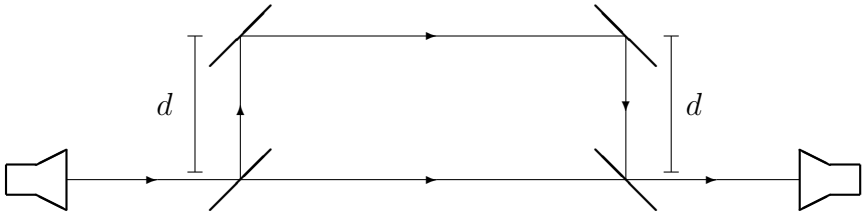
Assignment 2; Phys 186 Name _____

Note: You can ask me for help; for example, have me check if an answer is correct. Talk to me: you'll learn some physics, and that's the point of the course.

1. (20 points) You have the following interferometer set up in a lab:



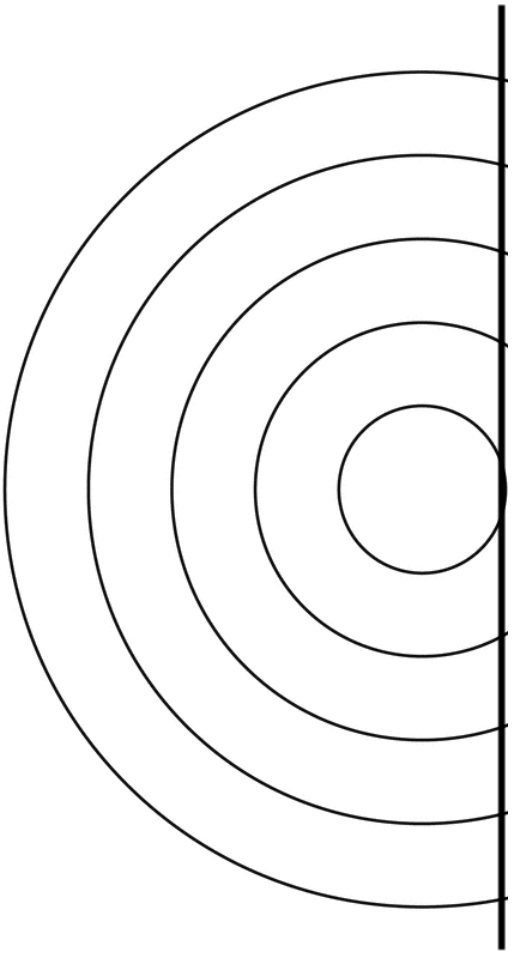
You have a microwave source on the left, and a microwave detector on the right. The microwaves have a wavelength of 3.00 cm.The two diagonal lines on top stand for fully silvered mirrors; the two diagonal lines lined up with the source and detector are half-silvered mirrors that reflect and transmit half the incident microwave intensity. The distance between the pairs of fully silvered and half-silvered mirrors is $d = 10.0$ cm. All other distances are irrelevant to the problem.

In other words, you split the microwave beam in two, and make one part travel a longer distance before joining the original beam.

Now you start increasing d (on both sides). Find the next two values of d for which you get *constructive* interference (an intensity maximum at the detector).

2. (30 points) You have water waves on the surface of a lake, with wavefronts that spread as concentric circles from a central source, traveling at a constant speed v_{deep}. The straight line indicates a boundary where the lake bottom suddenly steps up, so the waves enter a shallow region where $v_{\text{shallow}} < v_{\text{deep}}$.

(a) Draw how the wavefronts will look in the shallow part of the lake.



(b) Briefly explain your reasoning.

3. (50 points) You have an electric dipole arranged on the x-axis: a $+q$ charge at $x = +a$ and a $-q$ charge at $x = -a$. The charges are connected by a rigid rod, so the distance between them never changes.

(a) Calculate the electric field created by this dipole on point on the x-axis, for $x > a$. Get both magnitude and direction.

(b) Calculate the force the first dipole exerts on another dipole further down the x-axis. Get both magnitude and direction.

(c) You now have the second dipole oriented perpendicular to the first:

Qualitatively sketch the forces on this second dipole due to the first dipole. Also indicate in what direction (clockwise or counterclockwise) it rotates. Very briefly explain why.

(d) What can you conclude about dipole-dipole interactions from this problem? Do dipoles attract or repel one another? How do they orient themselves relative to each other?