## Physics 331 Advanced Classical Mechanics

## Problem M

Here are some problems you can solve using Bernoulli's theorem. Assume that the viscosity is zero, and that the density of water is constant. Note that the when water flows in a tube of area  $A_1$  that is then constricted to a different value  $A_2$ , the flow speed satisfies

$$v_1 A_1 = v_2 A_2.$$

This says the water must speed up in narrower sections, to keep the total volume flow rate constant.

- (a) Water is flowing with initial speed  $v_0$  out of a faucet of radius  $R_0$  (the faucet has a circular cross-section). Assume that the water is forming a continuous stream below the faucet, that is, it is not breaking into drops. Determine the diameter of the stream in terms of the distance h below the faucet.
- (b) A large tank is filled with water. A small circular hole of radius R is made in the side of the tank, a distance h below the surface of the water. Determine the velocity of the water coming out of the hole.
- (c) A horizontal pipe with circular cross section of radius  $R_1$  carries water flowing with velocity  $v_1$  at pressure  $p_1$ . The pipe is then constricted to a circular cross section of radius  $R_2$ . Determine the new pressure  $p_2$ .