# Classical Mechanics (PH211 + PH403)

## Tutorial V (on 17/09/2010)

*Note: Neglect friction unless otherwise stated. You need not have to solve the differential equations unless specifically asked to.*

1. Find the radius of the circular orbit of a particle having mass $m$ and angular momentum $l$ for the following central forces, **(a)** $V(r) = k\,r^2$ and **(b)** $V(r) = k\,r^4$.

2. The orbit of Halleys comet around sun has an eccentricity of 0.967 and a period of 76 years. (a) Find the distance of the comet from the sun at perihelion and at aphelion. (b) Find the angular velocity of the comet when it is closest to sun. (Useful data: mass of sun= $2\times10^30$ kg; G= 6.67 $\times10^{11}$ in S.I. Mass of the comet is negligible when compared to sun.)

3. For circular and parabolic orbits in an attractive $K/r$ potential having the same angular momentum, (a) show that the perihelion distance of the parabola is one half the radius of the circle. (b) the speed of a particle at any point in a parabolic orbit is $\sqrt{2}$ times the speed in circular orbit passing through the same point.

4. Two particles move about each other in circular orbits under the influence of gravitational force, with a period $\tau$. The motion is suddenly stopped at a given instant of time, and they are then released and allowed to collide each other. Prove that they collide after a time of $\tau/4\sqrt{2}$.

5. Two particles of equal mass, $m$, interact through gravitational potential. The initial conditions for the system (that is, the position and velocity of one of the particles at time, $t = 0$, relative to the other particle) is given by: $x(0) = 0$, $y(0) = \alpha$, $\dot{x}(0) = -(\frac{3Gm}{\alpha})^{1/2}$ and $\dot{y}(0) = (\frac{Gm}{\alpha})^{1/2}$. Where $G$ is the gravitational constant and $\alpha$ some constant. Determine the shape of the orbit, make a schematic sketch of the same, and obtain the apsidal distances.