Name: _____

PHYS 451: Quantum Mechanics I, Quiz #4

1. Determine if the following operators are hermitian, nonhermitian, or antihermitian (an operator $\hat{O}$ is called antihermitian if $\hat{O}^\dagger = -\hat{O}$):

   (a) Scaling operator: $\hat{S}_\alpha f(x) = \sqrt{\alpha} f(\alpha x) \quad (\alpha > 0)$

   (b) $\hat{x}\hat{p}_x$

   (c) $i(\hat{A}\hat{B} - \hat{B}\hat{A})$, if it is known that $\hat{A}^\dagger = \hat{A}$ and $\hat{B}^\dagger = \hat{B}$

   (d) $\hat{C} - \hat{C}^\dagger$

   (e) $\alpha\hat{x} - \beta\frac{d}{dx} \quad (\alpha, \beta > 0)$

2. Consider a projection operator, $\hat{P}$, whose action on a wave function, $\psi(x)$, is defined as

$$\hat{P}\psi = \gamma\phi,$$

   where $\phi(x)$ is some given state and $\gamma = \langle\phi|\psi\rangle = \int \phi^*(x)\psi(x)dx$.

   (a) Is this operator linear?

   (b) Is it hermitian?