Fluid Dynamics Basics Handout Answers

Questions:

1. What is the value of Bernoulli's equation with these values?
2. What are the units of this value?
3. Which variable contributes most for water in a reservoir?
4. What is the value of Bernoulli's equation at an elevation of 500 m?
5. If we measure the speed of the water to be 10 $\frac{m}{s}$ at 500 m of elevation, what is the pressure?
6. What is the pressure of the water in the faucet, again assuming the particle has traveled along the same streamline throughout the journey and also assuming no energy loss along its journey?
7. What fittings would you choose for this pipeline from the above table to minimize head loss?
8. Assume that the water flowing through the pipe is traveling at 10 $\frac{m}{s}$. What is the total head loss from the fittings you chose?
9. Based on the above equation for $h_{f,major}$, what factors will increase to head loss due to the flow of water through a pipe?
10. If we now consider head losses along our streamline, what has to be true about the change in elevation between points one and two?
11. If there are no change in elevation or pressure between points one and two, what would you expect the velocity to be at point two (v_2), relative to point one?

Answers:

1. $\frac{v^2}{2} + gz + \frac{p}{\rho} = \frac{.01^2}{2} + 9.8 \times 1000 + \frac{1}{1000} = 9{,}800$
2. $\frac{m^2}{s^2}$
3. The elevation, z, has the biggest effect on Bernoulli's equation in this case.
4. 9,800 $\frac{m^2}{s^2}$. It is the same everywhere along the streamline.
5. To solve, plug in the known values to the Bernoulli equation and solve for p: 4,850,000 Pa, or 4.85 MPa.
6. To solve, plug in the known values to the Bernoulli equation and solve for p: 9,800,000 Pa, or 9.8 MPa.
7. Two ball valves, two flanged long radius 90° elbows.
8. Assuming the acceleration of gravity to be 9.81 $\frac{m}{s^2}$, the total head loss from fittings,
   $h_{f,minor\ total} = \sum h_{f,minor} = (\xi_1 + \xi_2 + \xi_3 + \xi_4)\frac{v^2}{2g} = 2.55$ m.
9. Longer pipe length, faster water velocity, smaller pipe diameter, and a rougher pipe surface all increase head loss from the pipe. Conversely, a shorter pipe length, slower water velocity, larger pipe diameter, and smoother pipe surface all decrease head loss from the pipe.
10. Elevation has to be lower at point two ($z_2 < z_1$). We know we will have head losses; therefore the only way to make the left side equal to the right side in the energy equation is to decrease the elevation.
11. The velocity would be lower at point two ($v_2 < v_1$). Again, we know we will have head losses; therefore the only way to make the left side equal to the right side in the energy equation is to decrease the velocity.