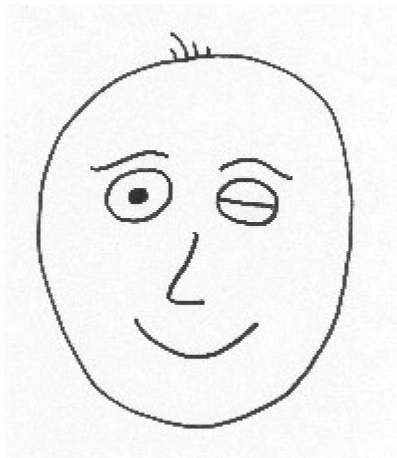
# Question #114

Well, shucks, it's time for another Otto set. It sort of makes you wonder how long this can keep up. If you have not yet done an Otto set, click to go to Question 97, Question 99, Question 102, Question 105, or Question 108, the previous Otto exercises. Shown in the drawing below is the face of Otto, the object for the optics exercises to follow. By clicking your mouse here you may view or print out the array of possible image faces that Otto might create when he positions himself at the appropriate place relative to the optical component under consideration. Again your job is to determine the characteristics of the image and answer questions about it. You may use any available technique, such as ray tracing, calculation, experience, looking it up in a textbook, or even building your own experiment.



You are to determine the following image characteristics:

- 1. the orientation and the relative size and shape of the image, by selecting from among the 28 examples given in the page linked above.
- 2. the location from where you must look to see the image.

Other details that you might want to ascertain include:

- 1. the location of the image.
- 2. the magnification.
- 3. whether the image is real or virtual.

The three optical elements for this week are:

- 1. **A parabolic concave mirror**: Otto will stand at a distance of four times the focal length in front of a spherically symmetric concave mirror, so that an observer at the mirror would see Otto's face as in the photograph above.
- 2. **A horizontally focusing cylindrical convex mirror**: Otto will stand at a distance equal to the focal length in front of a cylindrically symmetric convex mirror, so that an observer at the mirror would see Otto's face as in the photograph above.
- 3. **A horizontally focusing cylindrical convex lens**: Otto will stand at a distance equal to four times the focal length from a horizontally focusing cylindrical convex lens, oriented like a

vertical log in front of Otto. He again faces the lens so that an observer at the lens would see Otto's face as in the photograph above.

Click here for Answer #114 after April 29, 2002.

---

Question of the Week

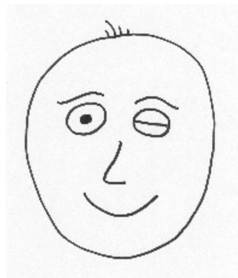
Outreach Index Page

Lecture-Demonstration Home Page

For questions and comments regarding the *Question of the Week* contact Dr. Richard E. Berg by e-mail or using phone number or regular mail address given on the Lecture-Demonstration Home Page.

## Background for Face Questions

This week we present one in a series of geometrical optics questions involving the image of the peculiar face below as produced by a variety of optical elements, such as different types of lenses and mirrors. Because there are a large number of them we will do a few at a time and present these problems on alternate weeks, mixed in with problems dealing with other topics.



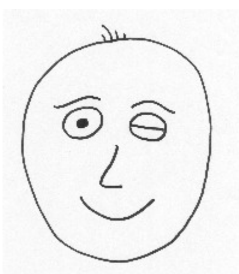
This is a peculiar face, with no ears and only the tiniest lock of hair. No one wanted to call him "Dufus," so we will name him "Otto," because OTTO spelled out in block capital letters reflected in a mirror spells "OTTO."

Below are 28 different possible images of the face above, organized as seven sets of four. These image faces are available for a neat printout on two pages using ".pdf" files: click for Image Faces Page 1 or Image Faces Page 2. Alternatively, these files are available as ".htm" documents: Image Faces Page 1 HTML or Image Faces Page 2 HTML. The document Faces contains all of the faces.

