Phys 451  Homework Set 5  one week

#1- An particle of mass $m$ is in the ground state $|\psi_1\rangle$ of an infinite square well of width $a$. The well suddenly expands to width $2a$. Find the probability that the particle will transition to the ground state $|\phi_1\rangle$ of the new system. In which state $n$ do we have the maximum chance of finding the particle after expansion?

![Diagram 1](image1)

#2- Given that the harmonic oscillator ground state wave function is given by

$$\psi_o(y) = \frac{1}{\sqrt{\pi a^2}} e^{-\frac{y^2}{2a^2}}$$

Use the raising operator $a^*$ to find $\psi_1(y)$

#3- A stream of particles of mass $m$ and energy $E$ move in the $+x$ direction from $-\infty$ into a step barrier at $x=0$ of height $V_o$ with $(E>V_o)$. (a) Find the reflection and transmission coefficients $R$ and $T$ for the particle. (b) Determine the transmission current $J_T$ of particle moving beyond $x>0$.

![Diagram 2](image2)

#4- Alpha particles of energy $E=5MeV$ and mass $4MeV/c^2$ are trapped in a nucleus which we model as a simple square well of height $10MeV$. The radius of the well is $r=8fm$. The alpha particles are trapped by a $1fm$ barrier. Find the tunneling probability through the barrier for the alpha particles using the WKB approximation. What is half-life of the nucleus with respect to alpha decay? ($1fm = 1.0e-15m$)

![Diagram 3](image3)