

ES202 LAB EXERCISE - INTRODUCTION TO TOPOGRAPHIC MAPS

(updated Feb. 2016, AGI Lab Manual 10th Edition)

Part 1 - Refer to the lab manual for the following questions.

1-1. Using lab computer resources (google, Wikipedia), the lab manual and referring to **Figure 9.3 on p. 232-233**, complete the following tasks / answer the following questions related to topographic maps.

A. What is a USGS 7.5-minute quadrangle map? List the types of information that it contains (refer to **p. 229-230**)?

_____ B. What year was the map in **Figure 9.3** first published?

_____ C. What year was the map in **Figure 9.3** revised?

D. What is longitude and latitude used for? What units are positions of longitude and latitude measured in? (refer to **p. 229-230**)

_____ E. How many angular degrees are contained in a circle (**refer to conversion sheets**)?

_____ F. How many angular degrees are contained in a semi-circle (**refer to conversion sheets**)?

_____ G. How many angular degrees are contained in a right angle (**refer to conversion sheets**)?

_____ H. How many angular degrees are contained in a straight line (**refer to conversion sheets**)?

_____ I. How many angular minutes are contained in 1 degree of angular measurement?

_____ J. How many angular seconds are contained in 1 minute of angular measurement?

_____ K. How many angular seconds are contained in 1 degree of angular measurement

_____ L. What is the geographic location of the quadrangle map show on **Figure 9.3**?

_____ M. What is the longitude of the western edge of the map in **Figure 9.3**?

_____ N. What is the longitude of the eastern edge of the map in **Figure 9.3**?

_____ O. What is the latitude of the southern edge of the map in **Figure 9.3**?

_____ P. What is the latitude of the northern edge of the map in **Figure 9.3**?

_____ Q. Define magnetic declination. What is the magnetic declination of the map in **Figure 9.3 (refer to p. 231)**?

_____ R. What does "UTM" stand for and how is it used (**refer to p. 236**)?

_____ S. What coordinate units are UTM positions measured in (**refer to p. 236**)?

_____ T. Define "ratio scale" (**refer to p. 230**). What is the ratio scale of the map in **Figure 9.3**?

_____ U. What are contour lines? What do they represent (**refer to p. 239**)?

_____ V. What is the contour interval for the map in **Figure 9.3**?

_____ W. How much elevation change is recorded between Index Contours in **Fig. 9.3**?

X. What is the Public Land Survey System (PLSS)? How is it used? (**refer to p. 236 and 239**)

_____ Y. How much land area is covered in a PLSS “section”? (**refer to p. 240**)

1-2. What are the latitude and longitude coordinates of points A and B in **Figure 9.2, p. 230**?

1-3. Using a protractor, what is the azimuth compass bearing from point C to point D in **Figure 9.5, p. 235**? How about from point D to point A?

1-4. In **Figure 9.8 (p. 240)**, locate points X and Z (**see inset box “C”**) using the Township-Range-Section method of location (Public Land Survey System).

	X	Z
Township	_____	_____
Range	_____	_____
Section	_____	_____

1-5. Referring to the caption in **Figure 9.8B (p. 240)**, how many acres are covered in 1 section (1 square mile = 640 acres)?

1-6. Refer to **p. 242-243** and **Figure 9.10**; answer the following questions.

A. Define contour line.

B. Define index contour.

C. Define contour interval.

_____ D. What is the contour interval of the 3-D diagram show in **Fig. 9.10**? In feet or meters?

_____ E. How is a circular hilltop depicted on a topographic map, as “V-shape” contour lines or “closed circles”? (**refer to Fig. 9.10**)

_____ F. The “relief” of a map or object is the difference between the highest elevation and lowest land elevation depicted on a topographic map. What is the relief of the island depicted in **Fig. 9.10**?

G. Define the term “benchmark”, how is it symbolized on a topographic map?

1-7. Refer to **p. 244-245** and **Figures 9.12 and 9.13**; answer the following questions.

A. Define “gradient”, how is it measured and what is the formula for calculating it?

B. Define “regional relief” on a map.

____ C. True or False: contour lines of different elevation can cross one another on a topo map?

____ D. True or False: Closely spaced contour lines indicate a steeper slope than widely spaced contour lines.

____ E. True or False: When contour lines cross a stream valley, they form a “V” shape, the apex or point of which, points down stream.

