淡江大學九十二學年度碩士班招生考試試題

系別：物理學系　　科目：近 代 物 理

准帶項目請打「○」否則打「×」
簡單型計算機
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1. A man wishes to travel to the farthest star in our galaxy (about 10^5 light years far from the earth) within his life time (assumed to be 100 years).

   (a) Estimate the required speed (in the unit of light speed c) with respect to the earth. [10%]

   (b) If his rest mass is 60 kg, what is his relativistic mass at this speed? [8%]

2. In a photoelectric experiment, monochromatic light and a sodium photocathode are used. The stopping potential is found to be 1.85 V for $\lambda = 300$nm and 0.82 V for $\lambda = 400$nm. From these data, please (a) determine the Planck's constant [10%], (b) the work function of sodium in electron volts [10%], and (c) the threshold wavelength for sodium [10%]. ($c = 3 \times 10^8$m/sec, 1nm$= 10^{-9}$m, and $e = 1.6 \times 10^{-19}$C.)

3. Consider the one-dimensional motion of a particle experiencing the potential $V(x)$.

   (a) Write down the Schrödinger equation and the time-independent Schrödinger equation for this system. [8%]

   (b) Assume the potential is an infinite square well given by

$$V(x) = \begin{cases} 0 & -\frac{a}{2} < x < \frac{a}{2} \\ \infty & x < -\frac{a}{2} \text{ or } x > \frac{a}{2}. \end{cases}$$

   Find the energy eigenvalues [8%] and the eigenfunctions [12%] of the time-independent Schrödinger equation.

4. One of the eigenfunction in the above problem is given by

$$\Psi(x) = \begin{cases} A\cos\frac{\pi x}{a} & -\frac{a}{2} < x < \frac{a}{2} \\ 0 & x < -\frac{a}{2} \text{ or } x > \frac{a}{2}. \end{cases}$$

   Find the expectation values: $\bar{x}$, $\bar{p}$, $\overline{x^2}$, and $\overline{p^2}$. [4×6%]