It rains during the construction of a building and water fills a recently excavated pit to a depth, h=0.5m. In order to continue construction, the water must first be pumped out of the pit. A hose with a length of L=50m, a diameter of D=2.5*10^{-2}m, and a surface roughness of ε=5.0*10^{-5}m is attached to a pump. Note that the kinematic viscosity of the water is ν=1.005*10^{-6} m^2/s and the density is ρ=1000 kg/m^3.

a. If the pump is placed at the pit's surface (figure a), what is the maximum depth of the pit, H, for which water can be pumped out at a velocity of V=1 m/s without causing cavitation in the pipe? The vapor pressure of water for the current temperature is p_v=2.337 kPa (absolute pressure) and atmospheric pressure is p_{atm}=101 kPa (absolute pressure).
b. If the pump is placed at the bottom of the pit (figure b), what is the maximum depth of the pit, H, for which water can be pumped out at a velocity of V=1 m/s? Assume that the pump supplies a power of P=200 W to the fluid.

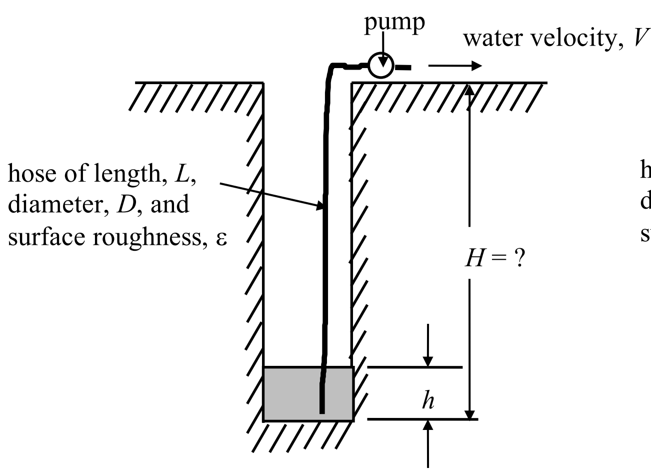

Figure a

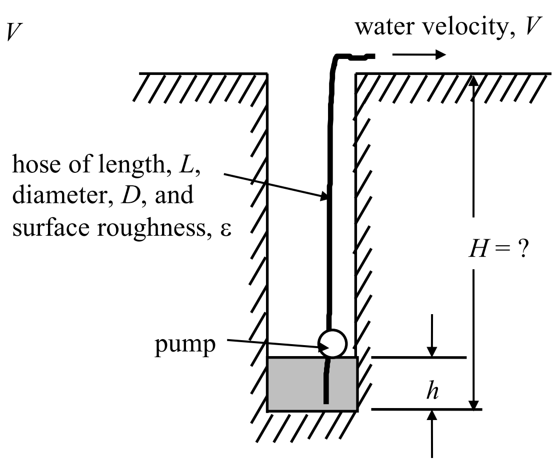

Figure b