

# Physics 106a/196a – Final Exam – Due Dec 8, 2006

## Instructions

**Material:** All lectures through Nov 28; see syllabus for details. Only Ph196 students are responsible for the following topics:

- virtual work and generalized forces
- derivation of Euler-Lagrange equations via virtual work
- nonholonomic constraints
- Lagrangians for nonconservative forces
- incorporating nonholonomic constraints via Lagrange multipliers
- canonical transformations, generating functions, symplectic notation, Poisson brackets, Hamilton-Jacobi theory
- mathematical structure of coupled oscillations

Ph106a students **are** responsible for action-angle variables and adiabatic invariance, but only the use thereof – not the derivations.

Review the material ahead of time, consult me, the TAs, your fellow students, or other texts if there is material you are having trouble with.

**Logistics:** The exam consists of this page plus 3 pages of exam questions. Do not look at the exam until you are ready to start it. Please use a blue book if possible (makes grading easier), but there will be no penalty if you don't have one. Problems 1 and 2 are for 106 students only, 3, 4, and 5 for 106 and 196 students, and 6 and 7 for 196 students only.

**Time:** 4 hrs, fixed time. You may take as many breaks as you like, but they may add up to no more than 30 minutes (2 x 15 minutes, 3 x 10 minutes, etc.).

**Reference policy:** Hand and Finch, official class lecture notes and errata, problem sets and solutions, your own lecture notes or other notes you have taken to help yourself understand the material. No other textbooks, no web searches, no interaction with your fellow students. Calculators and symbolic manipulation programs are neither needed or allowed.

**Due date:** Friday, Dec 8, 5 pm, my office (311 Downs). 5 pm means 5 pm. Late exams will require extenuating circumstances; otherwise, no credit will be given.

**Grading:** Each problem is 20 points out of 100. The exam is 1/3 of the class grade.

**Suggestions on taking the exam:**

- Go through and figure out roughly how to do each problem first; make sure you've got the physical concept straight before you start writing down formulae.
- Don't fixate on a particular problem. They are not all of equal difficulty. Come back to ones you are having difficulty with.
- Don't get buried in algebra (this really should not be an issue on this exam). Get each problem to the point where you think you will get most of the points, then come back and worry about the algebra.