

Moving Fluids and Bernoulli's Principle

Pre-Class Questions

Problem Set (due next time)

Ch 13 - 45, 47, 48, 51

Lecture Outline

1. Equation of Continuity
2. Bernoulli's Equation

You Hoser!

Shown below are eight identical hoses connected to eight nozzles with varying diameters. For each hose and nozzle, the speed of the water in the hose and the diameter of the nozzle is given. Rank these according to the speed of the water exiting the nozzle. That is, rank the one with the highest exit speed first and the lowest exit speed last.



$v = 32\text{m/s}$
 $D = 20\text{mm}$



$v = 32\text{m/s}$
 $D = 16\text{mm}$



$v = 8\text{m/s}$
 $D = 40\text{mm}$



$v = 8\text{m/s}$
 $D = 2\text{mm}$



$v = 8\text{m/s}$
 $D = 10\text{mm}$



$v = 8\text{m/s}$
 $D = 8\text{mm}$



$v = 2\text{m/s}$
 $D = 2\text{mm}$

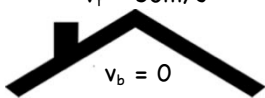

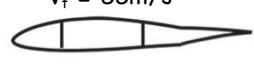
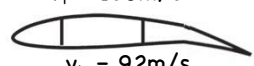




$v = 2\text{m/s}$
 $D = 0.5\text{mm}$

Example 1: A fountain is supplied water from a 50cm diameter pipe. The water sprays upward through a 1.0cm diameter hole at a velocity of 20m/s. Find (a) the speed of the water in the pipe and (b) the flow rate in kg/s.

Which Way is the Force?

Several objects are shown below along with the air speed below them and above them. Your job? Figure out the direction of the force exerted by the air.

<p>$v_t = 50\text{m/s}$</p>  <p>$v_b = 0$</p>	<p>1. The roof of a house in a hurricane.</p> <p>Which way is the force? UP DOWN</p> <p>Why are people advised to open their windows before evacuating?</p>
<p>$v_t = 20\text{m/s}$</p>  <p>$v_b = 0$</p>	<p>2. An umbrella in the wind.</p> <p>Which way is the force? UP DOWN</p> <p>Why do expensive umbrellas have slits in them?</p>
<p>$v_t = 88\text{m/s}$</p>  <p>$v_b = 124\text{m/s}$</p>	<p>3. An airplane wing with flaps up.</p> <p>Which way is the force? UP DOWN</p>
<p>$v_t = 130\text{m/s}$</p>  <p>$v_b = 92\text{m/s}$</p>	<p>4. An airplane wing with flaps down.</p> <p>Which way is the force? UP DOWN</p> <p>Why do wings have flaps?</p>
<p>$v_t = 38\text{m/s}$</p>  <p>$v_b = 42\text{m/s}$</p>	<p>5. A ball thrown with topspin.</p> <p>Which way is the force? UP DOWN</p>
<p>$v_t = 47\text{m/s}$</p>  <p>$v_b = 42\text{m/s}$</p>	<p>5. A ball thrown with backspin.</p> <p>Which way is the force? UP DOWN</p> <p>How do pitchers get the ball to change direction on its way to home plate?</p>

Example 2: Estimate the velocity that water will flow out from the bottom of a 50.0m high dam.

Example 3: Estimate the velocity of the air flowing over the ping pong ball.

Lecture 35 - Summary

Equation of Continuity $A_1v_1 = A_2v_2$

Bernoulli's Equation $P_1 + \rho gh_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho gh_2 + \frac{1}{2}\rho v_2^2$