QM Fall 02 B

A particle of mass m in a potential $V(x)$ is in a state of definite energy

$$E = -\frac{\hbar^2}{8ma^2}$$

with a wavefunction

$$\begin{aligned} \psi(x) &= \frac{1}{\sqrt{2a^3}}\, x\, e^{-x/2a} \quad (x \geq 0) \\ \psi(x) &= 0 \qquad\qquad\qquad\quad (x < 0) \end{aligned}$$

where a is a constant.

(a) Sketch the wavefunction. Does this wavefunction correspond to the ground state or an excited state of the particle? Explain your reasoning.

(b) Find the potential, $V(x)$, to which this wavefunction corresponds, and sketch it.

(c) Show explicitly that the above wavefunction satisfies Heisenberg's uncertainty principle.