Homework 2.2

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1 Problem a

$$tan\theta = \frac{0.2}{29.5} \rightarrow \theta = 0.388 \deg$$

2 Problem b

Two methods were used to calculate the delay arm on the interferometer. To start this, a box was move around 6 meters away from the interferometer in the direction of the viewing screen. This is where we found the interference pattern was found at a safe enough distance to ensure we would not burn out the USB spectrometer. Measuring the Green HeNe laser with the USB spectrometer gives a value of 543 nm and simple online search confirms this result with perfect accuracy.

The wavelength of light (λ) can be calculated as

$$\lambda = \frac{2d}{m}$$

where m is. the number of times the fringe pattern is restored to its original state and d is the distance measured in microns. The data collected in the lab for the trials is 4 cycles and 10 microns. The calculated values of λ is

$$\lambda = \frac{2 * (10 * 10^{-9} nm)}{4} \approx 500 nm.$$

While this is not completely accurate with the measurement using the USB spectrometer, it is still in the visible light spectrum.

Using the raspberry pi ...

3 Problem c

$$\frac{n_i - n_f}{P_i - P_f} = \frac{\Delta m * \lambda_o / 2 * d}{P_i - P_f}$$

Where P_i is the initial air pressure, P_f is the final air pressure, n_i is the index of refraction of air at P_i, n_f is the index of refraction of air at P_f, Δm is the wavelength of the laser light in vacuum, and d is the length of the vacuum chamber. After entering all of our data to a code in matlab (appendix A) the index of refraction of air was found shown in the figure below.

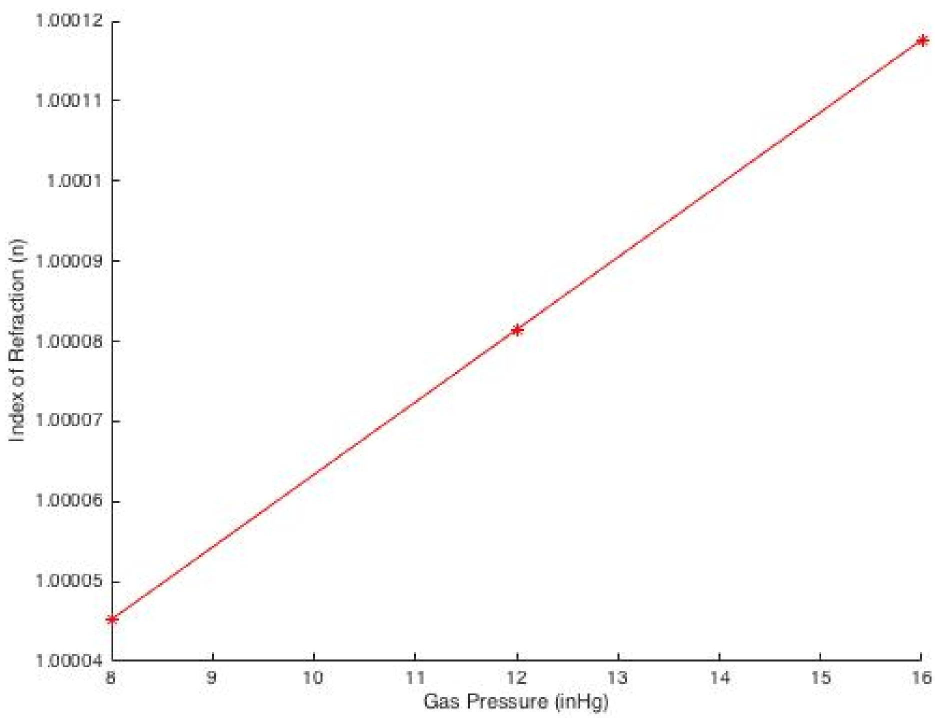

Figure 1: Index of refraction

Problem A

appendix A

```
function homework2_2

pi = 0; %inHg
pf = 8; %inHg
nf = 1;
```

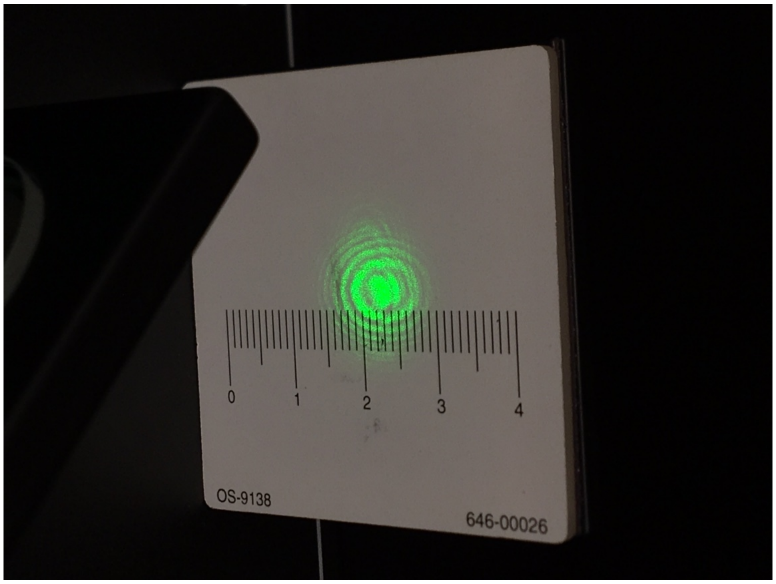

Figure 2: Interference pattern

```
dm = 5;
lambda = 543*10^-9; %nm
d = 0.03; %m

ni = nf+(((dm*(lambda/(2*d)))/(pi-pf))*(pi-pf));

fspec='answer %f \n';
fprintf(fspec,ni)

pi2 = 8; %inHg
pf2 = 12; %inHg
nf2 = 1;
dm2 = 9;
lambda = 543*10^-9; %nm
d = 0.03; %m

ni2 = ((dm2*(lambda/(2*d)))/(pi2-pf2))*(pi2-pf2)+nf2;

fspec='answer %f \n';
fprintf(fspec,ni2)

pi3 = 12; %inHg
pf3 = 16; %inHg
nf3 = 1;
```

```
dm3 = 13;
lambda = 543*10^-9; %nm
d = 0.03; %m

ni3 = ((dm3*(lambda/(2*d)))/(pi3-pf3))*(pi3-pf3)+nf3;

fspec='answer %f \n';
fprintf(fspec,ni3)

x = [pf pf2 pf3];
y = [ni ni2 ni3];

hold on

plot(x,y,'r*-')

ylabel('Index of Refraction (n)')
xlabel('Gas Pressure (inHg)')

hold off

end
```