Notes: *$c=3x10^8 m/s$ = 1 lightyear/year, 1 nanometer= $10^{-9}$ meters,*
*$h=6.626x10^{-34}$ J*s = $4.136x10^{-15}$ eV*s, $m_e c^2=0.511$ MeV,* $1eV=1.602x10^{-19}$ J,
*e* $=1.602x10^{-19}$ C, hc=1240 eV*nm, 1u=931.49 MeV, ħ=$1.055x10^{-34}$ J*s= h/(2π),
$g=9.8 m/s^2$, $R=1.0974x10^7 m^{-1}$

*There are 10 points in total and 2 questions.*
*Remember to write your quiz code # and your name on the front of your blue book, student ID number is not needed.*

----------------*Please write clearly. Show your work for all problems.*-----------------------

1. An electron is confined in an infinite potential well of length L. The electron's wavefunction in this situation is

$$\psi_n(x) = \sqrt{\frac{2}{L}}\sin\left(\frac{\pi n}{L}x\right)$$
$$n = 1, 2, 3, \ldots$$

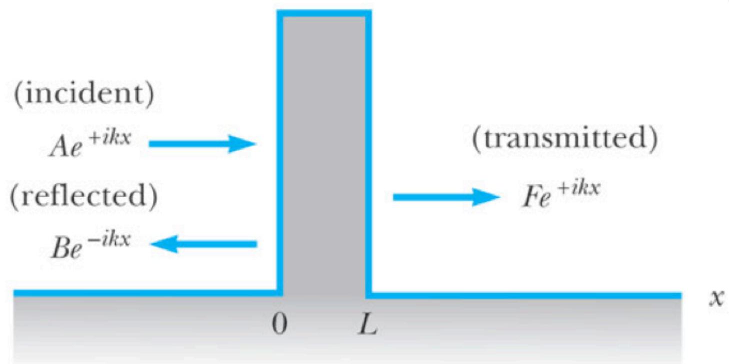
If the electron is in the second excited state (n=3), what is

a. (3pts) the probability for the electron to be between x=L/3 and x=2L/3 ?
Hint: $2\sin^2(\theta)=1-\cos(2\theta)$

b. (3pts) the expectation value of the electron's kinetic energy in terms of $m_e$, ħ, and L?

Hint: the kinetic energy operator is $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$

2. A free particle with energy E is incident upon a potential barrier of height U and width L, where E<U. Within the barrier, the general form of the wave function that solves Schrödinger's equation can be written as $\psi_{II}=Ce^{\alpha x}+De^{-\alpha x}$.




a. (2 pts) Use the general form of the wavefunction within the barrier to solve for α with Schrödinger's time independent equation in terms of E, U, m, and ħ.
b. (2pts) Solve for the two continuity conditions at the x=0 boundary in terms of A, B, C, D, F, k, and α.