Name:_____

GEOL 121 – Physical Geology

Lab 2 –Topographic Maps

Introduction: A topographic map represents three-dimensional space (the real world!) using only two dimensions. The elevation or depth of a feature, for example a mountain, is represented on a topographic map by lines of equal elevation, called contour lines. Topographic maps are useful for many professions as well as the general public, *e.g.*, hikers or landowners. They are especially useful for geology and related fields. Topographic maps give a birds-eye view, which can be complemented by a topographic profile, which gives a cross-sectional view. A cross-sectional view is a view from the side, similar to what you would see when you slice a piece of cake.

Objectives: This lab will teach you how to

1) Read and interpret topographic maps
2) Create a contour map from elevation points
3) Create a topographic profile

Exercise 1: Interactive computer program Topographic Maps

Take a look at the topographic map labeled "USGS Topo" in Blackboard. This is available in both pdf and jpg formats. One person in each group can open this file and share their screen so all members can work together to answer the questions. (Adapted from Dr. Christopher Woltemade; Shippensburg University)

Map names

Topographic maps are named after a prominent town or physical feature that appears on the map. The names of adjacent maps (or quadrangles) are printed at each corner of the map and along each side, to allow you to easily determine other maps in the area that you may need.

(1) What is the name of the map with which you are working?

(2) What is the name of the adjoining map to the northwest?

Map series, latitude and longitude

The map series (type of map) is described by how large an area the map covers in latitude and longitude. Latitude and longitude are expressed in degrees (°) - latitude extends from 0° at the equator to 90° north or south at the north and south poles, respectively. Longitude is based on a 0° line, the prime meridian, that runs north-south from the north pole, through Greenwich, England, to the south pole. Longitude is measured in degrees up to 180° east or west away from the prime meridian. Fractions of a degree are expressed in minutes (') and seconds (") - there are

60 minutes per degree and 60 seconds per minute. So, for example, a location half way between 40° and 41° north would be 40 degrees 30 minutes north, written as 40° 30' 00" north.

(3) Which series is the map with which you are working?

(4) What is the latitude of the southern edge of the map, to the nearest second?

(5) What is the longitude of the western edge of the map, to the nearest second?

(6) What is the latitude and longitude of the center of the map, to the nearest second? (You don't need to measure this, just calculate it.)

(7) What is the latitude of "Interchange 26" on the Baltimore Beltway (I-659), to the nearest minute?

Scale

Scale expresses the relationship between distances on the map and corresponding distances on the ground (in the "real world"). Topographic maps include both a ratio scale and a graphical scale. Ratio or fractional scales have no units associated, because the same units must be used on both sides of the ratio (or fraction). For example a scale of 1:10,000 indicates that one inch on the map corresponds to 10,000 inches on the ground or, alternatively, one millimeter on the map corresponds to 10,000 millimeters (or 10 meters) on the ground.

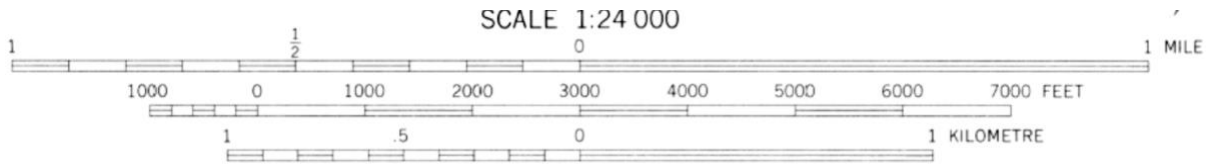
(8) What is the fractional or ratio scale of the map with which you are working?

(9) One inch on the map represents how many feet on the ground?

(10) One mile (5280 feet) on the ground covers how many inches on the map?

(11) One square mile on the ground is represented by how many square inches on the map? (Remember you are working with squared units here!)

(12) Locate I-695 on the map (labeled Baltimore Beltway). Measure the map distance from the York Road exit to the Cromwell Bridge Road exit. How long is this stretch of road in miles? *Make sure to pay attention to pay close attention to the scale! (Shown below, not to scale.) Note that the "zero" mile mark is in the middle, not on the left side.*



(13) How many miles on the ground are covered by the width of the map along the south edge?

Contour lines

A contour line on the map (shown in brown) connects points of equal elevation above or below a reference plane (usually mean sea level, MSL). These lines allow us (with some training) to visualize the shape of the land; that is, topography. The contour interval is the vertical difference in elevation between adjacent contour lines (e.g. if the contour interval is 20 feet, lines might correspond to 420', 440', 460', etc.). Index contours may be shown with a heavier brown line and are labeled with the corresponding elevation. Some general rules for contour lines follow:

- A contour line connects points of equal elevation.
- A contour line never branches or splits.
- Steep slopes are shown by closely spaced contours, flat areas are shown with widely spaced contours (a completely flat area would not have any contours).
- Contour lines never cross, except to show an overhanging cliff, where hidden contours are dashed. Contour lines merge only to show a vertical cliff.
- Hills are represented by a concentric series of closed contour lines.
- A closed depression (basin) is shown by concentric contour lines with hachures on the downhill side.
- Where contour lines cross a stream or a dry stream channel, they form a "V" that points upstream.

