Physics 460—Practice S–3 (Due Apr 28, 1 pm) Name:

S–3: I can apply and interpret wave functions in three dimensions in Cartesian coordinates.

Unsatisfactory Progressing Acceptable Polished

The normalized energy eigenstates for the particle in a cube are

$$\psi_{n_x,n_y,n_z}(x,y,z) = \sqrt{\frac{8}{L^3}} \sin\frac{n_x \pi x}{L} \sin\frac{n_y \pi y}{L} \sin\frac{n_z \pi z}{L},$$

with energies

$$E_{n_x,n_y,n_z} = \frac{\hbar^2 \pi^2}{2mL^2}\left({n_x}^2 + {n_y}^2 + {n_z}^2\right).$$

(1) A particle is prepared in the state

$$\psi(x,y,z) = A\Big[\psi_{111}(x,y,z) - 2\mathrm{i}\psi_{122}(x,y,z)\Big].$$

(a) Find A and explain why you don't have to evaluate any integrals to do so.

(b) If you measured the energy of the particle, what values could you obtain and with what probabilities?

(c) If you measured the position of the particle, what is the probability that you would find it in the lower corner of the box, in the region $0 \le x, y, z \le L/2$? Your answer should be a number!