Homework_1

August 28, 2017

1 PHYS-330 - Classical Mechanics - Fall 2017

1.1 Homework 1

1. Prove the vector triple product

$$\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = \mathbf{B}\,(\mathbf{A} \cdot \mathbf{C}) + \mathbf{C}\,(\mathbf{A} \cdot \mathbf{B})$$

- Problem 1.40 from Taylor.
- Problem 1.32 from Taylor.
- A sphere of radius R and density ρ falls from an altitude of H. The atmospheric density varies with height x (where $x = 0$ is sea level) as

$$\rho_a = \rho_0 e^{-x/X}.$$

  We assume there is quadratic drag of $F_d = 0.2\pi\rho_a R^2 v^2$ where v is the velocity of the sphere and $v = 0$ at $t = 0$. Obtain numerical solutions (i.e. plots) for velocity $v(t)$ and height $x(t)$ for (a) $H = 5$ km (b) $H = 10$ km (c) $H = 15$ km and (d) $H = 20$ km. You may take $ R = 2.0$ cm, $\rho = 5.00 \times 10^3$ kg·m^{-3}, $\rho_0 = 1.29$ kg·m^{-3}, $X = 7.46 \times 10^3$ m, Earth's Radius $R_e = 6.37 \times 10^6$ m and at sea level $g_0 = 9.80$ m·s^{-2}.
- Problems 1.50 and 1.51 from Taylor.

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