width of the lowest energy band (including the pre-exponential factor).