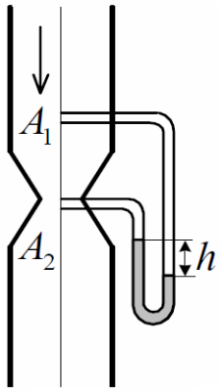
Applied Physics – Problem set #7

1. Water is flowing stationary in a pipe with vertical axis and cross-sectional area A_1=0.2m^2. A Venturi pipe is inserted in the pipe at one point with cross-sectional area A_2=0.1m^2. The mercury level is higher in the left side of the differential manometer by h=0.2m compared to the right side. What is the speed of the flow in the pipe? How many kg of water goes through per second? (The density of mercury is 13.6kg/dm^3).



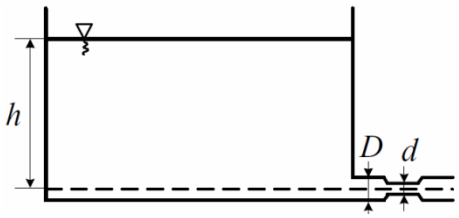
2. The wing area of a Boeing 747-400 is approximately 525m^2, and its mass with cargo is 440t. How much faster does the air has to flow above the wings than under the wings at the minimum necessary speed of 290km/h, if we ignore the change in density? Assume that under the wing the air flows at the cruising speed. (The atmospheric pressure is 10^5Pa).

3. A 1.6m-long steel piano wire has a diameter of 0.2cm. (a) What is the tension in the wire if it stretches by 0.25cm when tightened? (b) How large stress and the strain is created in the wire? (c) How much force would be required to break the wire? (The elastic modulus for steel is $2 \cdot 10^{11}\mathrm{N/m^2}$, and the ultimate tensile strength is $5 \cdot 10^{8}\mathrm{N/m^2}$.)

4. A wave whose wavelength is 0.30m is traveling down a 300m-long wire whose total mass is 15kg. If the wire is under a tension of 1000N, what are the speed and frequency of this wave?

<u>Homework #7</u>

1. The height of the water level in the container seen below is *h*=1m, the diameter of the exit pipe is *D*=5cm, that of the container is much larger. One part of the exit pipe is narrower, here its diameter is *d*=4cm. The atmospheric pressure is 1bar.
a) What is the speed of the flow at the end of the exit pipe? How many liters of water leaves per second?
b) What is the pressure in the narrow section? (The density of water is 1g/cm^3.)



2. The fundamental frequency of a low E (E2) guitar string is 82.41Hz, and the vibrating length of the string is 651mm. What is the wavelength of this fundamental frequency and how much tension is required if the mass of the string is 6 grams per meter? What is the stress and strain in the string if its diameter is about 1.3mm and its elastic modulus is $2 \cdot 10^{11}$Pa?