Physics Problems September-2010

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Q1. If r_1 & r_2 are the apogee & perigee for an ellipse then find the radius of curvature of the ellipse at the apogee/perigee. See this as a gravitation problem not as one of conic sections!!

Q2. Four particles A, B, C & D of mass m and charge q each are connected by six ideal strings of length l each such that they lie on the vertices of a regular tetrahedron(a pyramid). The entire assembly is floating in outer space. If suddenly the string between A and B snaps then what is the maximum speed of the particle A after that?

Q3. Two identical massive rods are joined end to end through a smooth joint such that the angle between them can vary from 0° to 180°. You can imagine the entire assembly similar to a compass divider. The assembly is hung from the ceiling by attaching one of the remaining free ends again through a smooth joint at the ceiling. What should be angle between the rods themselves such that their common pivot point is closest to the ceiling?

Q4. A non-conducting sphere of radius R has a radially distributed charge density given by $\rho = kr$ $(0 \leq r \leq R)$. What is the magnitude of the force exerted by the northern hemisphere on the southern hemisphere?