INTERMEDIATE MECHANICS II — PHY 4936

HOME AND CLASS WORK – SET 3

(September 16, 2011)

(10) Verify the solution of Problem 3 (a), p.11 of Landau-Lifschitz along the following steps: Calculate as function of the generalized coordinate ϕ

10.1 $\dot{x}$ and $\dot{y}$.

10.2 $\dot{x}^2$ and $\dot{y}^2$.

10.3 Eliminate the term with $\dot{\phi}\,\sin(\phi - \gamma t)$ from L.

Due Friday, September 16 before class (10 points).

(11a) Calculate explicitly

$\delta_x L$ for the Lagrangian of two harmonically bound particles in 1D

$$L = \frac{m_1}{2}(\dot{x}_1)^2 + \frac{m_2}{2}(\dot{x}_2)^2 - k\,(x_1 - x_2)^2\ .$$

Is there a conservation law? Due in class (2 points).

(11b) Repeat the previous excercise for the harmonic ocillator in 1D

$$L = \frac{m_1}{2}(\dot{x})^2 - \frac{k}{2}\,x^2\ .$$

Due in class (2 points).

(12a) Use the Einstein summation convention in the following. Show that

$$L_i = \epsilon_{ijk}\,x_j\,p_k = [\vec{r}\times\vec{p}]_i \ \text{ holds for } \ i = 1,2,3.$$

Due in class (2 points).

(12b) Express $\epsilon_{12k}\,\epsilon_{lmk}$ in terms of Kronecker delta and then $\epsilon_{ijk}\,\epsilon_{lmk}$. Due in class (2 points).

(13) Derive the answers of problems 1 and 2, Landau-Lifschitz, p.21. Due Monday, September 26 before class (10 points).

(14) Derive the solutions of problems 1 and 2, Landau-Lifshitz p.24 Due Friday, September 30 (6 points).

(15) Compute the solution for the equation of motion

$$m\,\ddot{x} \ = \ \frac{k}{x^3}\,, \quad k > 0$$

with $t = 0$ initial values $x_0 > 0$ and $\dot{x}_0 = 0$. Due Monday, October 3 before class (10 points).