

DEPARTMENT OF PHYSICS
INDIAN INSTITUTE OF TECHNOLOGY, MADRAS

PH350 Classical Physics

Problem Set 1

8.8.2009

Find the number of independent degrees of freedom possessed by each of the following systems. Wherever possible, try to find alternative ways of counting these, to check your answer. Also identify the configuration space in each case.

1. A point particle moving (a) on a given line; (b) on a given plane; (c) in space.
2. A point particle moving on the surface of a given fixed sphere.
3. 3 point particles moving in space.
4. 3 point particles moving in space, but constrained such that r_{12} , r_{23} and r_{31} are given constants.
5. A rigid body in space.
6. A bead constrained to move on the parabola $y = x^2$ in the xy -plane.
7. A simple pendulum oscillating in a given plane.
8. A conical pendulum moving with a given cone angle.
9. A circular hoop rolling down an inclined plane.
10. A circular hoop partially rolling and partially slipping down an inclined plane.
11. A bead constrained to move on a wire whose equation is $y = \cosh x$ initially; the wire then rotates about the y -axis with a nonuniform angular speed.
12. 4 particles moving in space, but constrained such that $r_{12} = r_{23} = r_{34} = r_{41} =$ a given constant.
13. A methane molecule (assume that the C and H atoms are point particles); the interatomic distances are fixed.
14. A methane molecule; the interatomic distances are variable but the H atoms always lie on the vertices of a *regular* tetrahedron with the C atom at its center.
15. A planet, in revolution around a star. Assume the planet and star to be point masses.
16. An LC circuit with a given charge q_0 initially on the capacitor. (The switch is closed at $t = 0$.)

