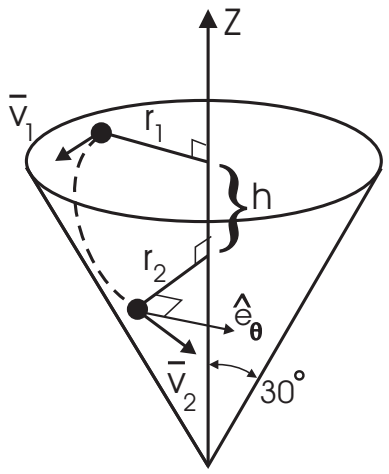
SD 553: Advanced Dynamics **Assignment 1**

Prof. J. McPhee **Due: 2 October 2015**

Instructions: *On all five assignments this term, there will be 4/5 problems, three of which will be graded to determine your assignment mark for the term. Marks will be deducted for assignment problems not attempted. Be neat and organized in your solutions, and be sure to include units, directions, and 3 significant figures in your final answer.*

1. A small block of mass 0.1 kg is given a horizontal velocity of $v_1 = 0.4$ m/s when $r_1 = 500$ mm. It slides along the smooth conical surface. Determine the distance h it must descend for it to reach a speed of $v_2 = 2$ m/s. Also, what is the angle of descent α at that point, that is, the angle measured from the $\hat{e}_\theta$ axis to the tangent of the path? Assume that gravity acts vertically downward.

Hint: Take advantage of conservation principles.



2. Optional: Problem 2.3 from Ginsberg's text (p.47).

3. Problem 2.19 from Ginsberg's text (p.50).
Express your answer in radial ($\hat{e}_R$) and transverse ($\hat{e}_\theta$) components.

4. At a certain instant, the position $\bar{r}$, velocity $\bar{v}$, and the acceleration $\bar{a}$ of a particle are observed to be $\bar{r} = 2000\hat{i} - 1000\hat{j} + 2000\hat{k}$ (m), $\bar{v} = 100\hat{i} + 150\hat{j} + 200\hat{k}$ (m/s), and $\bar{a} = 30\hat{j} - 50\hat{k}$ (m/s/s).

If the particle's location is expressed using a cylindrical coordinate system $\{R, \theta, Z\}$ where the Z direction coincides with the direction of $\hat{k}$, determine the values of $\theta, \dot{\theta}, \ddot{\theta}$ at that instant.

Hint: Draw a sketch of the particle's position and velocity in the XY plane to check your answer.

5. Problem 2.29 from Ginsberg's text (p.53).
Express your answer in terms of $\hat{e}_E$ (east), $\hat{e}_N$ (north), and $\hat{e}_U$ (up).