ADVANCED MECHANICS — PHY-4241/5227 HOMEWORK 3

(January 19, 2004) Due Monday, January 26, 2004 (in the lecture)

PROBLEM 7

- 1. Make a table of the nine scalar products of the cartesian unit vectors \hat{x} , \hat{y} , \hat{z} with the spherical unit vectors \hat{r} , $\hat{\theta}$, $\hat{\phi}$.
- 2. Calculate the velocity

$$\vec{v} = \frac{d}{dt}\vec{r} = \frac{d}{dt}(r\hat{r})$$

algebraically along the following lines:

(a) Calculate

$$\frac{d}{dt}\hat{r}$$

as linear combination in the basis \hat{x} , \hat{y} and \hat{z} .

(b) Expand \hat{x}, \hat{y} and \hat{z} in terms of $\hat{r}, \hat{\theta}$ and $\hat{\phi}$. Use trigonometric relations to simplify the result.

PROBLEM 8

Re-consider example 7.6 of Marion and Thornton (4th edition).

- 1. Derive equation (7.36) from the Lagrangian.
- 2. Find the equation of motion for $\ddot{\eta}$ when η is **not** small.