Science-1: Classical Mechanics Assignment

Due at 9pm on Monday 26-Oct-2020

1. A rocket exhausts gasses at constant relative velocity v ; find the equation of motion for the rocket starting with zero velocity from the surface of earth.
2. A particle having mass m, and charge q is moving in a region of constant electric and magnetic field. What are the possible trajectories for such a particle?
3. Double pendulum can be described as a simple pendulum whose bod is support for another simple pendulum.
   (a) identify appropriate genearlised coordinates
   (b) Lagrangian
   (c) Euler-Lagrange equations
4. A solid cylinder is rolling with out slipping on an fixed inclined plane that makes an angle θ with horizontal. Identify and write down the
   (a) appropriate generalised coordinates
   (b) Lagrangian
   (c) Euler-Lagrange Equation
   (d) Solve it
5. Consider a solid cyliner rolling without slipping on a inclined plane; the inclined plane can slide on the horizotnal plane on which it is resting. Idenfity and write down
   (a) the appropriate generalised coordinates
   (b) Lagrangian
   (c) Euler-Lagrange Equations
   (d) Hamiltonain
   (e) Hamilton's Canonical Equations of motion
6. A bead can slide on a straight wire which is always in the vertical plane. C is point on wire and wire is moving so the line joining origin O and Point C is rotated in the vertical plane with constant angular velocity ω.
   (a) Find appropriate generalised coordinates, Lagrangian, and the Euler-Lagrange equations and solve it for the position of the bead.
   (b) Find Hamiltonain. Comment on the total energy of the system.
7. A bead can move freely on a circular loop; the circular loop is vertical and is rotating about its vertical diameter with constant angular velocity ω. The bead will reach some equilibrium position, find oscillartory frequency about this mean equilibrium position. Note that there are two different kinds of regimes; identify them. Find Hamiltonian, use it to graphically describe the two regimes.
8. For a two-body system, use Lagrangian Mechanics and show how the Kepler's Laws follow from them.
9. Considerr a family of orbits in a central potential fo which total energy is constant; show that if a stable circular orbit is possible, the angular momentum associated with orbit is LARGER than for any other orbit in the family of orbits.
10. A booster rocket on a satellite that is in a circular oribit around Earth fires suddenly, and it is found that the velocity of rocket has an outward radial velocity v in addition to its original velocity. Find (a) Calculate the new energy and angular momentum, and the ratio of new to old values. (b) Plot kinetic, potential and total energy of after the rocket burn as a function of time.