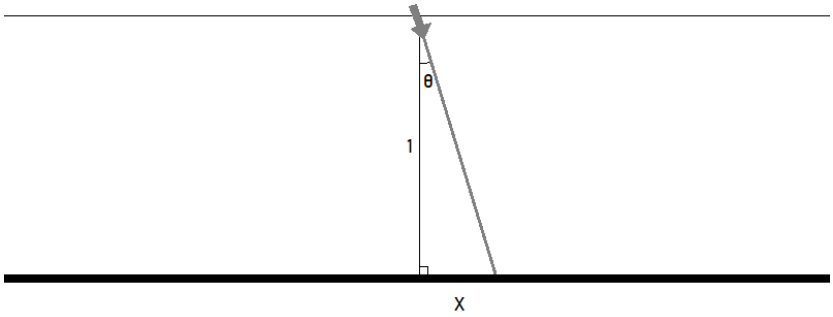
1. Show that the variance of a geometric random variable with parameter p is $\frac{1-p}{p^2}$. What does this mean if $p \approx 0$ or $p \approx 1$? (I'm going to do this example for the class; I'm just writing it here for convenience)

2. Suppose we have a flashlight at the point $(0, 1)$ and a wall on the x-axis. We give it a spin and wait for it to stop at a random angle Θ from the y-axis. We can take Θ to be distributed uniformly on $(-\pi/2, \pi/2)$. Let X be the point on the x-axis where the beam of light hits. (See the picture).



   (a) What is the relationship between Θ and X? (This is a trigonometry problem).

   (b) For any real x, find $F_X(x) = \mathbb{P}(X \leq x)$? (This is called the *cumulative distribution function* of X, and completely describes the distribution of X).

   (c) Use F_X to find the density f_X of X. (Hint: it is of the form $\frac{C}{1+x^2}$ for some constant C).

   (d) Show that $\mathbb{E}X \neq 0$ even though the distribution of X is symmetric about zero.