Examination 2 for PHYS 6220/7220, 13th November 2024

First Last

Student Name:

Instructions:

1) **This test is worth a total of 25 points which will be scaled to a weight of 20% of the final letter grade.**

2) **Use more pages as needed for question 11.**

1. How is the time dependence of H related to that of L? [**1 point**]

2. How is [A, B] related to [B, A]? [**1 point**]

3. Write equations for the fundamental Poisson brackets? [**1 point**]

4. If a particle is only under the influence of a central force what vector physical quantity of the particle is conserved? What scalar physical quantity is conserved? [**2 points**]

5. In a central force problem, it is known that at a certain time the radial coordinate r of the particle is at its minimum. What physical quantity is zero at that instance? [**1 point**]

6. Write the differential equation for the orbit of a particle, in a central force field. [**1 point**]

7. Write the integral equation for the orbit of a particle, in a central force field. [**1 point**]

8. For a central potential $V(r) = -k/r$, $k > 0$, write the equation of the orbit when its energy is negative. State the two special shapes that occur. [**2 points**]

9. What is the maximum number for the degrees of freedom of a rigid body? [**1 point**]

10. Write the definition of an orthogonal matrix. [**1 point**]

11. Consider a particle of mass m moving in a central potential $U(r) = -kr^n$, where n is any integer and $k > 0$. The magnitude of its angular momentum, ℓ, is not zero. The radial coordinate is r.
    (a) Find the radius r_0 for which the particle orbit can be circular. [**4 points**]
    (b) For what values n is this circular orbit stable? [**2 points**]
    (c) Sketch the effective potential for $n = 2$, -1 and -3. [**3 points**]
    (d) Are your sketches in part (c) consistent with the answer in part (b)? [**2 points**]
    (e) Justify your answer to part (d). [**2 points**]