Opti 435/535 - Midterm October 7, 2009

Instructions: Graduate Students do all four problems. Undergraduates choose any three.

1. A wavefront has spherical aberration and coma and is given by the following expression:

$$W=0.00004r^4 - 0.00003r^3\cos\theta$$

   (a) What is the power error $d\phi$ for this wavefront?
   (b) For the horizontal meridian, plot $d\phi$.
   (c) For a pupil diameter of 2 mm (r = 1 mm), plot $d\phi$ as a function of θ.

2. Suppose you have two lenses with prescriptions +1.00 / +2.00 x 40º and +1.00 / +2.00 x 30º. What is the combined power of these lenses? **Give your answer in both plus cylinder form and minus cylinder form.**

3. A wavefront of the form $W = -0.002x^2$ is measured with a Shack Hartmann sensor for a 4 mm diameter pupil. Suppose the lenslets of the array have a focal length of 24 mm and a spacing of 1 mm.

   (a) What does the *unaberrated* Shack Hartmann pattern look like?
   (b) What are the focal spot shifts Δx and Δy for each spot?
   (c) What does the Shack Hartmann pattern look like for the wavefront W?

4. The far point of the eye is 1 m in front of the eye. The near point is 0.5 m in front of the eye.

   (a) Is the person near-sighted or far-sighted?
   (b) How much accommodative amplitude (in diopters) do they have?
   (c) What power contact lens is needed to correct their eye to infinity?