Physics 412—Practice S–6 (Due Feb. 24, 4 pm) Name:

S–6: I can use the wave function in position or momentum space to make predictions about measurements for a free particle in one dimension.

Unsatisfactory Progressing Acceptable Polished

(1) A particle is in a quantum state with momentum-space wave function

$$\phi_0(p) = A\mathrm{e}^{-p^2/2\hbar^2a^2}(1 + \mathrm{e}^{-\mathrm{i}px_0/\hbar}).$$

Here p has the range $-\infty < p < \infty$. For this question, I want you to explicitly write out *and simplify* any integrals necessary to answer the questions, but you don't try to evaluate them.

(a) Explain how to find the normalization constant A.

(b) Does the $\mathrm{e}^{-\mathrm{i}px_0/\hbar}$ term affect the probability density for the momentum? If so, how? Explain.

(c) If this is the momentum-space wave function of the particle at time $t = 0$, what is the momentum-space wave function at a later time t?

(d) Explain how you would calculate the probability that the particle will be found in the range $x = [x_1, x_2]$ if its position were measured at time $t = 0$.