# Physics 375 - Homework 2

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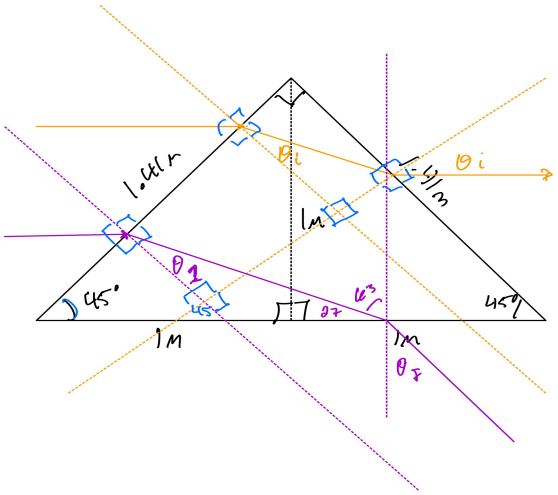
## 1 Problem 1

### 1.1




### 1.2

The first beam will be moving in a line parallel to the beam when it entered.

The second beam will be moving 45° to the incident beam because it has exited a surface which is at an angle 45° to the original surface.

### 1.3

The angle between these two beams should be 45°. To follow my reasoning, please see the drawing above. Since the second beam exits a surface that is at an angle 45° to the surface the second beam is exiting, it should be "shifted" by the same angle. When drawing out the geometry, this is the case.

# 2 Problem 2

## 2.1

At $\theta_c$ the light is internally reflected, so we find $\theta_c$ and use geometry to find the maximum radius the float must have in order to cover all the light up until that point.

$$\begin{aligned} n_i &= 1.35 \\ n_f &= 1 \\ \sin\theta_f &= 1 \end{aligned}$$

Since we know distance from bottom of the pool to the water, we can calculate the radius from:

$$\tan\theta_c = \frac{radius}{2} \tag{1}$$

$$\begin{aligned} 1.35 * \sin\theta_c &= 1 \\ \theta_c &= \sin^{-1}(\frac{1}{1.35}) \\ &= 47.79^\circ \end{aligned} \tag{2}$$

$$\begin{aligned} \tan\theta_c &= \frac{radius}{2} \\ radius &= 2 * \tan\theta_c \\ &= 2.205m \end{aligned} \tag{3}$$

## 2.2

Since we moved 0.2 m to the right (assuming the wall is on the left), we know the incident angle is 45°, since a right triangle is formed with the same length of 2m for both sides (not including the hypotenuse. Therefore, we know our $\theta_i$, and we just have to calculate $\theta_f$. From there, we can again use geometry, knowing we exited the pool 1m from the wall (3m - 2m) and we know the angle which we exited with. We use simple trig functions to calculate the rest.

$$\begin{aligned} n_i &= 1.35 \\ \theta_i &= 45^\circ \\ n_f &= 1 \end{aligned}$$

$$\begin{aligned} n_i * \sin\theta_i &= \sin\theta_f \\ 1.35 * 0.707 &= \sin\theta_f \\ \sin^- 1(0.9545) &= \theta_f \\ &= 71.8^\circ \end{aligned} \tag{4}$$

This is the angle from the normal to the surface, therefore we substract it from 90 to get the angle we can use in our trig function.

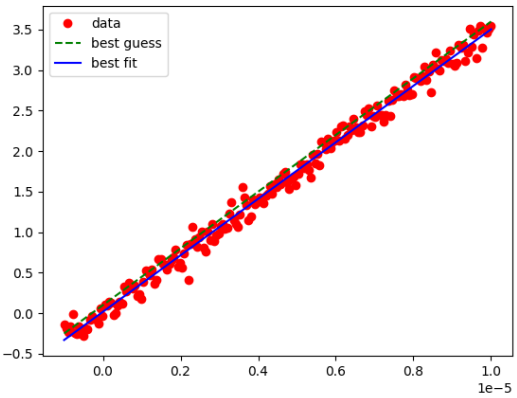
$$\tan 18.2^\circ = \frac{h}{1} \qquad (5)$$
$$h = 0.32m$$

# 3 Problem 3

## 3.1 Linear fit

Best guess slope: 350000
Best guess intercept: 0.1

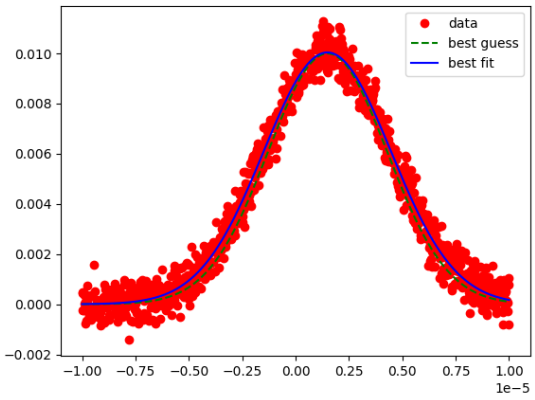
Fit slope: 348617.16
Fit intercept: 0.01789




## 3.2 Gaussian

Best guess mean: 0.01
Best guess $x_0$: 1.5 E-06
Best guess std dev: -2.8 E-06

Fit mean: 0.01004
Fit $x_0$: 1.48647
Fit std dev: -2.9836


data
best guess
best fit
0.010
0.008
0.006
0.004
0.002
0.000
−0.002
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1e−5