

STEREOSCOPY TEST AND OBJECT RECOGNITION

Laboratory Exercise

Air Photo Inter. & Photogrammetry

Name _____

Please Print

Photos: M1337-54, 55, 56 (Instructor)

"I have neither given nor received unauthorized aid on this assignment."

Signature _____

Objectives

1. To determine your stereoscopic viewing ability.
2. To learn how to set up a pair of overlapping aerial photographs for stereo viewing.
3. To practice applying the seven principles of photo interpretation to identify objects or features on photographs.

Stereo Viewing and Photo Interpretation

A. Guides to Better Stereo Viewing and Photo Interpretation:

1. Use the best equipment available for the job, and make sure it is clean, especially lenses and reflecting surfaces.
2. Illumination is very important--more important than in ordinary vision because the interpreter is basing much of his or her information on tone difference.
 - a. Illuminate the darkest areas of the photo so that they can be seen clearly.
 - b. Light should be even, steady, and cool. Adjustable fluorescent lamps are best.
3. Some people find they do not need to use their glasses when using a stereoscope. However, if the correction is for unequal vision, (different eye strengths) or for a spherical anomaly (e.g. an astigmatism) you will probably need to wear your glasses. Try viewing with and without your glasses to determine which is more comfortable for you.
4. Do not work for long periods of time. Your eyes do tire, and after a steady two hours of viewing your rate of information extraction decreases significantly.
5. Be as comfortable as possible when interpreting. Especially, make sure you are sitting at the proper height for the particular table and equipment you are using.

B. The Stereoscope:

1. Stereoscope: A binocular instrument for assisting the observer to view two properly oriented photographs or diagrams to obtain the mental impression of a three-dimensional model.
2. The lens stereoscope which you will use has the advantage of being inexpensive, portable, and provides a magnified three dimensional image. Its main disadvantage is that the entire overlap area of standard aerial photographs cannot be viewed at one time.
3. There are several other types of stereoscopes. Some of which are described at the back of this lab. During the semester, you will have opportunities to try out some of these. Familiarize yourself with the descriptions so that you will be prepared to identify and work with other types of stereoscopes.

C. Stereograms:

Using the materials provided, perform the following activities:

1. Measuring Interpupillary Distance (IPD)

With the aid of another student, determine your interpupillary distance also known as eye base; that is, the distance between the centers of the pupils of your eyes. This is done by looking at infinity while the other student measures the distance in inches using a ruler.

Record your INTERPUPILLARY DISTANCE: _____ inches.

Convert this measurement to millimeters. There are 25.4 mm in an inch. Interpupillary Distance: _____ mm. Then set this distance on the adjustable center portion of your stereoscope. This is only an estimate of the lens separation which will be most comfortable for you. If you do not see stereoscopically with this distance, vary the adjustment until best suited for you.

