Refraction of Light
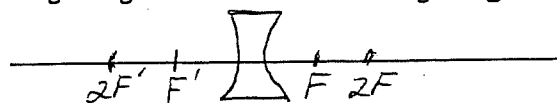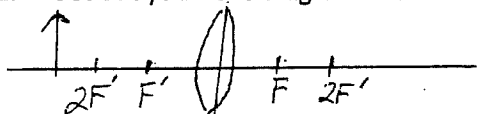
Take 26 minutes to get a head start and then I will provide the answers.

1. Get out your lens diagram sheet and do at least one real image diagram and one virtual image diagram.

2. If the focal length of a converging lens is 5 cm and the object is located at 13 cm. Find the distance of the image and the magnification.

$$S_i =$$ $$M =$$

3. If the distance of the object is 7 cm and the distance of the image is 14 cm for a converging lens find the focal length and the magnification.

$$f =$$ $$M =$$

4. If the focal length of a diverging lens is -5 cm and the object is located at 13 cm. Find the distance of the image and the magnification.

$$S_i =$$ $$M =$$

5. What is the speed of light in glass with index of refraction 1.48?

$$V_{glass} =$$

6. What is the angle of refraction of a ray whose angle of incidence is 26 degrees and is going from water to air?

$$\angle r =$$

7. What is the index of refraction of a substance whose angle of incidence is 10 degrees and whose angle of refraction is 12 degrees if the light is going from this substance into air?

$$n =$$

8. What is the critical angle for water into air?

$$\theta_c =$$

9. Draw the diagram for the mirage of a water puddle appearing in the road on a hot day.

10. Draw two raindrops showing the route of a ray of red and blue light through the drops for both the 1st rainbow and the 2nd rainbow.

11. Name all the labs we did this unit.

1.   2.   3.   4.

12. Name all the demonstrations we did this unit.

1.   2.   3.   4.   5.   6.

13. Draw light traveling by TIR through a fiber optic cable or the pissing bucket.

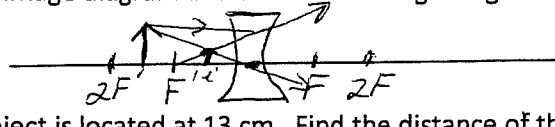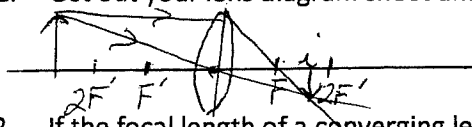**KEY**

Take 26 minutes to get a head start and then I will provide the answers.

1. Get out your lens diagram sheet and do at least one real image diagram and one virtual image diagram.

2. If the focal length of a converging lens is 5 cm and the object is located at 13 cm. Find the distance of the image and the magnification.

$$S_i = \frac{S_o f}{S_o - f} = \frac{(13\,cm)\cdot(5\,cm)}{(13-5)\,cm} = \boxed{\frac{65}{8}\,cm} \quad 8\tfrac{1}{8}\,cm$$

$$M = -\frac{\frac{65}{8}\,cm}{13\,cm} = -\frac{65}{8}\times\frac{1}{13} = \boxed{-\frac{5}{8}}$$

3. If the distance of the object is 7 cm and the distance of the image is 14 cm for a converging lens find the focal length and the magnification.

$$f = \frac{S_o S_i'}{S_o + S_i'} = \frac{(7\,cm)(14\,cm)}{21\,cm} = \boxed{\frac{14\,cm}{3}}$$

$$M = -\frac{S_i'}{S_o} = -\frac{14\,cm}{7\,cm} = \boxed{-2}$$

4. If the focal length of a diverging lens is -5 cm and the object is located at 13 cm. Find the distance of the image and the magnification.

$$S_i = \frac{S_o f}{S_o - f} = \frac{(13\,cm)(-5\,cm)}{(13--5)\,cm} = \boxed{-\frac{65}{18}\,cm}$$

$$M = -\frac{-\frac{65}{18}\,cm}{13\,cm} = +\frac{65}{18}\cdot\frac{1}{13} = \boxed{+\frac{5}{18}}$$

5. What is the speed of light in glass with index of refraction 1.48?

$$V_{glass} = \frac{c}{n} = \frac{3\times10^{8}\,m/s}{1.48} = \boxed{2.027\times10^{8}\,m/s}$$

6. What is the angle of refraction of a ray whose angle of incidence is 26 degrees and is going from water to air?

$$\frac{\sin\angle i}{\sin r} = \frac{n_2}{n_1} \quad \frac{\sin 26°}{\sin r} = \frac{1}{1.333}$$

$$\sin r = 1.333\sin 26° \quad \angle r = \sin^{-1}(.5843) \quad \boxed{\angle r = 35.76}$$

7. What is the index of refraction of a substance whose angle of incidence is 10 degrees and whose angle of refraction is 12 degrees if the light is going from this substance into air?

$$\frac{\sin\angle i}{\sin r} = \frac{n_2}{n_1} \quad n_1 = \frac{n_2\sin r}{\sin i} = \frac{(1)\sin 12°}{\sin 10°} = \frac{.2079}{.1736} = \boxed{1.19758} \quad \boxed{n = 1.198}$$
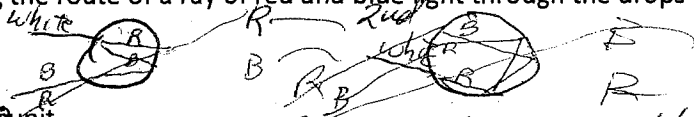
8. What is the critical angle for water into air?

$$\sin\theta_c = \frac{n_2}{n_1} = \frac{1}{1.333} = .75 \quad \boxed{\theta_c = 48.6°}$$

9. Draw the diagram for the mirage of a water puddle appearing in the road on a hot day.

10. Draw two raindrops showing the route of a ray of red and blue light through the drops for both the 1st rainbow and the 2nd rainbow.

11. Name all the labs we did this unit.
    1. GA   2. Lens LAB   3. Index of Refraction   4. 1.333

12. Name all the demonstrations we did this unit.
    1. brain image Turkey   2. fiber optic   3. pissing bucket   4. bearings   5. magic bubbles   6. shell game   7. white board optics   8. lens watch

13. Draw light traveling by TIR through a fiber optic cable or the pissing bucket.

TIR