Name: ________________________________ Period: _____

Phet Simulation: Fluid Pressure and Flow

https://phet.colorado.edu/en/simulation/fluid-pressure-and-flow You need to have Java installed on your computer to run this simulation.

Part 1: Pressure in Various Tanks

For this part of the simulation, stay on the "pressure" tab. Explore the simulation to answer the following questions.

1. For the first 2 kinds of tanks:
   a. Place the pressure gauge near the bottom of the tank. Use the faucet and the drain to change water level, observe and record how the pressure gauge reading changes according to the water level qualitatively.

   b. With the tank at least partially filled so there is some water above the pressure gauge, change fluid density to
      i. Gasoline: 700kg/m^3. Record pressure gauge reading ______________kPa.
      ii. Honey: 1400kg/m^3. Record pressure gauge reading _______________kPa.
      iii. Does the pressure double when the density of the liquid doubles? ________ Why/why not?

   c. Repeat part b with the atmosphere turned off (i.e. place the tank in vacuum):
      i. For gasoline: 700kg/m^3. Record pressure gauge reading ______________kPa.
      ii. Honey: 1400kg/m^3. _______________kPa.
      iii. Does the pressure double when the density of the liquid doubles? ________ Why/why not?

   d. **Turn the atmosphere back on.** With the tank at least partially filled so there is some fluid above the pressure gauge, record pressure gauge reading _____________kPa. Then change g from 9.8 m/s^2 to 19.6 m/s^2 and record pressure gauge reading _____________kPa. How does the pressure reading change? Explain the change.

2. For the 3rd kind of tank:
   a. Place one pressure gauge at the bottom of each side of the tank. Make sure that both gauges are placed at the same height, so they get the same reading. Record the reading: _____________kPa.
   b. Place the 250kg weight on the left side of the tank. How did it affect the pressure on the left? Right? Explain.

   c. Make prediction on the readings of both gauges if you add another 250kg and the 500kg to the left side.
      i. Prediction on the gauge on the left: _____________kPa.
      ii. Prediction on the gauge on the right: _____________kPa.
      iii. Now add the weights. How do your predictions match the actual readings?

Name: ___________________________________ Period: _____

Part 2: Flow

In this simulation, the flow rate out of the pipe at the left end is kept at a constant value shown in the box in the upper left corner. Explore this second tab of the simulation to answer the questions below.

1. With the friction box unchecked, move the speed gauge to different locations inside the pipe to take speed reading. What do you find from the speed gauge?

2. Now use a handle in the middle to make the pipe narrower in the middle. Check the box for flux meter to add the meter. Record the readings of the flux meter:
   a. Flow rate with large pipe: _________________, area: ______________
   b. Flow rate with narrow pipe: _____________, area: ___________, (flux: Ignore this reading and the way "flux" is used in this simulation because the term "flux" can be ambiguous.).
   c. Which of these quantities stayed the same when you change the size of the pipe and why?

   d. Move e the speed gauge around. How does the speed varies at different locations inside the pipe?

3. What do you think will happen qualitatively to these 2 readings of the flux meter if you use a handle in the middle to make the pipe wider in the middle? Flow rate: _____________, area: ___________.
   Do the actual readings match your expectations? Please also move the speed gauge around to see how the speed varies at different locations inside the pipe. Briefly write down your observations.

4. Click "Reset All" and then check both the friction and the flux meter boxes. Move the speed gauge different locations inside the pipe to take speed reading. What do you find from the speed gauge? How did friction change the behavior of the fluid?

5. Now change the fluid to honey and then to gasoline. For each type of fluid, move the speed gauge to different locations inside the pipe to take speed reading. How does the fluid density change the behavior of the fluid?

Name: ______________________________ Period: _____

Part 3: Water Tower

For this part of the simulation, use the third tab "Water tower"

1. Click "Fill" to fill the tower with water. Then open the red cover at the bottom of the tank and observe the trajectory of the water coming out of the opening. You may wish to use the speed meter and ruler to measure the speed of water flow at various locations and the depth of water or the horizontal displacement of the water flow. Briefly explain how the path of water flow changes as the water level in the tank goes down.

2. Click "Hose" to connect a hose to the water tank. Click "Match leakage" on the giant faucet on the top left and then click "Fill". How does the maximum height of the water flow compare to the water level in the tank?

3. Now use the brown knob at the opening of the hose to adjust the angle at which water comes out. When water comes out at an angle (instead of going straight up), water does not shoot as high as before. Explain your observations qualitatively.

   Use the ruler and speed meter to take some measurements for the surface of the water inside the tank and the stream of water at the maximum height. Plug these numbers into Bernoulli's equation to see whether Bernoulli's equation holds true in this case:

4. Now use the brown knob to adjust the hose so the stream of water shoots straight upward again. Click "Manual" on the giant faucet on top left, so the faucet turns off. Compare the water level in the tank to the maximum height of the stream of water as both of them go down. Why is the maximum height of the water stream always a little taller than the water level in the tank?