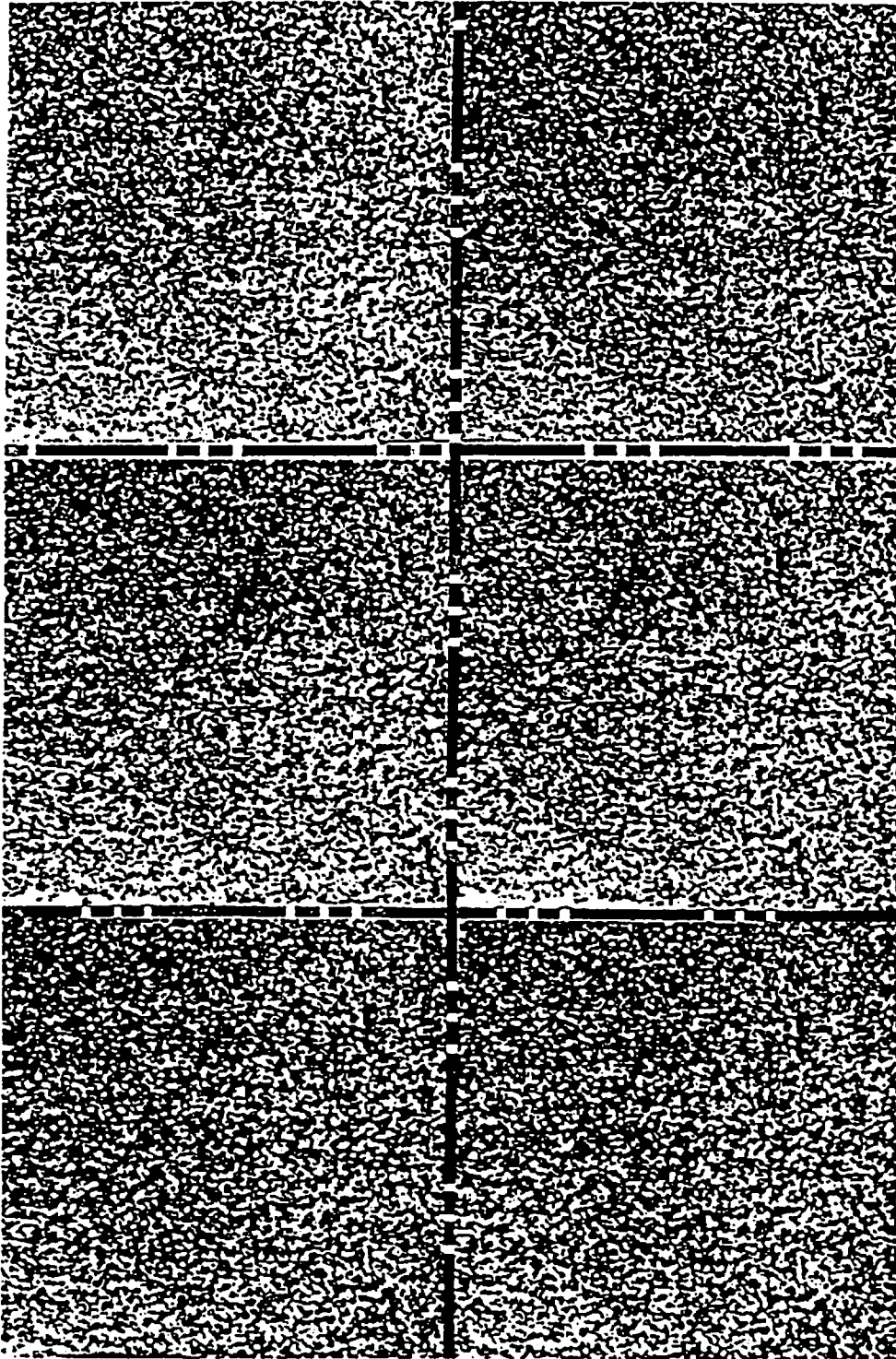
Note that stereograms are mounted in place, usually in accordance with an average eye base around 60 mm or 2.25 in. Consequently, you may have to adjust your lens spacing to conform to the spacing of the stereogram.

2. Position a lens stereoscope over the hidden word stereograms provided (also in the Avery textbook). What words appear in the three views?

Top View _____

Middle View _____

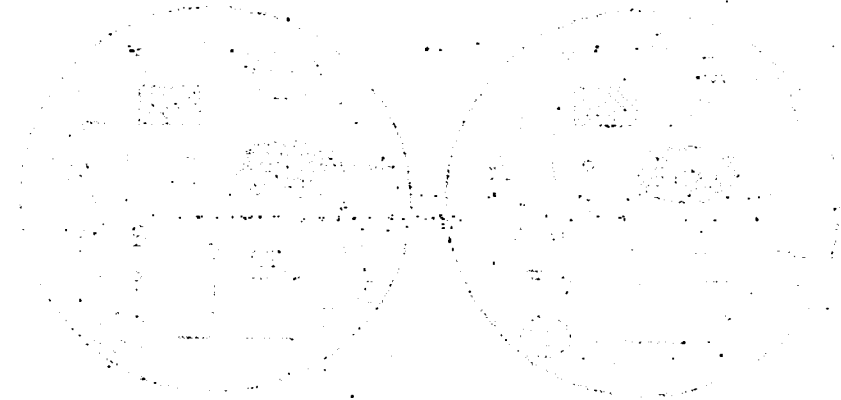
Bottom View _____



Hidden-word stereoscopic test developed by Sims and Hall (1956).

