MAE561/471, Fall 2013 Homework #6

1. Consider a circular pipe with a bloated mid-section, as illustrated in Fig. 1. The detailed dimensions of the apparatus are given in Fig. 2. The *x*-axis is the axis of symmetry of the pipe. A uniform velocity is imposed at the inlet. Use ANSYS-Fluent to find the steady state solutions for the following three cases: (a) Inlet velocity = 5 cm/s. In this case, set "Model" to "Viscous - Laminar". (b) Inlet velocity = 20 cm/s. Also set "Model" to "Viscous - Laminar". (c) Inlet velocity = 80 cm/s: Explore the following two sub-cases: (c1) Set "Model" to "Viscous - Laminar"; (c2) Set "Model" to "Viscous - k-epsilon". In case (c2), you will also need to specify additional parameters for turbulence. Please use the same parameter values (e.g., the "turbulence intensity" at the inlet is 5%) as you did for the Tutorial in HW2.

In all four cases (two under (c)), perform the following tasks: **(A)** Starting from the default mesh, refine your mesh to see how it affects your solution. In each of the four cases, you will need to show the results (see the list of required outcomes in (B)) from at two different runs with different mesh resolution. In you report, state clearly what option/procedure you choose to refine the mesh. (Different people may use different approaches and obtain different answers.) **(B)** Make the following plots for the results of the simulations: (i) A line plot of the profile of u-velocity along the *x*-axis. (ii) A line plot of the profile of u-velocity along the *y*-axis. (iii) A contour plot of the u-velocity in the *x*-*z* plane. Note that for the cases with a large inlet velocity, if "Model" is set to "Viscous - Laminar" the simulation might not converge (but you might see the residue leveling off then oscillating with the number of iterations). In that case, set the number of iteration to 2000 and take the outcome as your final result. (We will explain the subtlety of the situation in class.)

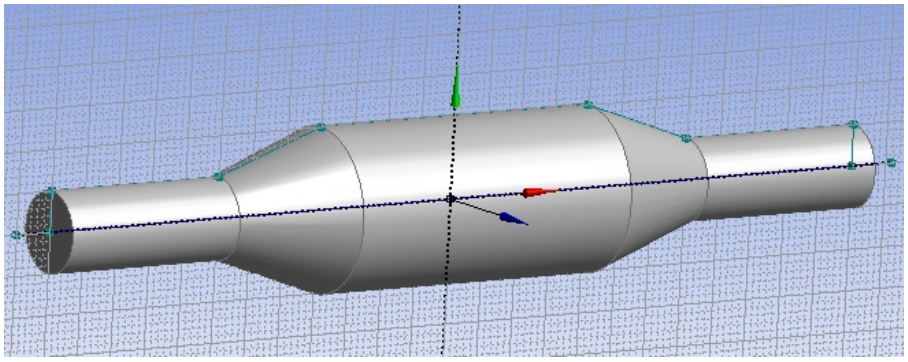

Fig. 1. The pipe with a bloated mid-section. It is filled with regular liquid water. The red, green, and blue axes are the *x*-, *y*-, and *z*-axis, respectively. The left opening is the inlet and right opening the outlet. See Fig. 2 for detailed dimensions.

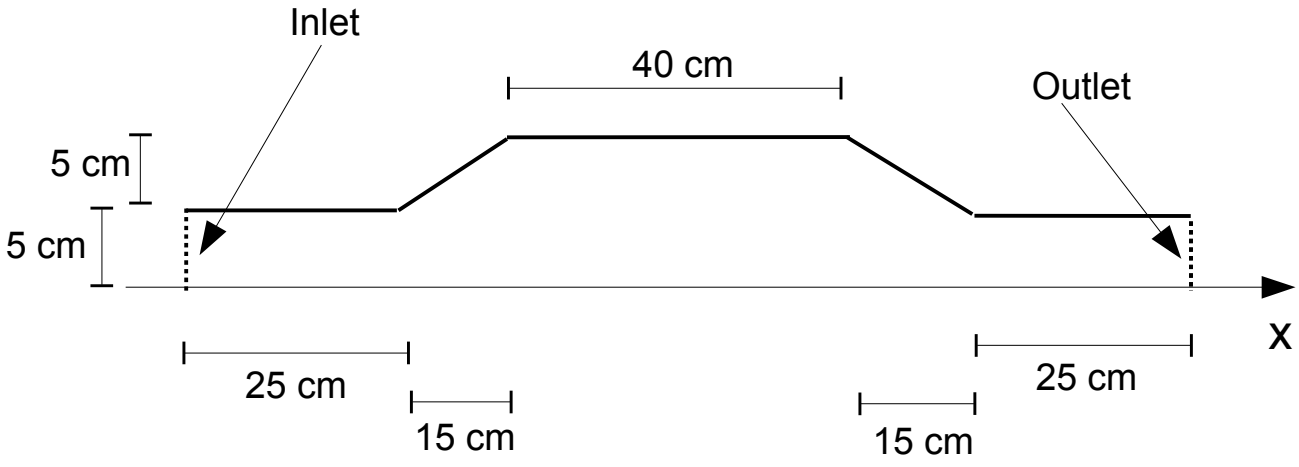

Fig. 2 The dimensions of the cross section of the pipe (not drawn to scale).