Homework Assignment #8

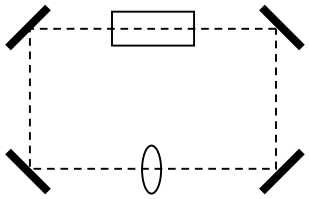
1) **7.15**

   This is a common situation. Use Figure 5.13 to help determine the aperture size. (You may wish to re-read Section 5.5.2. An accurate value cannot be read off the graphs, so just do the best you can. The key point here is that the loss for the TEM_{01} mode is larger than that for the TEM_{00} mode.)

2) **7.16**

3) **7.17**

4) Consider the CW ring laser shown. Its dimensions are 30 cm x 20 cm. The gain medium has index of refraction n = 1.6 and a length of 10 cm. All the mirrors are flat and have R=1 except one mirror which has R = 90%. The round-trip internal loss is 4%. (Apparently the lens and gain medium are AR coated.)



   (a) What are the allowed values of the lens focal length if the cavity is to support a stable, Gaussian mode?

   (b) Sketch the allowed stable mode (or modes) of the cavity. By this I mean that you should take the figure above and add 1/e contour lines so that it is clear where the waist or waists occur, where the beam is largest, etc.

   (c) What is the longitudinal mode spacing and what is the width of a longitudinal mode? You'll need to modify the expressions we found for these quantities for a linear cavity. We still require a self-consistent mode, so the phase change per round trip should still be an integer multiple of 2π.

   (d) Why is the use of a lens better than using curved mirrors? Or is it? If the gain medium had been Brewster cut instead of having flat faces, how would your answer change?

5) An amplifier with a small-signal gain of 10 dB (G = 10) is irradiated by a square pulse of 100 ns duration. The saturation energy of the amplifier is 100 mJ/cm^2. Consider three cases: an input fluence of 10 mJ/cm^2, 50 mJ/cm^2 and 200 mJ/cm^2 at the input.

   (a) Plot the output pulse shape versus time for each case.

   (b) Find the output fluence for each case.