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4. Complete the Floating-Circle Stereogram Test, using the answer sheet provided. (Also in Figure 3.18 page 60 in the Paine text.) Be sure to read the instructions carefully.

**INSTRUCTIONS FOR TAKING THE FLOATING-CIRCLES TEST FOR
STEREOSCOPIC PERCEPTION**

1. Adjust the lenses to the most comfortable spacing for your eyes.
2. Set the stereoscope up over Block A of Stereogram I. If you can readily superimpose the A's centered in each half of the block, use this stereogram for the test. If it is impossible to fuse the letters on this one, shift the stereoscope to Stereogram II below, which has a separation distance one-third of an inch shorter.
3. After selecting the more "comfortable" of the two stereograms, adjust the instrument so that the A's are superimposed again. Then beginning with row A, record the number of each circle that appears to "float" above the datum plane formed by the paper and rest of the circles.
4. When you have completed Block A, shift the stereoscope down to rest directly over Block B. After making sure that the two B's are superimposed, proceed as in 3.
5. Repeat the process for Blocks C and D.

CAUTION: BE SURE THAT YOU:

- A. Set the stereoscope to a lens separation normal for your eyes, and you use the stereogram (I or II) that is within this separation range.
- B. View the stereogram directly below the center of the lens, even though this means shifting the stereoscope to the right or left and vertically as the test progresses. Any attempt to look through the lens at an angle will produce a curved datum and make it harder to recognize the floating circles.
- C. See that the letters centered in each block are superimposed--any other orientation will cause the wrong circles to float.
- D. Read the stereogram systematically from left to right starting with the top line of Block A. Skipping around or reading vertically merely increases the difficulty, and may result in errors.

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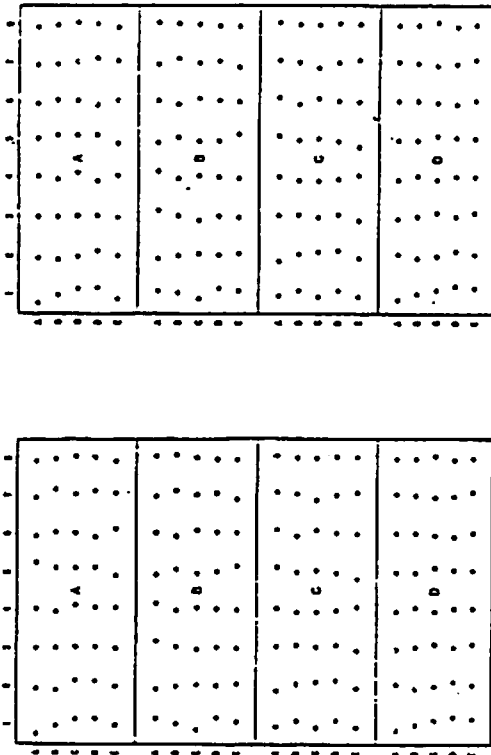
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FLOATING-CIRCLES STEREOGRAM TEST SHEET

