

PHY 711 – Assignment #7

September 10, 2008

1. Consider a particle of mass m moving in 3-dimensions in a force field of the form (as expressed in Cartesian coordinates):

$$\mathbf{F}(x, y, z) = K \frac{x\hat{\mathbf{x}} + y\hat{\mathbf{y}} + z\hat{\mathbf{z}}}{(x^2 + y^2 + z^2)^{3/2}},$$

where K is a constant.

- (a) Write down the Lagrangian and Lagrange's equations of motion for this particle in Cartesian coordinates – $L(x, y, z, \dot{x}, \dot{y}, \dot{z})$
- (b) Now, transform the coordinate system to cylindrical coordinates:

$$x = \rho \cos \phi$$

$$y = \rho \sin \phi$$

$$z = z$$

so that you can write the Lagrangian and Lagrange's equations of motion for the particle in cylindrical coordinates – $L(\rho, \phi, z, \dot{\rho}, \dot{\phi}, \dot{z})$.

- (c) Identify any “constants of motion” in either coordinate system.