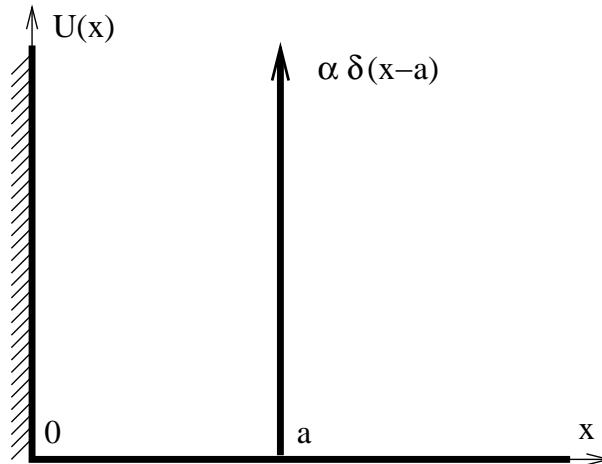


**Problem Set 4.**

Quasistationary states. Perturbation theory for scattering.

**Problem 4.1**

Consider a one-dimensional particle on half-line  $x > 0$  constrained by a  $\delta$ -potential  $U = \alpha\delta(x - a)$  (Fig. 1). (The boundary condition at  $x=0$  correspond to the infinitely high potential wall  $\Psi(x = 0) = 0$ .) Find the quasistationary levels (their energies and widths) assuming that the tunneling through the potential is weak ( $m\alpha a/\hbar^2 \gg 1$ ). Relate the level widths to the transmission coefficient of the barrier (see Problem 0.1).

**Problem 4.2**

To the first order in the perturbation theory, find the reflection coefficient of a short-ranged potential barrier  $U(x)$ . Apply the result to the scattering of fast particles on a (a)  $\delta$ -potential  $U(x) = \alpha\delta(x)$ ; (b) potential with a discontinuity at  $x = 0$  (as in Problem 3.2). Compare the results to those of Problems 0.1 and 3.2.