Paper S7 "Classical Mechanics" 2006

There were 32 scripts, mean 70.9%; SD 17%. The students seemed to have a good understanding of the material, and good problem-solving skills.

Q1 (small oscillations) 25 attempts; mean 17.4, SD 8.9

The mechanics in this question were well handled. The greatest difficulty encountered here was expanding the given, one-dimensional Lagrangian about the point of equilibrium. Even though most students knew that the first-order terms in the Taylor expansion of the Lagrangian had to vanish, few students tried to do this with a straightforward Taylor expansion, but instead fumbled with sin(A+B) formulae, with often poor results.

Q2 (Noether's theorem) 5 attemps (no P&P) mean 14.4, SD 11.2

The mean here is deceptively low because a weak student scored zero on this problem and problem 1; all the other 4 candidates could state & prove the theorem, and 2 produced faultless solutions. One candidate knew that the N-body system conserves momentum and angular momentum by virtue of translational and rotational invariance, but couldn't prove it from Noether's theorem.

Q3 (Hamiltonian system) 23 attempts, mean 19.9, SD 6.3

A few weak candidates had difficulty deriving Hamilton's equations, but most were convincing on this. The only fairly common weakness here was a failure to express H as a function of p rather than $\dot{q}$. The students were good at identifying the invariants.

Q4 (Poisson brackets) 11 attempts, mean 15.45, SD 4.1

On the whole well done. This question was probably a little on the hard side; the highest mark was 23. However, some students made it to the end, including a student who confused a Poisson bracket with a commutator, and hence gave an incorrect proof of $[AB, C] = [A, C]B + A[B, C]$. Fortunately, his subsequent work used only the correct Poisson-bracket algebra and therefore scored high marks.