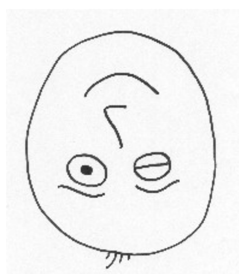
Note that there are seven rows of faces, each of which contains images with four permutations of inversion: normal, inverted vertically, inverted horizontally, and inverted both horizontally and vertically. The seven sets of images show the "normal" face (a-d), the face magnified along both axes (e-h), the face demagnified along both axes (i-l), the face magnified along the vertical axis only (m-p), the face demagnified along the vertical axis only (q-t), the face magnified along the horizontal axis only (u-x), and the face demagnified along the horizontal axis only (y-bb). Note that there is a difference between image sets (m-p) and (y-bb), also between image sets (q-t) and (u-x).

Return to the question for this week by clicking on the "back" button to view the actual questions.

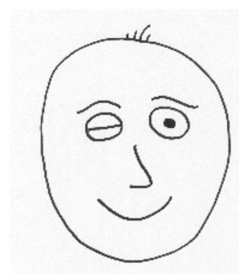
## Possible Images



(a)



(b)

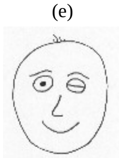


(c)

(e)

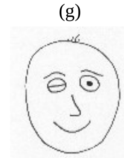
(f)

(g)



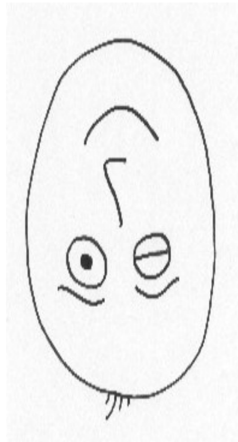
(i)

(j)

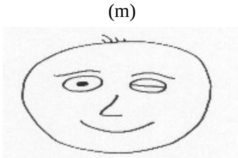


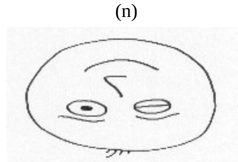
(k)

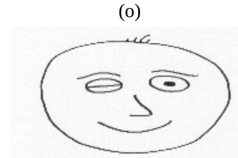

(m)

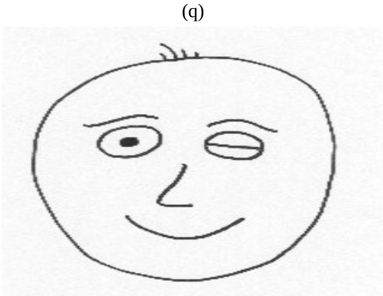

(n)

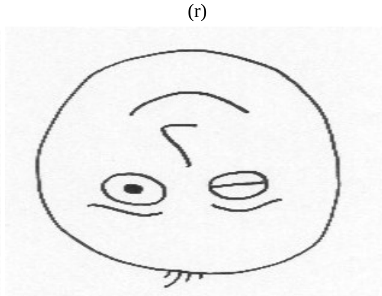

(o)

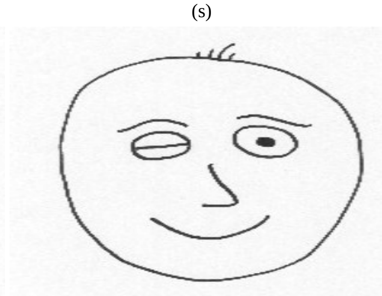

(q)


(r)


(s)


(u)


(v)


(w)

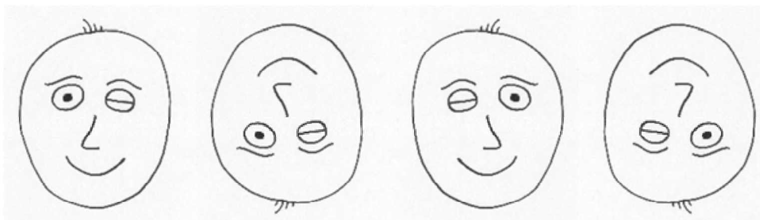

(y)