USFS Central States Forest Experiment Station, Technical Paper 144

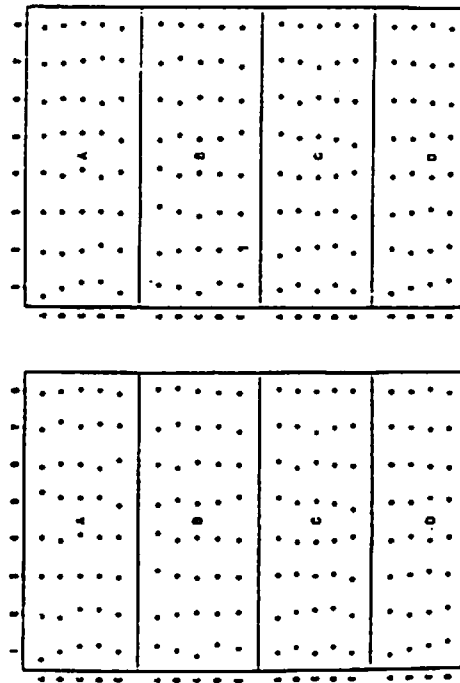
Stereogram I

(Lens separation - 2.25 inches)



Stereogram II

(Lens separation - 1.9 inches)



Upper and lower stereograms are the same except for IPD. Choose the stereogram which you find most comfortable to view in stereo. At least one circle in each row appears to float above the datum plan.

In each row and block mark the number of each circle that appears to float above the datum plane formed by the paper.

	1	2	3	4	5	6	7	8
A	1	2	3	4	5	6	7	8
B	1	2	3	4	5	6	7	8
C	1	2	3	4	5	6	7	8
D	1	2	3	4	5	6	7	8
E	1	2	3	4	5	6	7	8
A	1	2	3	4	5	6	7	8
B	1	2	3	4	5	6	7	8
C	1	2	3	4	5	6	7	8
D	1	2	3	4	5	6	7	8
E	1	2	3	4	5	6	7	8
A	1	2	3	4	5	6	7	8
B	1	2	3	4	5	6	7	8
C	1	2	3	4	5	6	7	8
D	1	2	3	4	5	6	7	8
E	1	2	3	4	5	6	7	8

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Photo interpretation involves the synthesis of one or more "clues" as to the identity and significance of the feature(s) being analyzed. Generally objects are recognized on aerial photographs according to their:

1) tone, 2) texture, 3) pattern, 4) shape, 5) shadow, 6) size, 7) association with surrounding objects (location or site), and 8) the interpreter's knowledge of the area.

For example, bare soil or rocks are light in tone, grass is somewhat darker, brush is darker, forest is even darker, and water and shadow appear darkest. Roads, railroads, irrigation canals, and highways are recognized by their size and shape. Grass and water have smooth textures; brush, rocks, and trees have rough textures. Orchards and farmlands have regular patterns while wildland and forest do not have any particular pattern.

The first seven of these are known as the basic principles of photo interpretation. The eighth principle is added to emphasize that the best interpreter is, first, knowledgeable within a specific discipline and, then, has learned to use photography as an aid within that discipline.

5. Using the 10-part stereogram issued to you, interpret 20 of the 50 points numbered on these stereograms. Indicate your answer by placing an "X" before one of the four possible answers on the answer sheet on the back of this page. Then use the answer sheet at the back of the lab to further familiarize yourself with object recognition on aerial photos and correct your answer(s) for the ones that you have missed, if any (see Paine text, Chapter 13).

