PHYS 426 – Week 1 Readings **Kyle Argue V00788941**

Q1

Let's look at the ideal gas law (1) and the definition of density (2):

$$PV = mRT \tag{1}$$
$$\rho = \frac{m}{V} \tag{2}$$

Dividing equation 1 by V, substituting equation 2 into 1, and solving for density, we get

$$\rho = \frac{P}{RT} \tag{3}$$

Therefore density clearly depends on pressure and temperature, and it has a direct relation to pressure and an inverse relation to temperature.

Q2

Pressure is the average force exerted by molecular motion due to the particles kinetic energy. Pressure "pushes" on the surface equally in all places. There is no direction to pressure because it is in fact directed in every direction.

Q3

The weight exerts a pressure onto the fluid with the following relation:

$$P = \frac{mg}{A} = \frac{(10\text{kg})(9.81\text{m/s}^2)}{0.1\text{m}^2} = 9.81\text{Pa}$$

This pressure must be balanced at the other end of the tube by having the fluid rise above the weight until the pressure of the mass of water above the weight equals the pressure exerted by the weight.

The height can be found solving for h in the following equation:

$$P = \frac{\rho V g}{A} = \frac{\rho h A g}{A} = \rho g h = (1000\text{kg/m}^3)(9.81\text{m/s}^2)h = 981\text{Pa} \tag{4}$$

In this case, the difference in the height of fluid on each side of the tube is $h = 10$ cm. Therefore the water in the tube with the weight on it will be 95 cm high and the water on the other side will be 105 cm high.

Q4

The river at our current location has a caffeine density of 100 g/m^3, and 150 g/m^3 100 km upstream. If the river is flowing downstream at any velocity we would expect the concentration of caffeine to increase as time goes by.