F. Draw a sketch of contour line patterns depicting a stream crossing.

G. Draw a sketch of contour line patterns depicting the top of a hill.

H. Draw a sketch of contour line patterns depicting a closed depression at the top of a hill

____ I. What is the elevation of the point marked “BM24” on the map model shown on Fig. 9.13?

____ J. What is the total relief (in feet) of the map model shown in Fig. 9.13?

____ K. Using a ruler and the map scale on Fig. 9.13, determine approximately how many miles of ground distance are represented by one inch of measurement on the map sheet.

____ L. In which direction is the water flowing in the main “valley” river shown on Fig. 9.13?

M. Draw a sketch showing contour line patterns depicting a vertical cliff face.

1-8. Refer to p. 230 of the lab manual regarding “ratio” or “fractional” scales. The common fractional scales for 7.5-minute topographic maps is 1:24,000 or expressed as a fraction 1/24,000. This means that one unit of map measurement is equal to 24,000 units of actual ground measurement. The length units of measurement are the same in the numerator or denominator. For example 1 cm on map = 24,000 cm on the ground; 1 in on the map = 24,000 in on the ground; 2 in on the map = 48,000 in on the ground, etc.

Fractional Scale

- The fractional scale or the representative scale expresses the scale of a map as a fraction or ratio.

- 1/24,000 or 1:24,000

- This scale, which is read “one to twenty-four thousand”, says that one unit of measurement on the map represents 24,000 units of measurement on the Earth.

- At this scale, one centimeter on the map represents an actual distance of 24,000 centimeters on the Earth, and one inch on the map equals 24,000 inches on the map.

- Units of measurement must be the same in both the numerator and the denominator.

$$\begin{aligned}\frac{\text{Distance on the Map}}{\text{Distance on the Ground}} &= \frac{2 \text{ cm}}{1 \text{ km}} = \frac{2 \text{ cm}}{100\,000 \text{ cm}} \\ &= \frac{1}{50\,000} \\ &= \text{1/50 000 Scale}\end{aligned}$$

- A. Given a fractional scale of 1:24,000 (1/24,000), one inch on the map equals how many inches on the ground (refer to your conversion tables) (show all your math work)?

One inch on the map equals how many miles on the ground (show all your math work).

One centimeter on the map equals how many centimeters on the ground (show all your math work).

One centimeter on the map equals how many kilometers on the ground (show all your math work)

- B. If 5 inches on a hypothetical map equals 10 miles on the ground, determine the fractional scale of the map (show all your math work)

Step 1: determine how many inches are contained in 10 miles.

Step 2: 5 inches map = _____ inches ground.

Step 3: Divide both sides of equation by 5 inches, cancel units are both sides

Step 4: Fractional scale = 1 (map): _____ (ground)

1-9. Complete the topographic map depicted in **Activity 9.3 Item C (p. 253)**. Label each contour line using a contour interval of 10 feet. Start with 0 m elevation at sea level.

1-10. Refer to **Activity 9.5 Item A (p. 257)**, Read the instructions and **complete the tasks 1-5**.

1-11. Read and review the topographic profile instructions presented in **Figure 9.16, p. 248**. Using the example topographic map in **Activity 9.6 (p. 258)**, draw a topographic profile along line A-A'. Plot your profile on the graph paper provided in the lab manual. Start with an elevation of 500 ft at the origin of the y-axis, and use a vertical scale of 1 in = 100 ft.

A) What is the horizontal fractional scale of the map?

B) What is the fractional scale of the vertical axis of your profile (hint: convert 1 in = 100 ft to a dimensionless fractional scale)?

C) Refer to the example on **Fig. 9.16, p. 248** of your lab manual ("**step 4**") and determine the vertical exaggeration of your profile from **p. 258**.

1-12. Using a contour interval of 10 ft, draw the following contour lines for the spot elevation data provided on **Activity 9.3 B (p. 253)**: 80 ft, 90 ft, 100 ft, 110 ft, 120 ft, 130 ft, 140 ft.

1-13. Using a contour interval of 100 feet, draw the following contour lines for the spot elevation data provided on **Activity 9.3 A (p. 253)**: 100, 200, 300, 400, 500, 600.

Part 2. - Refer to the Monmouth Quadrangle (maps located on table in lab)

2-1. What is the fractional scale, contour interval, and magnetic declination of this map?

a) Scale: b) Contour Interval: c) Declination:

2-2. What quadrangle maps are located immediately adjacent to the Monmouth Quad.?

a) North: b) South: c) East: d) West:

2-3. What is the quadrangle size series of this map (in long. and lat.)?

2-4. What is the date of publication of this map?

2-5. What is the name of the major river system flowing through this area. Of What larger drainage basin(s) does this river form a part of?

