Examination 1 for PHYS 6220/7220, 11th October 2024
First Last First Name

Student Name:

Instructions: 1) This test is worth a total of 21 points which will be scaled to a weight of 20% of the final letter grade. 2) Use more pages as needed for question 10.

1. How is the Rayleigh dissipation function related to the rate of energy loss from the system? [**1 point**]

2. Write an expression for the Lagrangian for a particle moving in an electromagnetic field consisting of an electric field E and magnetic field B. Relate any potentials you may use to these fields. [**2 points**]

3. Define the δ derivative of a functional. [**1 point**]

4. State Hamilton's principle. [**1 point**]

5. Under what conditions is the energy function h a constant? [**1 point**]

6. When can one say that the energy function, h, equals the total energy in a system? [**1 point**]

7. Write down Hamilton's equations for a system of N particles. [**2 points**]

8. When a particular generalized q_i coordinate is cyclic what quantity is preserved? Write an expression for it in terms of the Lagrangian of the system. [**1 point**]

9. The method of Lagrange's un-determined multipliers helps us obtain some physical quantity which would otherwise not be possible to obtain from Euler-Lagrange's equations. What is that physical quantity? [**1 point**]

10. A particle of mass m moves in a potential $V(x, y) = (k(x^2 + y^2))/2$, $k > 0$. It is constrained to move on a sphere, of radius b, centered at the origin.
(1) Choose appropriate generalized coordinates and clearly define them with a figure and in words. [**2 points**]
(2) Write the Lagrangian for the system. [**3 points**]
(3) Note all constants of motion. [**2 point**]
(4) Use the answer in (3): (i) to construct an equation of motion purely involving only one generalized coordinate and (ii) state any other consequences. [**3 points**]