PHYS 532 SPRING 2023 HWA#2

(You may use the mathematica notebook I sent you).

Consider the free particle solutions of the Dirac equation in the standard representation of γ matrices (either Ryder or Björken–Drell will do but beware I use below $u^{(1)}(\vec{p}), u^{(2)}(\vec{p})$ for $E=\sqrt{p^2c^2+m^2c^4}$ solutions and $v^{(1)}(\vec{p})$, $v^{(2)}(\vec{p})$ for $E=-\sqrt{p^2c^2+m^2c^4}$ solutions.

Confine the solutions to 1D for this assignment $\vec{p}=p\hat{z}$

{also I meant $u^{(1)}(p)$ to represent the solution with $e^{-ip^\mu x_\mu/\hbar}$ included...}

1) Consider $\psi=u^{(1)}(p)$ and calculate $\bar{\psi}\gamma^\mu\psi$. Repeat for $\psi=v^{(1)}(p)$

Repeat for $\psi=\alpha u^{(1)}(p)+\beta v^{(1)}(p)$

2) Consider $\psi=u^{(1)}(p)+u^{(1)}(-p)$ and calculate $\bar{\psi}\gamma^\mu\psi$. {Also $\bar{\psi}\psi$}

3) Can there be a general solution ψ {any linear combination} such that $\psi(0)=0$ & $\psi(L)=0$ {a particle in a 1D box}?

Can there be a solution that include only u type solutions?