University of Kentucky Department of Physics and Astronomy

PHY 520 Introduction to Quantum Mechanics Fall 2004 Test 2

Name: _____

Answer all questions. Write down all work in detail. Time allowed: 50 minutes

1. (50 points)

A Consider two operators A and B in matrix form:

$$A = \begin{pmatrix} 2+2i & -2+2i \\ -2+2i & 2+2i \end{pmatrix} \qquad B = \begin{pmatrix} -2 & -6 \\ -6 & -2 \end{pmatrix}$$

(a) (10 points)Are A and B Hermitian? Which one (can be both or none) is not physical observable?

(b) (10 points) Do A and B commute? Do they share the same set of eigenfunctions?

(c) (10 points) What are the eigenvalues of A and B?



(d) (10 points) Find the *unitary* matrix U_A and U_B so that $U_A^{-1}A U_A$ and $U_B^{-1}B U_B$ are diagonal matrices.

(e)

and U_B are ur. (10 points) Show explicitly that U_A and U_B are unitary. What is the reason that they are unitary?

2. (50 points)

Consider a particle of mass moving under the influence of a delta function potential $V(x) = -\lambda \delta(x)$ with energy E<0.



(b) (20 points)

Solve for the eigenfunction(s) and the corresponding energy eigenvalue(s). How many bound states are there?

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(c) (20 points)

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A wall is now placed at x=-d so that the potential is given by



Solve for the eigenfunction(s) and the corresponding energy eigenvalue(s) for the bound state(s). (To save time, you do not need to normalize the state function). Can you reduce your result to that of part (b) by letting $d \rightarrow \infty$?