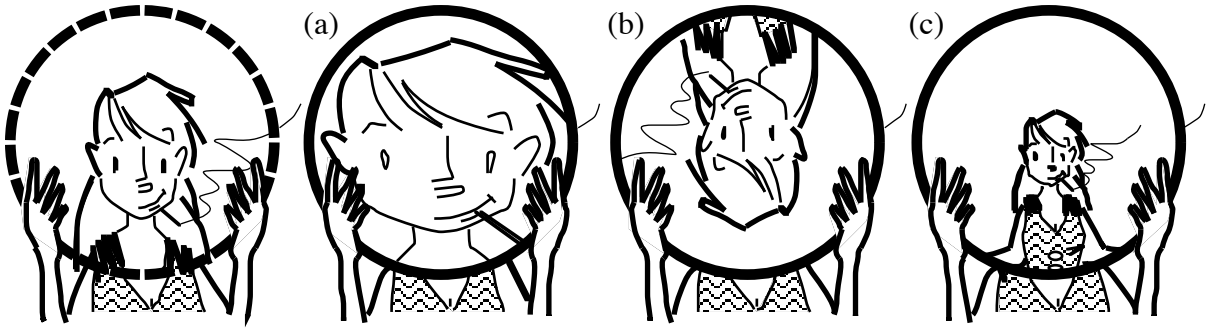
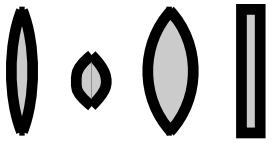
Exercises

1. Fray is holding up several large pieces of curved pieces of glass in front of her. Determine the type of lenses (converging/diverging) these are, and what kind of Fray image (real/virtual) you are seeing through the glass.



This is Fray with no lens in front of her.

2. Rank these lenses ((I)-(IV)) from shortest to longest focal point. Then rank these lenses from greatest to least optical strength.



3. Kelly's eyeglasses have a focal length of +10cm and Fray's eyeglasses have a focal length of -5cm. Whose eyeglasses could start a fire by focusing the light from the Sun onto a piece of newspaper to ignite it—Fray's or Kelly's?

4. Lens Practice: i) Locate the each of the following objects with a ray tracing, ii) Locate each of the following objects with the thin lens equation, iii) Determine the magnification with your ray tracing, iv) Determine the magnification mathematically, v) Check that your answers match (if you didn't already), vi) Check your work with the applet on the course web page.

a) An object is placed 4 cm from an f=+10cm lens.
b) An object is placed 8 cm from an f=+10cm lens.
c) An object is placed 8cm from an f=-10cm lens.
d) An object is placed 18 cm from an f=+10cm lens.
e) An object is placed 18 cm from an f=-10cm lens.
f) An object is placed 15cm from a converging lens that has a focal length of +7.5cm?

5. Refer to your ray tracing diagrams for a one lens system that you complete for FNTs. For each of the following statements, indicate whether they are true or false.

(a) A real image is *always* on the opposite side of a converging lens as the object. [T|F]
(b) A virtual image is *always* on the same side of a converging lens as the object. [T|F]

(c) A virtual image is *always* on the same side of a diverging lens as the object. [T|F]

6. Refer to your ray tracing diagrams for a one lens system that you completed in FNTs. For each of the following statements, indicate whether they are true or false.
(a) A converging lens will *always* make a real image when the object is within the near *f*. [T|F]
(b) A diverging lens will *always* make a virtual image that is smaller than the original object. [T|F]
(c) A converging lens will *always* make a real image that is smaller than the original object. [T|F]
(d) A converging lens will *always* make a virtual image that is larger than the original object. [T|F]

7. What is the focal length of a diverging lens that has an object that is 10cm from the lens and an image that is 5 cm from the object?

8. A converging lens produces a virtual image from an object held to the left of it. A second converging lens is then placed to the right of the first converging lens. If the focal length of the first lens is longer than the focal length of the second lens, is it possible for a real image to be produced by the second converging lens? [T|F]

9. A converging lens produces a virtual image from an object held to the left of it. A second converging lens is then placed to the right of the first converging lens. If the focal length of the first lens is longer than the focal length of the second lens, is it possible for a virtual image to be produced by the second converging lens? [T|F]

10. A converging lens produces a virtual image from an object held to the left of it. A second converging lens is then placed to the right of the first converging lens. If the focal length of the first lens is longer than the focal length of the second lens, is it possible that no image to be produced by the second converging lens? [T|F]

11. Is a concave (curves in) lens a converging lens or a diverging lens?

12. Is a convex (curves out) lens a converging lens or a diverging lens?

13. If an image is on the left side of a lens (*i.e.*, same side as the object), does that make the image distance positive or negative?

14. If an image is on the right side of a lens (*i.e.*, opposite side as the object), does that make the image distance positive or negative?

15. Which lens can burn crumbs—converging or diverging?

Exercise Solutions

1. (a) converging, virtual.
(b) converging, real.
(c) diverging, virtual.

2. Ranking these by focal length from shortest to longest will give us: (II), (III), (I), and (IV). Now, ranking these by optical strength from least to greatest will give us: (IV), (I), (III), and (II).

3. Since Kelly's eyeglasses have a positive focal length, they must be converging lenses (and Fray's are diverging). Converging lenses focus real light rays and would be the lenses that could start a fire on a newspaper.

4. **a)** image distance is -6.67cm; same side of lens as the object, upright, M=1.67.
b) image distance is -40cm; same side of lens as the object, upright, M=5
c) image distance is -4.44cm; same side of lens as the object, upright, M=5/9=0.556
d) image distance is +22.5cm; opposite side of lens as the object, inverted, M=-1.25
e) image distance is -6.43cm; same side of lens as the object., upright, M=5/14=0.357
f) image distance is +15cm.; opposite side of lens as object, inverted, M=-1.

5. Statements (a), (b), (c) are true.

6. Statements (b) and (d). Statements (a) and (c) are false.

7. Using the thin lens equation, and the information that the image distance is -5cm; since it is on the same side of lens as the object. We find that the focal distance is -10cm.

8. This statement is true.

9. This statement is true.

10. This statement is false. However, if the focal length of the second lens is longer than the focal length of the first lens, then this statement would also be true!

11. A concave lens is a diverging lens.

12. A convex lens is a converging lens.

13. This will make the image distance negative.

14. This will make the image distance positive.

15. Definitely a converging lens can burn crumbs, since it has parallel light rays from the sun converging at the focus.