PHY260 Homework #3

Due Date: Feb. 11th, 5:00pm via Sakai

Golf

Write a program to calculate the trajectory of a golf ball of mass 46 grams and calculate the trajectories as a function of angle (use $\vartheta = 45°, 30°, 15°$ and $9°$). Choose the initial velocity of the golf ball to be 70 m/s. For the drag, assume a general form of

$$F_{\text{drag}} = -C\,\rho\,A\,v^2 \tag{1}$$

where ρ is the density of air (at sea level), 1.29 kg/m^3, A is the frontal area of the golf ball, 0.0014 m^2, and C is a coefficient to be discussed below. For each angle, calculate and compare the trajectories for the following cases:

a) ideal trajectory: no drag and no spin [2 points]

b) smooth golf ball with drag: choose $C = 1/2$ [2 points]

c) dimpled golf ball with drag: choose $C = 1/2$ for speeds up to $v = 14$ m/s and $C = 7.0/v$ at higher velocities. This transition to a reduced drag coefficient is due to turbulent flow, caused by the dimples. [3 points]

d) dimpled golf ball with drag and spin: use a Magnus force $\vec{F} = S_0\,\vec{\omega} \times \vec{v}$ with a backspin of $S_0\omega/m = 0.25s^{-1}$ for a typical case. [3 points]

Please note that from now on source code lacking comments or unsafe programming (e.g. risking division by zero or over/underflow of arrays and variables) will lead to a 1 point deduction, respectively.

Your homework submission should consist of:

- a document outlining the problem, detailing your solution and discussion of your results - the document should include the requested figures. The document should be in pdf format and you should use colors and different marker symbols to enhance the readability of your figures.
- the source code of your program

Both files should be submitted as separate attachments on Sakai