Answer Sheet for Problem #5

<u>a</u>	<u>b</u>	<u>c</u>	<u>d</u>
1. ___ plantation	___ piles of rock	___ orchard	___ vineyard
2. ___ bridge	___ dam	___ siphon	___ ford
3. ___ drain ditch	___ fence line	___ irrigation canal	___ highway
4. ___ borrow pit	___ farm pond	___ basement hole	___ sludge pit
5. ___ farm building	___ mine building	___ lumber pile	___ haystack
6. ___ dry ditch	___ railroad grade	___ pack trail	___ road
7. ___ small town	___ construction camp	___ mine building	___ ranch building
8. ___ aspen	___ cottonwood	___ pine	___ spruce
9. ___ irrigated field	___ plowed field	___ swamp	___ tall grass
10. ___ farm buildings	___ lumber piles	___ baled hay piles	___ corral
11. ___ bare ground	___ grass-sagebrush	___ rock slope	___ sand slope
12. ___ irrigation ditch	___ fence line	___ hedgerow	___ windbreak
13. ___ clay bank	___ lava rock ledge	___ sandstone ledge	___ boulder rocks
14. ___ hardwoods	___ conifers	___ juniper	___ white pine
15. ___ hard rock cliff	___ tilted rock	___ clay bank	___ retaining wall
16. ___ sand bar	___ dry bed	___ dam	___ rapids
17. ___ fence line	___ irrigation ditch	___ road	___ tillage pattern
18. ___ fence line	___ soil change	___ tillage pattern	___ irrigation ditch
19. ___ hayfield	___ grass-sagebrush	___ sand dunes	___ chaparral
20. ___ irrigation canal	___ stream	___ drainage canal	___ highway ditch
21. ___ marsh pattern	___ beaver ponds	___ muskeg swamp	___ salt flats
22. ___ clay piles	___ rock piles	___ dry grass	___ brush piles
23. ___ standard gage	___ narrow gage	___ old road grade	___ water ditch
24. ___ gravel pit	___ sawmill	___ mine building	___ cabins
25. ___ abandoned mine	___ old rock slide	___ old sawmill	___ gravel pit
26. ___ standard gage RR	___ improved road	___ paved highway	___ haul road
27. ___ water ditch	___ drain ditch	___ fence line	___ road
28. ___ pine trees	___ cottonwood	___ oak trees	___ spruce trees
29. ___ pinyon pine	___ pine saplings	___ juniper	___ sagebrush
30. ___ rock pile	___ tree stump	___ water hole	___ exploration pit
31. ___ cutting line	___ fireline road	___ sale boundary	___ mining road
32. ___ aspen poles	___ cottonwood poles	___ oakbrush	___ pine poles
33. ___ hayfield	___ sagebrush	___ old lakebed	___ mountain meadow
34. ___ aspen poles	___ pine saplings	___ tall grass	___ hardwood brush
35. ___ ledge rock	___ rock dike	___ line fence	___ tilted sandstone
36. ___ main haul road	___ unimproved road	___ old RR grade	___ paved road
37. ___ clearcut	___ selective cut	___ dead spruce	___ fire-kill trees
38. ___ gravel pit	___ sand and rock	___ fire pattern	___ beaver meadows
39. ___ cutting line	___ type line	___ section line	___ fireline
40. ___ spruce	___ lodgepole	___ aspen	___ oak
41. ___ mud flat	___ irrigated area	___ beaver pond	___ ice
42. ___ main haul road	___ skidroad	___ jammer road	___ mine road
43. ___ main haul road	___ skidroads	___ fire trails	___ jammer roads
44. ___ landing	___ yard	___ skidding setup	___ road junction
45. ___ clay bank	___ toe slope	___ cirque wall	___ talus slope
46. ___ toe slope	___ talus slope	___ gravel slope	___ snowslide
47. ___ cirque wall	___ cirque floor	___ sand	___ talus slope
48. ___ blue spruce	___ lodgepole pine	___ spruce, fir	___ pinyon juniper
49. ___ timberline fir	___ sagebrush	___ chaparral	___ pinyon juniper
50. ___ bare rock	___ sand	___ short grass	___ snow

D. Stereo-pairs

For effective stereo viewing, a pair of overlapping photographs must be properly aligned. In most (but not all!) aerial photographs, the photo annotation (writing) is perpendicular to the line of flight. Stereo pairs should always be viewed parallel to the line of flight. Follow these three steps when preparing the photos used in today's lab for stereo viewing:

1. The annotation is perpendicular to the line of flight, so turn both photographs such that the annotation is up and down to one side. Both photographs should be oriented in the same direction and shadows should fall toward the observer.
2. Mosaic the two photographs; that is, overlap the photographs such that features which appear on both photographs are roughly on top of each other. This is a gross alignment; you will not be able to match features exactly, particularly along the edges of the photographs.
3. Anchor one photograph in place and move the adjacent photograph in the direction of the flight line until corresponding features on each print are 2.0 to 2.5 inches (or about your IPD) apart.

