PHGN 350 Practice Test #2
November 14, 2011

1) You have a pendulum hanging in an elevator that is accelerating *down* with magnitude *a*.
    a. How many degrees of freedom are there if the pendulum string remains taught?
    b. What generalized coordinate(s) lend themself(ves) best to this problem?
    c. Solve for the Lagrangian of this system using your generalized coordinate(s).
    d. Solve for the Hamiltonian for this problem.
    e. Is the Hamiltonian conserved? Why? (No why no credit (and no woman no cry))
    f. Is the Hamiltonian the total energy of the system? Why? (No why no credit)
    g. I just like the letter (g).

2) Assume you have a spherical bead allowed to move and rotate in free space.
    a. How many degrees of freedom does the bead have? A few words explaining them here goes a long way when being graded.
    b. Now say the bead is constrained to roll *without slipping* on a hemispherical surface. How many constraints does that impose on the bead (explain them in words)? How many degrees of freedom does it have now?
    c. Draw a picture of the situation, and write down what you think are the best generalized coordinates to use.

3) A meteor of mass *m* approaches the earth from Infinity (a long time ago in a galaxy far far away). When it is out at infinity, its line of motion is a distance *d* from the earth (perpendicular distance, closest distance, etc.). When it's at infinity, it also has a speed *v*. What is its speed and distance at closest approach to the earth (mass M)? Hint: use conservation of energy and angular momentum. Neglect any interactions with the sun/other planets.

4) If a projectile is fired due east from a point on the surface of Earth at a northern latitude λ, with a velocity of magnitude V_0, at an angle of inclination α, find the lateral deflection of the projectile in terms of the above variables, *g*, and the angular frequency of the earth.