## Physics 412—Practice S–5 (Due Feb. 17, 4 pm) Name:

**S–5:** I can use the Schrödinger equation to find the energy eigenstates and propagator for a quantum system described by a time-independent Hamiltonian.

Unsatisfactory Progressing Acceptable Polished

A quantum system with a three dimensional Hilbert space evolves in time according to the Hamiltonian

$$H \leftrightarrow \hbar\omega \begin{bmatrix} 1 & 0 & 0 \\ 0 & 3 & -4\mathrm{i} \\ 0 & 4\mathrm{i} & 3 \end{bmatrix},$$

where $\omega$ is a positive real number.

**(1)** Find the propagator for this system. Express your answer as a $3 \times 3$ matrix in the same basis used for the Hamiltonian above.

**(2)** Apply your propagator to the state vector shown below in order to find its time evolution.

$$|\psi(0)\rangle \leftrightarrow \frac{1}{2} \begin{bmatrix} \mathrm{i} \\ 1-\mathrm{i} \\ 1 \end{bmatrix}.$$