2-6. What is the approximate elevation of the Natural Sciences Building based on the map representation?

2-7. Given the fractional scale determine the following

5 inches on the map= _____ Feet on ground = _____ Miles on ground.

10 inches on the map= _____ Meters on ground = _____ Kilometers on ground.

2-8. A. What is the road distance in miles along Rt. 99 between Helmick State Park and Monmouth city limits?

B. What is the distance in kilometers?

2-9. A. What is the highest point of elevation represented on this map?

B. What is the lowest point of elevation represented on this map?

C. What is the maximum relief.

2-10. A. What is the longitude and latitude location of the road intersection at Buena Vista

B. What is the longitude and latitude location of Davidson Hill?

C. What is the straight line distance in miles between these two points?

D. What is the azimuth bearing FROM Davidson Hill TOWARDS Buena Vista?

E. What is the quadrant bearing FROM Buena Vista TOWARDS Davidson Hill?

2-11. A. What is the nature of the topographic slope in the vicinity of the town of Monmouth? What is the local relief between WOU and the Willamette adjacent to Independence?

2-12. Determine the elevations of the following locations:

A. Wigrich

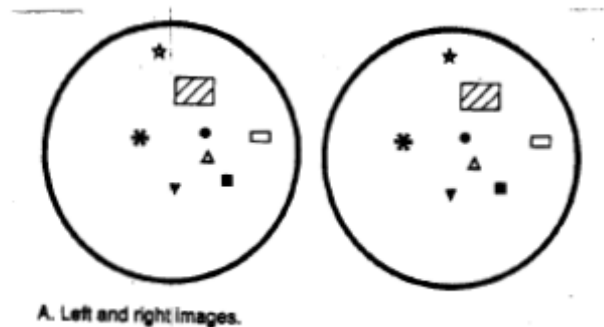
B. Oak Hill (SC)

Part 3 - Introduction to Aerial Photographs

3-1. Read over p. 239-241 in your lab book, answer the following questions:

- A. What is an aerial photograph?
- B. Define “stereo pair” and “stereogram”, draw a sketch.
- C. Describe “orthorectification” and “orthoimages”
- D. Using the pocket stereoscopes in the lab, and Figure 9.9 on p. 241, try viewing the stereo image of Mt. Meru in 3-D using both your “naked eye” and stereoscope. Read the figure caption carefully, follow tips and instructions.
- E. One side of the Mt. Meru crater has a steep and jagged, knife-edge rim, the other side is eroded and open. Using the north arrow depicted, in which direction is the steep, knife-edge rim of the crater?

3-2. Test of Stereo vision: to test your ability to see in 3-D, use a student pocket stereoscope and view the image below. Observe the apparent height of the shapes, and rank from highest = 1, to lowest = 8.



3-3. Refer to Air Photo Station 1 in the lab. View the images in stereo and answer the following questions.

- A. What is the dominant type of surface environment? (fluvial, glacial, coastal, or other?)
- B. What is the dominant type of climate (warm or cold? wet or dry?)
- C. Is this area vegetated or non-vegetated?
- D. Do you see evidence for human landuse? If so, list your observations.
- E. Hypothesize as to what you think the cone-shaped geologic feature is in the lower right of the photograph.
- F. Hypothesize as to where you think these photos were taken in the U.S.. What is your line of reasoning?

3-4. Refer to Air Photo Station 2 in the lab. View the images in stereo and answer the following questions.

- A. What is the dominant type of surface environment? (fluvial, glacial, coastal, or other?)
- B. What is the dominant type of climate (warm or cold? wet or dry?)
- C. Is this area vegetated or non-vegetated?
- D. Do you see evidence for human landuse? If so, list your observations.
- E. Hypothesize as to what you think the dominant mode of surface erosion is in this area. What is your evidence?
- F. Hypothesize as to where you think these photos were taken in the U.S. What is your line of reasoning?.

3-5. Refer to Air Photo Station 3 in the lab. View the images in stereo and answer the following questions.

- A. What is the dominant type of surface environment? (fluvial, glacial, coastal, or other?)
- B. What is the dominant type of climate (warm or cold? wet or dry?)
- C. Is this area vegetated or non-vegetated?
- D. Do you see evidence for human landuse? If so, list your observations.
- E. Hypothesize as to what you think the horseshoe shaped objects are in the center of the photo. How might they form?
- F. Hypothesize as to where you think these photos were taken in the U.S.. What is your line of reasoning?

3-6. Complete Activity 9.4 in the lab manual, p. 254-256; parts A, B, C.