Q. The (1+1)－D Dirac Hamiltonian in the presence of a potential V(x) can be written

$$H_D = -i\alpha_x \frac{\partial}{\partial x} + \beta m + V(x),$$

where $\alpha_x = \sigma_1$ ***and*** $\beta = \sigma_3$ ***($\sigma's$ denote 2×2 Pauli matrices).***

Suppose that the potential V(x) is given by

$$V(x) = \begin{cases} 0, & x<0 \\ V_0(>0), & 0<x<a \\ 0, & x>a \end{cases}$$

i.e., we have a square barrier.

(i) When the particle is incident from the left with energy E(>m), find the reflection and transmission coefficients.

(ii) If the potential is weak, i.e., $V_0 \ll m$ ***, does your finding reproduce the result of nonrelativistic scattering (based on the Hamiltonian*** $H = -\frac{1}{2m}\frac{\partial^2}{\partial x^2}$ ***) ?***

(iii) Discuss the result in the opposite limit $V_0 \to \infty$ ***. In this case, can you provide a sensible interpretation on your finding ?***