Now adjust your stereoscope so that the distance between centers of lenses corresponds to your IPD. Place the stereoscope over the prints, parallel to the line of flight, such that the left-hand lens is over the left photograph and the right-hand lens is over the same feature on the right photograph. Use one hand to hold one photograph and the stereoscope in place. While viewing through the stereoscope, use your other hand to make slight adjustments to the other photograph to improve the alignment. When properly set up, the three-dimensional image should be clear and sharp, not fuzzy.

Hint: When viewing through the stereoscope, select one or two clearly defined, stationary objects, such as buildings, roads or fields which contrast sharply from their surroundings to view in stereo. Once you have the object(s) in stereo, the entire area of overlap can be viewed in stereo (with only minor adjustments) by moving the stereoscope up and down the overlap area.

Pseudo-stereo, or a tendency to see relief in reverse, can result from improper set-up such as: shadows falling away from the viewer; reversing the order of the photographs along the flight line; viewing photographs perpendicular to the flight line.

- 4a. Using the seven basic principles of photo interpretation and your knowledge of the area, identify 6 objects or features (e.g., Western Blvd., Biltmore Hall, Grass, etc.) appearing on any one of the three Raleigh photographs (M-1337, Photos 54, 55, and 56) and record your answers on this page. Indicate what property of the object (i.e., tone, texture, pattern, shape, shadow, size, or site) helped you to identify it. If you are not familiar with the area; identify general objects (e.g. building, house, road, railroad track, etc.)

	<u>Object</u>	<u>Property</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____

- 4b. These photographs were acquired by the N.C. Department of Transportation in 1978. Many changes have occurred in Raleigh and NCSU since that time. Look closely at campus and the surrounding area. Identify five changes which have taken place and record your answers below.

	<u>Change</u>
1.	_____
2.	_____
3.	_____
4.	_____
5.	_____

Types of Stereoscopes: There are three general categories of stereoscopes: 1) lens stereoscopes, 2) reflecting stereoscopes, and 3) zoom stereoscopes.

1. Lens or pocket stereoscope - Consists of two magnifying lenses mounted in a frame which is usually adjustable so that lens separation can be changed. Simple, inexpensive, and portable but photos must be bent back to view entire area of overlap.
2. Mirror stereoscope (reflecting) - Consists of a pair of small eyepiece mirrors and a pair of larger wing mirrors oriented at a 45° angle to the plane of the photographs. Photographs can be completely separated for stereo viewing. Binocular attachments (for magnification) are normally available as an added option. One type of reflecting stereoscope, the scanning stereoscope, allows the viewer to scan X and Y directions over the entire area of overlap without moving either the photographs or the stereoscope. Good mirror stereoscopes can cost several thousand dollars and are usually not very portable.
3. Zoom stereoscope - Provides continuously variable, in-focus magnification from 2x to 20x (or more). These, too, generally cost thousands of dollars and are not portable. The high magnification these stereoscopes provide is only useful for interpreting very high quality, high resolution photography.

Concepts and Terms:

1. Stereoscopic vision (stereo) - Use of binocular vision which permits the viewer to see objects from two different perspectives resulting in the impression of a single, three dimensional image.
2. Stereoscope - A binocular, optical instrument used as an aid to viewing two properly oriented photographs or diagrams to obtain the impression of a three dimensional model.
3. Stereogram - Two sections from overlapping photographs (or two diagrams) which are mounted in place for stereo viewing.
4. Stereo pair - Two overlapping photographs, which, when properly aligned, can be viewed in stereo to give the impression of a 3-D model of objects or areas common to both photographs.
5. Pseudo stereo (pseudoscopic view) - The illusionary reversal of highs and lows in a stereo image.
6. Interpupillary distance - Distance between centers of pupils when the eyes are focused on infinity.
7. Air photo interpretation (PI) - The detection, identification and analysis of objects and features recorded on aerial photographs.

