

Physics 601 Homework 9---Due Friday November 6

Jose and Salatan 2.18

1. Show by explicit evaluation that

a. $\{A_x, L_y\} = A_z$

b. $\{A_x, A_y\} = 2\mu E L_z$

where \vec{A} is the Runge-Lenz vector. If one includes cyclic permutation this yields the Lie algebra discussed in class.

2. Show by explicit computation that $\{A_x, H\} = 0$. Since analogous Poisson brackets for the y and z will necessarily vanish if this does, this result is an algebraic demonstration that the Runge-Lenz vector is conserved.

3. Suppose one has a "hard sphere" of radius R off of which a particle scatters via specular reflection---that is angle of incidence = angle of reflection on the plane tangent to the sphere. Find the differential cross-section.

4. Consider the potential $V(r) = \alpha/r^2$. Find the differential cross-section.

5. Consider an elliptical orbit in the Kepler problem ($V(r) = -\alpha/r$) with energy, E , and orbital angular momentum ℓ . Find $\overline{r^{-1}}$, $\overline{r^{-2}}$ and $\overline{\dot{r}^2}$ where the bar means time average. You may find the virial theorem helpful but you will need more input than that.