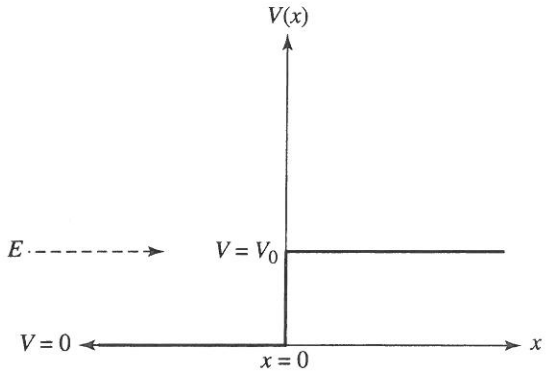
NOEN OPPGAVETEKSTER KAP. 4

4.2 Show that the general expression for the wave function for a free particle, given by Equation (4.8) as $\Psi(x, t) = C_1 e^{i(kx-\omega t)} + C_2 e^{i(-kx-\omega t)}$, is not an eigenfunction of momentum unless $C_1 = 0$ or $C_2 = 0$.

4.4 A particle with mass m and energy E is moving in one dimension from *left to right*. It is incident on the step potential $V(x) = 0$ for $x < 0$ and $V(x) = V_0$ for $x \geq 0$, where $V_0 > 0$, as shown on the diagram. The energy of the particle is exactly equal to V_0, i.e., $E = V_0$.



(a) Solve the Schrödinger equation to derive the wave function for $x < 0$ and $x \geq 0$. Express the solution in terms of a single unknown constant.

(b) Calculate the value of the reflection coefficient R for the particle.

4.6 An electron is accelerated through a potential difference of 3 eV and is incident on a finite potential barrier of height 5 eV and thickness 5×10^{-10} m. What is the probability that the electron will tunnel through the barrier?

4.8 A baseball (see Example 4.2) is confined between two thick walls a distance 0.5 m apart. Calculate the zero-point energy of the baseball.

4.9 A particle is trapped inside an infinite one-dimensional square well of width a in the first excited state ($n = 2$).

(a) You make a measurement to locate the particle. At what positions are you most likely to find the particle? At what positions are you least likely to find it?

(b) Calculate $\langle p^2 \rangle$ for this particle.