

February 4, 2015

Fluid dynamics

Problem 1 (12 points)

Consider the T-junction sketched in the figure below: a pipe of diameter d_1 bifurcates into two pipes of diameters d_2 and d_3 , respectively. The two daughter pipes are at right angles with the parent pipe. All pipes have a circular cross-section. Let us assume that the fluxes Q_1 , Q_2 and Q_3 and the pressures p_1 , p_2 and p_3 are all known in the three cross-sections 1, 2 and 3. Considering the fluid volume delimited by the three cross-sections and neglecting the role of gravity compute the force (x and y components) that the pipe exerts on the fluid.

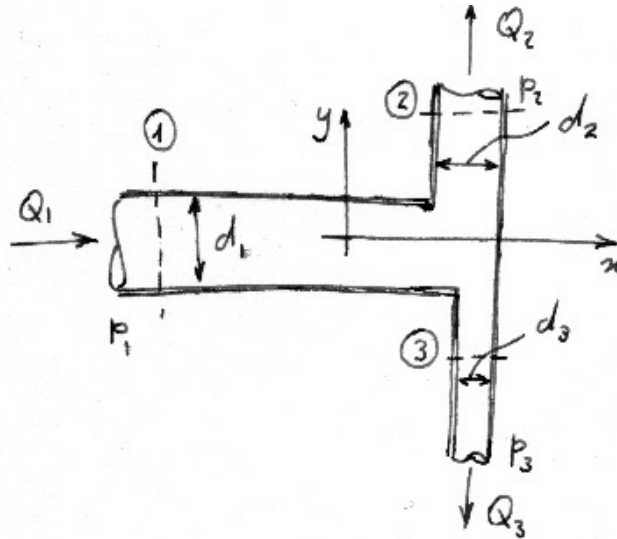


Figure 1: Sketch of the problem.

Theoretical question 1 (10 points)

Scale the Navier-Stokes equations (make them dimensionless) and discuss the physical meaning of the dimensionless parameters that arise from the procedure.

Theoretical question 2 (10 points)

Prove the Reynolds transport theorem.