PHYS 5382 Introduction to Quantum Mechanics **Practice Test 1**

Time allowed 1 hour 15 min.

Resources allowed:
Griffiths textbook, calculator, formulas from the covers of Griffiths hardback

1. Given the spatial wavefunction $\psi(x) = Ax \exp(-kx)$ $(0 < x < \infty, k > 0)$, $\psi(x) = 0$ $(0 > x)$,

   (a) what value must the constant A take in terms of k in order that ψ is normalized?
   [5 points]

   (b) If $k = 0.5 \times 10^{10}$ m^{-1}, what is the probability of finding the particle described by ψ between $x = 0$ m and $x = 2.0 \times 10^{-10}$ m?
   [5 points]

2. Consider a stationary state having a wave function periodic in time, namely, that there exists a time T for which $\psi(x,t) = \psi(x,t + T)$. Find the allowed values of the energy in terms of T.
   [5 points]

3. Consider a particle of mass m in the one-dimensional infinite square well potential

$$V(x) = +\infty \ \{x < -L \text{ and } x > L\}$$

$$V(x) = 0 \ \{-L < x < L\}$$

   (a) Write down all the normalized stationary state wavefunctions $\psi(x)$ in terms of L and also the corresponding energies (you may either rewrite those already shown in Griffiths, or derive them directly by solving the Schrodinger equation).
   [5 points]

   (b) For the odd wavefunctions, $\psi(x) = -\psi(-x)$, calculate the spatial uncertainty $\Delta x = \sigma_x$ and the momentum uncertainty $\Delta p = \sigma_p$ and then verify that the uncertainty principle is satisfied.
   [10 points]