NAME: _____	Quiz #10a: Phys270

1. [10 pts] Consider a particle in a rigid box of length L in the n=3 state. The rigid box has walls whose potential energy is infinitely high at x<=0 and x>=L, and a potential energy that is zero in between.
    a. [7 pts] Sketch a graph of $|\psi(x)|^2$. Label the points x=0 and x=L.

    b. [3 pts] Where, in terms of L, are the positions at which the particle is most likely to be found?

Useful Data

M_e	Mass of the earth	5.98×10^{24} kg	
R_e	Radius of the earth	6.37×10^{6} m	
g	Free-fall acceleration on earth	9.80 m/s^2	
G	Gravitational constant	6.67×10^{-11} N m^2/kg^2	
k_B	Boltzmann's constant	1.38×10^{-23} J/K	
R	Gas constant	8.31 J/mol K	
N_A	Avogadro's number	6.02×10^{23} particles/mol	
T_0	Absolute zero	−273°C	
σ	Stefan-Boltzmann constant	5.67×10^{-8} W/m^2 K^4	
p_{atm}	Standard atmosphere	101,300 Pa	
v_{sound}	Speed of sound in air at 20°C	343 m/s	
m_p	Mass of the proton (and the neutron)	1.67×10^{-27} kg	
m_e	Mass of the electron	9.11×10^{-31} kg	
K	Coulomb's law constant ($1/4\pi\epsilon_0$)	8.99×10^{9} N m^2/C^2	
ϵ_0	Permittivity constant	8.85×10^{-12} C^2/N m^2	
μ_0	Permeability constant	1.26×10^{-6} Tm/A	
e	Fundamental unit of charge	1.60×10^{-19} C	
c	Speed of light in vacuum	3.00×10^{8} m/s	
h	Planck's constant	6.63×10^{-34} J s	4.14×10^{-15} eV s
$\hbar$	Planck's constant	1.05×10^{-34} J s	6.58×10^{-16} eV s
a_B	Bohr radius	5.29×10^{-11} m	

Common Prefixes

Prefix	Meaning
femto-	10^{-15}
pico-	10^{-12}
nano-	10^{-9}
micro-	10^{-6}
milli-	10^{-3}
centi-	10^{-2}
kilo-	10^{3}
mega-	10^{6}
giga-	10^{9}
terra-	10^{12}

Conversion Factors

Length
1 in = 2.54 cm
1 mi = 1.609 km
1 m = 39.37 in
1 km = 0.621 mi

Velocity
1 mph = 0.447 m/s
1 m/s = 2.24 mph = 3.28 ft/s

Mass and energy
1 u = 1.661×10^{-27} kg
1 cal = 4.19 J
1 eV = 1.60×10^{-19} J

Time
1 day = 86,400 s
1 year = 3.16×10^{7} s

Pressure
1 atm = 101.3 kPa = 760 mm of Hg
1 atm = 14.7 lb/in^2

Rotation
1 rad = $180°/\pi = 57.3°$
1 rev = $360° = 2\pi$ rad
1 rev/s = 60 rpm

Cos(60°) = 1/2 Sin(60°) = $\sqrt{3}/2$ Tan(60°)= $\sqrt{3}$	Cos(30°) = $\sqrt{3}/2$ Sin(30°) =1/2 Tan(30°)=1/$\sqrt{3}$	Cos(45°) = $\sqrt{2}/2$ Sin(45°) = $\sqrt{2}/2$ Tan(45°)=1

NAME: _____	Quiz #10b: Phys270

1. [10 pts] Suppose that $\psi_1(x)$ and $\psi_2(x)$ are both solutions to the time-independent Schrodinger equation for the same potential energy U(x). Prove that the superposition $\psi(x) = A\,\psi_1(x) + B\,\psi_2(x)$ is also a solution to the time-independent Schrodinger equation.

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NAME: _____	Quiz #10c: Phys270

1. [10 pts] An electron in a finite potential well has a 1.0 nm penetration distance into the classically forbidden region. How far below U_0 is the electron's total energy?

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NAME: _____	Quiz #10d: Phys270

1. [10 pts] Sketch the n=6 wave function for the potential energy shown below: