

CHENNAI MATHEMATICAL INSTITUTE
CLASSICAL MECHANICS I
PROBLEM SHEET IV

3rd September 2012
date due 10th September 2012

16. Consider an undamped simple harmonic oscillator and trace the trajectory of a point A with initial conditions $x(t = 0) = A$; $p(t = 0) = 0$ in phase space. Choose three neighbouring points in phase space and show that the area of the triangle in phase space is independent of time.

17. Consider the motion of a particle of mass M whose motion is given by

$$M \frac{d^2 z}{dt^2} + \lambda \frac{dz}{dt} = mg$$

Choose an appropriate initial condition for the motion of the particle and trace it's trajectory in phase space. Choosing three neighbouring points at time $t = 0$ and find the area of the triangle in phase space and show it is not independent of time.

18. Draw the phase space plot of a few trajectories for a particle moving under the potential

$$V(x) = -ax + bx^3 \quad a, b > 0$$

You need not solve the equation of motion. Draw the potential and use physical arguments to get the trajectories for different initial conditions. When will the trajectory be closed ?

19. Consider the motion of a particle described by $\vec{r}(t)$. Find the velocity and acceleration vectors in spherical polar coordinates (r, θ, ϕ) along $(\hat{r}, \hat{\theta}, \hat{\phi})$.

20. A pendulum has a period of one second in vacuum. When placed in a resistive medium (resistance is proportional to the velocity), it is observed that the amplitude on each swing becomes half that of the previous swing. What is it's new period?