Sardar Vallabhbhai National Institute of Technology, Surat
Department of Physics
M.Sc Fourth Year
Computational Physics Lab (MP-407)
Practical No:01

Date-01/09/2022 **Time: 4 hours**

1. The velocity υ of a falling parachutist is given by $\upsilon = \frac{gm}{c}(1 - e^{-(c/m)t})$ where g = 9.8 m/s^2 . For a parachutist with a drag coefficient c = 15 kg/s, compute the mass m so that the velocity is υ = 35 m/s at t = 9 s. Use the false-position method to determine m to a level of εs = 0.1%.
2. Use bisection to determine the drag coefficient needed so that an 80-kg parachutist has a velocity of 35 m/s after 3.9 s of free fall. Note: The acceleration due to gravity is 9.8 m/s^2 . Start with initial guesses of xi = 3 and x_u = 5 and iterate until the approximate relative error falls below 5%. Also perform an error check by substituting your final answer into the original equation
3. According to Archimedes principle, the buoyancy force is equal to the weight of fluid displaced by the submerged portion of an object. For the sphere depicted in Fig. 1, use bisection to determine the height h of the portion that is above water. Employ the following values for your computation: r = 1.25 m, ρ_s = density of sphere = 250 kg/m^3 , and ρ_w = density of water = 1000 kg/m^3 . Note that the volume of the above-water portion of the sphere can be computed with $V = \frac{\pi h^2}{3}(3r - h)$

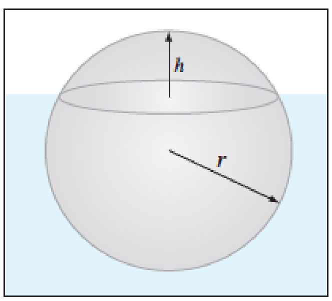

Figure 1

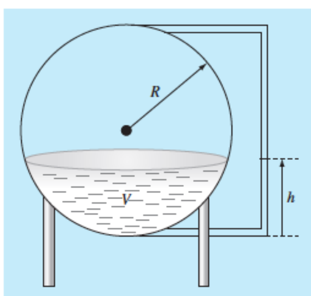

Figure 2

4. You are designing a spherical tank (Fig 2.) to hold water for a small village in a developing country. The volume of liquid it can hold can be computed as $V = \pi h^2 \frac{[3R - h]}{3}$ where V = volume (m^3), h = depth of water in tank (m), and R = the tank radius (m). If R = 4 m, what depth must the tank be filled to so that it holds 50 m^3? Use three iterations of the Newton-Raphson method to determine your answer. Determine the approximate relative error after each iteration. Note that an initial guess of R will always converge.