

# Homework\_1

August 24, 2017

## 1 PHYS-330 - Classical Mechanics - Fall 2017

### 1.1 Homework 1

1. Prove the vector triple product

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

- Problem 1.40 from Taylor.
- Problem 1.32 from Taylor.
- A sphere of radius  $R$  and density  $\rho$  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,  $\rho = 5.00 \times 10^3 \text{ kg}\cdot\text{m}^{-3}$ ,  $\rho_0 = 1.29 \text{ kg}\cdot\text{m}^{-3}$ ,  $X = 7.46 \times 10^3 \text{ m}$ , Earth's Radius  $R_e = 6.37 \times 10^6 \text{ m}$  and at sea level  $g_0 = 9.80 \text{ m}\cdot\text{s}^{-2}$ .

- Problems 1.50 and 1.51 from Taylor.

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