**KOÇ UNIVERSITY**
**College of Arts and Sciences**
**Department of Physics**

**Course:** PHYS401 Quantum Mechanics I
**Credits:** 3
**Semester:** Fall 2003
**Instructor:** Professor **Tekin Dereli**

**2. Midterm Exam:** 10 December 2003, 15.30.00-16.45

**Question: 1** Suppose a point particle moving along the x-axis is sent from the left on a potential barrier given by

$$V(x) = \begin{cases} 0 & , \quad x < 0 \\ V_0 & , \quad 0 < x < a \\ 0 & , \quad a < x. \end{cases}$$

Let $E > V_0$.

i. Write down the most general stationary solution of the Schrödinger equation.

ii. State the boundary conditions to be imposed.

iii. Determine the coefficient of reflection.

iv. When does total transmission occur?

**Question: 2** Consider a Dirac delta function potential

$$V(x) = -\alpha\delta(x - x_0).$$

Derive a condition (starting from the Schrödinger's equation) that gives the amount of discontinuity in the gradient of the wave function at the point $x_0$.

**Question: 3** Consider the matrix

$$A = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}.$$

i. Determine the eigenvalues of $A$.

ii. Find the corresponding eigenvectors.

iii. What is the similarity transformation that would diagonalize $A$ ?