**10.005 Physics II 2D Project**

**Analysis on Hot Air Molecules Kinematics**

**Problem Statement:** The hot steam, existing in the form of vapor, naturally go up in the space. Thus, a special design of the piping and flux exporting system based on the relationship between the amount of steam and location of the steam in the pipes is needed.

According to ideal gas law,

(1)

The represents the number of molecules. Substituting , where is the Avogadro constant, and , where is the molar mass, there is,

The steam is in a **constant-pressure** system. According to this equation, because the steam has a much higher temperature , the density will be much smaller than the air in the surrounding environment.

According to Archimedes' principle, *any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object*.

where is the density of the air displaced by the steam and represents the volume of the displaced air. While the gravity of the steam is

is the density of the steam and is the volume of the steam.

Since the displaced volume of the air is the same volume of steam, i.e., . As explained earlier, according to , , therefore, . For the same amount of water vapor and air, the hot steam spontaneously goes upwards in the space.

The change of impulse of N steam particles when they hit the wall, with a velocity in an arbitrary direction, , is:

Therefore, the force exerted on N steam particles when they hit the wall, with a velocity in an arbitrary direction, , is:

This force is exerted on an area . Therefore, the pressure of the gas is

+Multiplying volume on both sides, there is:

(2)

From equation (2), it can be concluded that the faster the molecule moves, the higher the pressure is.

Combining both equation (1) and (2), there is:

(3)

From equation (3), it can be concluded that higher the temperature of the steam is, the faster the molecule moves. This conclusion agrees with common sense.

Due to convective heat transfer, the steam loses heat as it moves higher and higher in the pipes. According to , where is the change of heat, is the heat capacity of the steam and is the change of temperature, the temperature of the steam becomes lower as it moves up. Referring back to equation (2) and (3), the lower temperature results in a smaller speed and thus a smaller pressure in the pipe.

Based on this conclusion, we improved our piping system design by adding another horizontal pipe with more holes at a lower higher of the pipe frame. Because this height is low and thus has a higher pressure and higher velocity as concluded earlier. So more steam can be exported out of the holes on this horizontal pipe and go into the clothes to be ironed while reducing the amount of steam that is exported at the higher holes, where little is effective in ironing the clothes since most directly rise to the roof of the chamber.