(z)

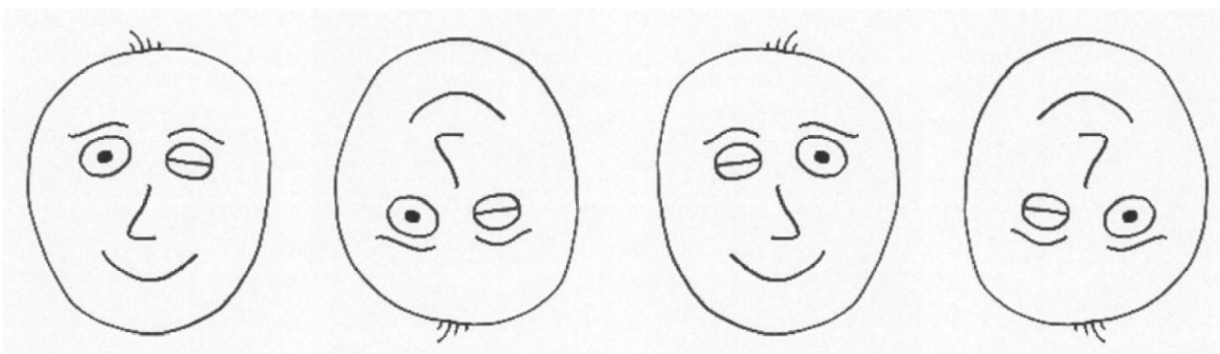

(aa)

R emhfw=#

Srvvleoh#Ip djhv#+sdjh#4#ri#5,=#



+d,################+e,################+f,###############+g,#

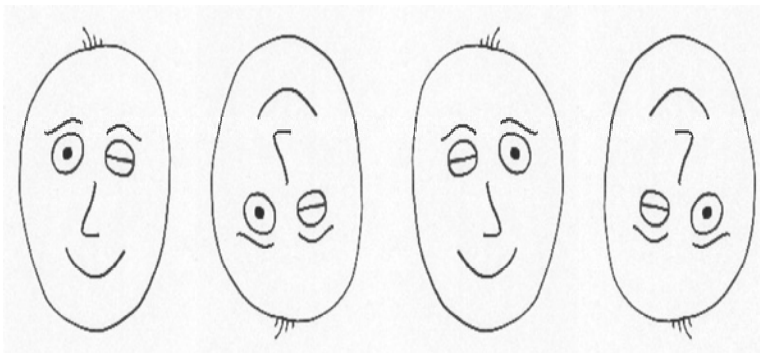


+h,##########################+i,###########################+j,########################+k,#

+l,#######+m,#######+n,#######+o,#

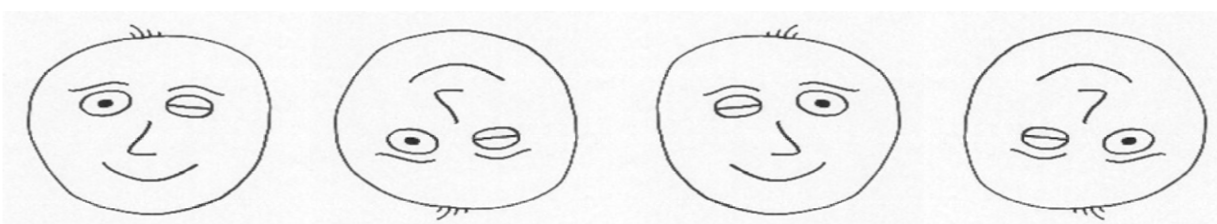
R emhfw=#

Srvvleoh#lpdjhv#+sdjh#5#ri#5,=#

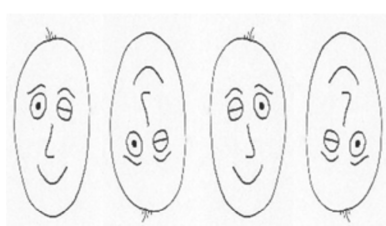


+p ,################+q,################+r,################+s,#

+t,################+u,#################+v,################+w,#



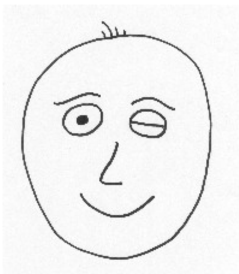
###############+x,#############################+y,###########################+z ,##########################+{,#



