Phys 375 - Homework #3

1) You have a converging lens with focal length 20 cm, and a diverging lens with unknown focal length. You place the converging lens after the diverging lens, with a separation of 2 cm, and a light bulb filament 76 cm before the diverging lens. Using a screen you find an image of the filament 40 cm after the converging lens.

a) (2 pts) Is the image real or virtual?

b) (2 pts) Where is the image created by the diverging lens? Is it real or virtual?

c) (2 pts) What is the focal length of the diverging lens?

d) (2 pts) If all of the distances listed above have error of 0.5 cm, (including the focal length of the converging lens), what is the error on your measurement of the diverging lens focal length?

2) (6 pts) What is the minimum distance between a real object and its real image formed a converging lens, in terms of its focal length f?

3) Sketch the following ray trace diagrams, on a one-to-one scale using a ruler, and find the images formed. Use objects that are 1 cm tall, and confirm your measurements using the thin lens equation.

a) (2 pts) Converging lens with focal length 3 cm, and an object distance of 8 cm.

b) (2pts) Converging lens with focal length 3 cm, and an object distance of 1 cm.

c) (2pts) Diverging lens with focal length 3 cm, and an object distance of 1.5 cm.

4) (5 pts) An object and a screen are 48 cm apart, and you have a converging lens with a focal length of 9 cm. Find the two locations where you can place the lens and form an image on the screen.

5) (4 pts) A double convex lens has a diameter of 5 cm and zero thickness at its edges. A point object on an axis through the center of the lens produces a real image on the opposite side. Both object and image distance are 30 cm, measured from a plan bisecting the lens. The lens has a refractive index of 1.52. Using the equivalence of optical paths through the center and the edge of the lens (Fermat's principle of least time – all converging rays must all take the same time), determine the thickness of the lens at its center.

6) (4pts) A presbyopic eye has no astigmatism, a near point of 125 cm, and a far point of infinity. Correction, with glasses using a lens placed 1.5 cm from the eye, requires that this person see objects at the normal near point (25 cm) clearly.

a) What is the power of the corrective lens?

b) With the lens of part (a), what is the far point of the corrected eye?