Relief refers to the difference in elevation between two points. Total relief is the difference between the highest and lowest points in an area (or on a map), while local relief refers to the difference in elevation between two nearby points (e.g. a hilltop and nearby valley).

(14) What is the contour interval on your map?

(15) What is the difference in elevation between index contours?

(16) How can you tell an area that is relatively flat? Look near Loch Raven Reservoir and give the location (in latitude & longitude) of an area which exhibits this characteristic.

(17) How can you tell an area that has a steep slope? Look near Loch Raven Reservoir and give the location (in latitude & longitude) of an area which exhibits this characteristic.

(18) Estimate the elevation of the I-695 in two places: at the western edge and southern edge of the map.

(19) Find Smith Hall on the map and estimate its elevation.

(20) In which direction is Fitzhugh Run flowing (northeast of Loch Raven Reservoir)? How do you know this?

(21) What are the highest and lowest points on the map? What is the total relief? Show how you calculated this.

Exercise 2: Build your own topographic map

1. Construct a contour map using the map in the answer key. The point elevations are in meters. **Use a pencil**, NOT a pen, because you will need to adjust your lines as you go in order to have the map work out. Use a contour interval of **10 m**. Interpolate between elevations to find where contours should go - for example, the 40 contour should pass about halfway between elevations 30 and 50. Label all contours with their elevation value.

   Rules for making contour maps:
   1) Contours should be constructed at constant intervals and connect points of equal elevation. For topographic maps, the interval is usually 10 or 20 feet (or meters).
   2) Contour lines never touch or merge or split.
   3) Unless they end at the edge of the map, contour lines should form a closed circle or ellipse.

2. Draw a topographic profile along line A-A' using the grid supplied at the bottom. Lay the edge of a piece of paper along the line and mark both ends with ticks. Where each contour crosses the line, place a tick and label it with the contour elevation. You can then transfer the horizontal distance between contours to the profile simply by placing the paper edge along the bottom of the grid. Project each tick mark up vertically to the corresponding elevation line on the grid and mark that point. Then, all you need to do is connect the points with a smooth line to draw the profile. Remember, though, that the profile line will be highest over ridges.

Exercise 3: Survivor Island Journey

You and your pilot friend were taking a joyride over the ocean but had to make an emergency landing on Survivor Island. From the map you found in your plane, you know where you landed and that there is a lighthouse on the far side of the island. This is the best chance you have for getting help and getting off the island. So, you have to make a plan to get there.

However,

- During the landing you were both injured and can never climb more than *75 feet* above your starting elevation of that day.
- You can only manage to walk *12 miles per day*.
- Because of your injuries, neither of you can swim across rivers.
- Besides, the rivers have crocodiles, which makes swimming and even fetching water impossible.
- You have enough *water for 3 days* and that’s all you can carry at any time.
- There is a well with drinking water towards the south.

- There is a large patch of quicksand in the middle of the island (that probably has R.O.U.S's – rodents of unusual size) that you need to avoid.
- Additionally, you can't traverse the jungle because it is known to have abundant lions, tigers, and bears. It is unknown whether or not they are cowardly.

Using the map sheet, complete the following.

1. With a *pencil and ruler*, draw the shortest route from the crash site to the lighthouse, keeping in mind your distance, elevation, and water limitations. To make sure you don't get lost, you walk in a straight line until you make a turn. Every new turn – large or small – represents a new leg of your trip. *Be sure to submit your completed map along with your answer sheets.*
2. In the table on page 3 of the answer sheets, log the distance of each leg for each day.

   Also record your answers to the following questions on page 3 of your answer sheets.
3. How many days will your trip take?
4. Did you have to stop for water? If so, on what day did you stop?
5. What is the elevation of the crash site?
6. What is the elevation of the lighthouse?
7. What is the elevation of the highest point on the island?
8. What is the elevation of the lowest point in Sinking Feeling Basin?

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 Name:_____

GEOL 121 – Lab #2 Topographic Maps Answer Sheets

Exercise 1: Responses to *Introduction to Topographic Maps* questions

Quest	*Response*	*Quest*	*Response*
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8			