8. Seven principles of PI - Recognition elements, or characteristics of features, which help the interpreter identify what is being seen in photographs. They are tone, texture, pattern, shape, size, shadow, and site.
9. Mosaic - Two or more overlapping photographs assembled such that the edges match to form one continuous picture of ground surface features.

Stereo.Lab

ANSWERS TO PROBLEMS:

Problem 2. Top view Father Sun
 Middle view Soft Shoot
 Bottom view Fir

Problem 3.

<u>9</u>	—○↓	<u>13</u>	+ Ms
<u>10</u>	□	<u>14</u>	⊗
<u>11</u>	= ⊙ ⊕	<u>15</u>	⊙
<u>12</u>	▨ ⊕	<u>16</u>	⊙
<u>5</u>	—○	<u>1</u>	○
<u>6</u>	+ * ⊕	<u>2</u>	⊗
<u>7</u>	!	<u>3</u>	□
<u>8</u>	=	<u>4</u>	⊗

Problem 4. Block A: A-5, B-7, C-2, D-4, E-1, E-6
 Block B: A-1, B-8, C-3, D-1, D-5, E-6
 Block C: A-2, A-5, B-7, C-3, D-1, E-8
 Block D: A-1, B-4, B-7, C-2, C-5, D-3, E-6

Answer Sheet for Problem #5

a

b

c

d

1. ___ plantation	___ piles of rock x orchard	___ vineyard
2. x bridge	___ dam	___ siphon	___ ford
3. ___ drain ditch	___ fence line	x irrigation canal	___ highway
4. ___ borrow pit	x farm pond	___ basement hole	___ sludge pit
5. x farm building	___ mine building	___ lumber pile	___ haystack
6. ___ dry ditch	___ railroad grade	___ pack trail	x road
7. ___ small town	___ construction camp	___ mine building	x ranch building
8. ___ aspen	x cottonwood	___ pine	___ spruce
9. x irrigated field	___ plowed field	___ swamp	___ tall grass
10. ___ farm buildings	___ lumber piles	x baled hay piles	___ corral
11. ___ bare ground	x grass-sagebrush	___ rock slope	___ sand slope
12. x irrigation ditch	___ fence line	___ hedgerow	___ windbreak
13. ___ clay bank	x lava rock ledge	___ sandstone ledge	___ boulder rocks
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15. x hard rock cliff	___ tilted rock	___ clay bank	___ retaining wall
16. ___ sand bar	___ dry bed	___ dam	x rapids
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18. ___ fence line	___ soil change	x tillage pattern	___ irrigation ditch
19. ___ hayfield	x grass-sagebrush	___ sand dunes	___ chaparral
20. ___ irrigation canal	___ stream	x drainage canal	___ highway ditch
21. x marsh pattern	___ beaver ponds	___ muskeg swamp	___ salt flats
22. x clay piles	___ rock piles	___ dry grass	___ brush piles
23. ___ standard gage	x narrow gage	___ old road grade	___ water ditch
24. ___ gravel pit	___ sawmill	x mine building	___ cabins
25. x abandoned mine	___ old rock slide	___ old sawmill	___ gravel pit
26. ___ standard gage RR	x improved road	___ paved highway	___ haul road
27. x water ditch	___ drain ditch	___ fence line	___ road
28. x pine trees	___ cottonwood	___ oak trees	___ spruce trees
29. ___ pinyon pine	x pine saplings	___ juniper	___ sagebrush
30. ___ rock pile	___ tree stump	___ water hole	x exploration pit
31. ___ cutting line	x fireline road	___ sale boundary	___ mining road
32. x aspen poles	___ cottonwood poles	___ oakbrush	___ pine poles
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48. ___ blue spruce	___ lodgepole pine	x spruce, fir	___ pinyon juniper
49. x timberline fir	___ sagebrush	___ chaparral	___ pinyon juniper
50. ___ bare rock	___ sand	___ short grass	x snow