Physics 201, Fall 2008
Final Exam
December 8, 2008 1:30-4:30 pm

Write your name on each page of paper submitted. You must show all work to receive credit, but only turn in work you would like graded. This exam is closed book. **You may use a calculator**, but no other electronic devices. There are four problems. Good luck!

Possibly Useful Relations:

Quantum mechanics:

$$-\frac{\hbar^2}{2m}\nabla^2\psi(\mathbf{x}) + V(\mathbf{x})\psi(\mathbf{x}) = E\,\psi(\mathbf{x})$$

$$i\hbar\frac{\partial\Psi(\mathbf{x},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi(\mathbf{x},t) + V(\mathbf{x})\Psi(\mathbf{x},t)$$

$$E = \hbar\omega, \quad \mathbf{p} = \hbar\mathbf{k}$$

Hydrogen atom:
Wavefunctions $\psi_{nlm}(\mathbf{x})$

$$E_n = -E_R/n^2, \quad \mathbf{L}^2 = \hbar^2\, l(l+1), \quad L_z = \hbar m$$

$$E_R = \frac{m_e(ke^2)^2}{2\hbar^2}$$

1-D particle in a box:

$$E_n = \frac{\hbar^2 n^2\pi^2}{2mL^2}, \quad \psi_n(x) = \sqrt{\frac{2}{L}}\,\sin\frac{n\pi x}{L}$$

Relativity:

$$E^2 = \mathbf{p}^2c^2 + m^2c^4, \quad E = mc^2\,\gamma, \quad \mathbf{p} = m\mathbf{u}\gamma$$

$$\gamma = \frac{1}{\sqrt{1 - \mathbf{u}^2/c^2}}$$

$$\Delta t' = \Delta t/\gamma, \quad l' = l\,\gamma$$