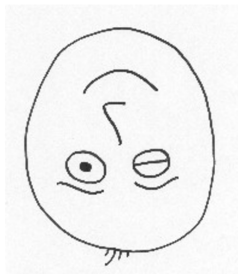
+|,######+},######+dd,#####+ee,#

## Object:

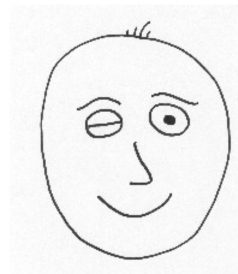
## Possible Images



(a)

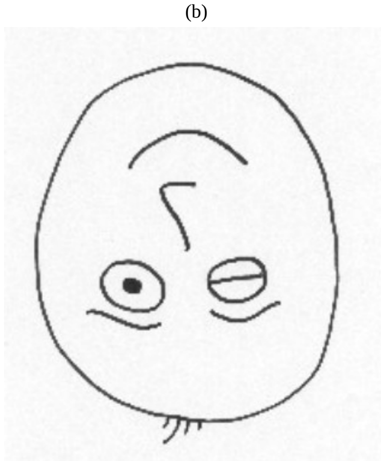


(b)



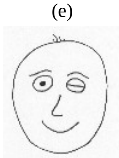
(c)

(e)



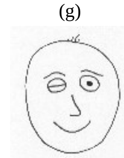
(f)

(g)



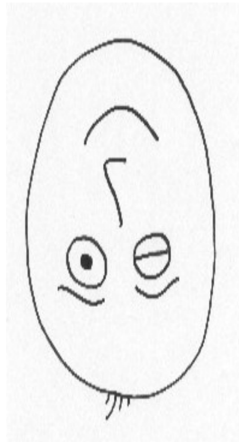
(i)

(j)



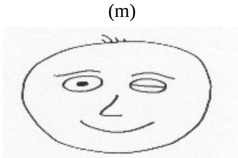
(k)

(m)

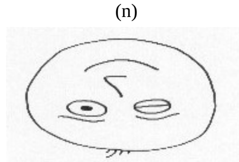


(n)

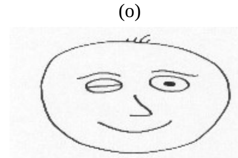
(o)



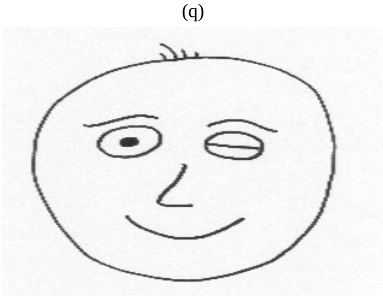
(q)



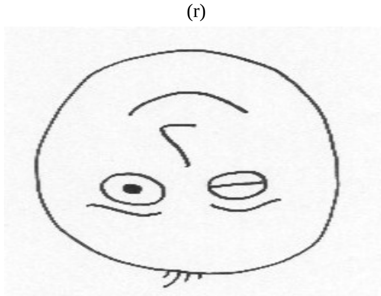
(r)



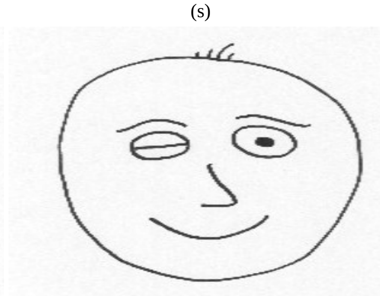
(s)



(u)



(v)



(w)

(y)

(z)

(aa)