16) _____

17) _____

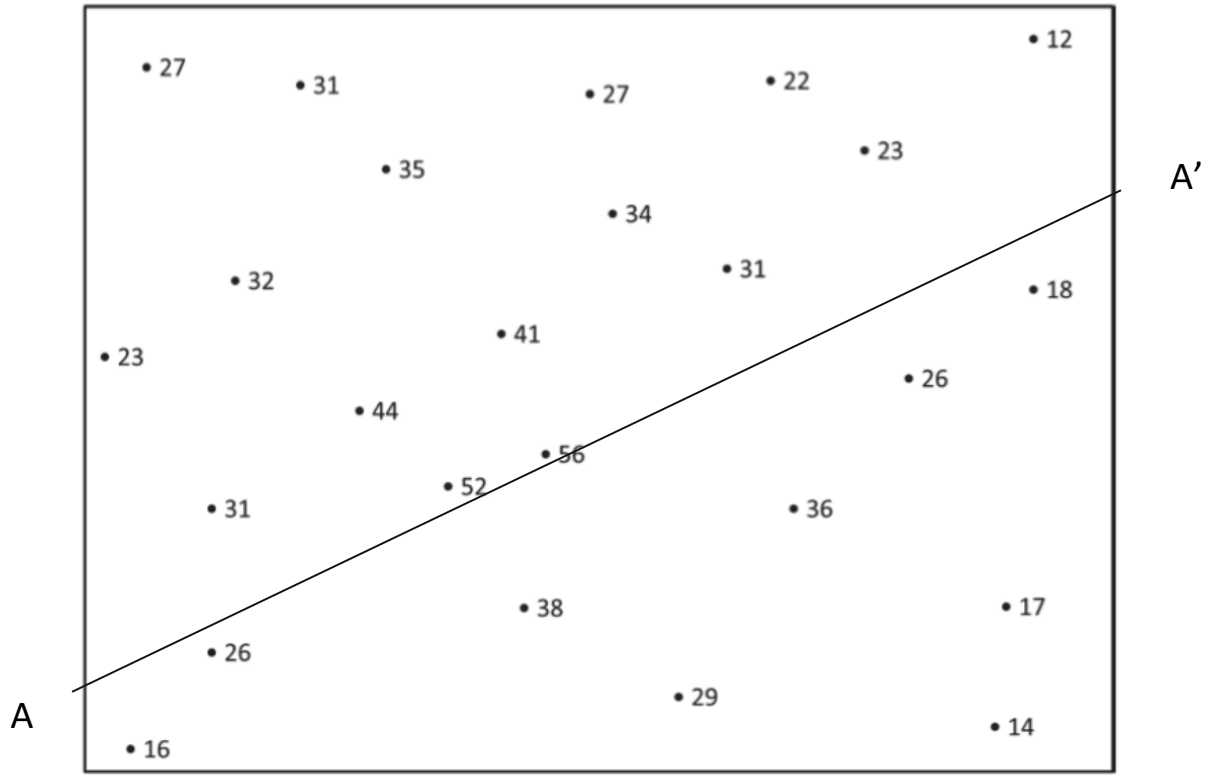
18) _____

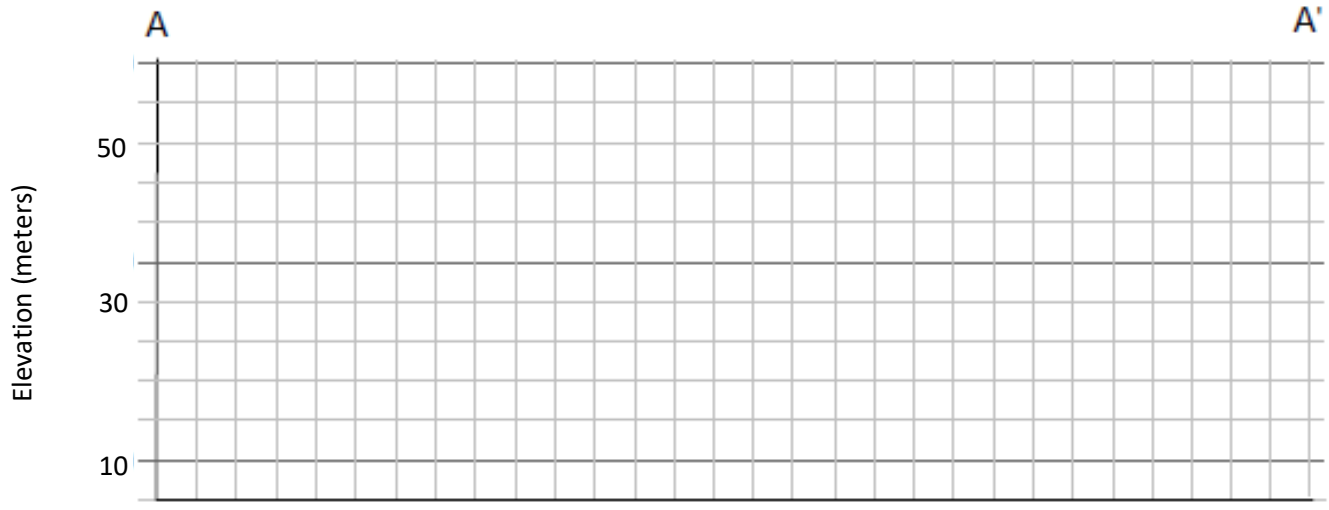
19) _____

20) _____

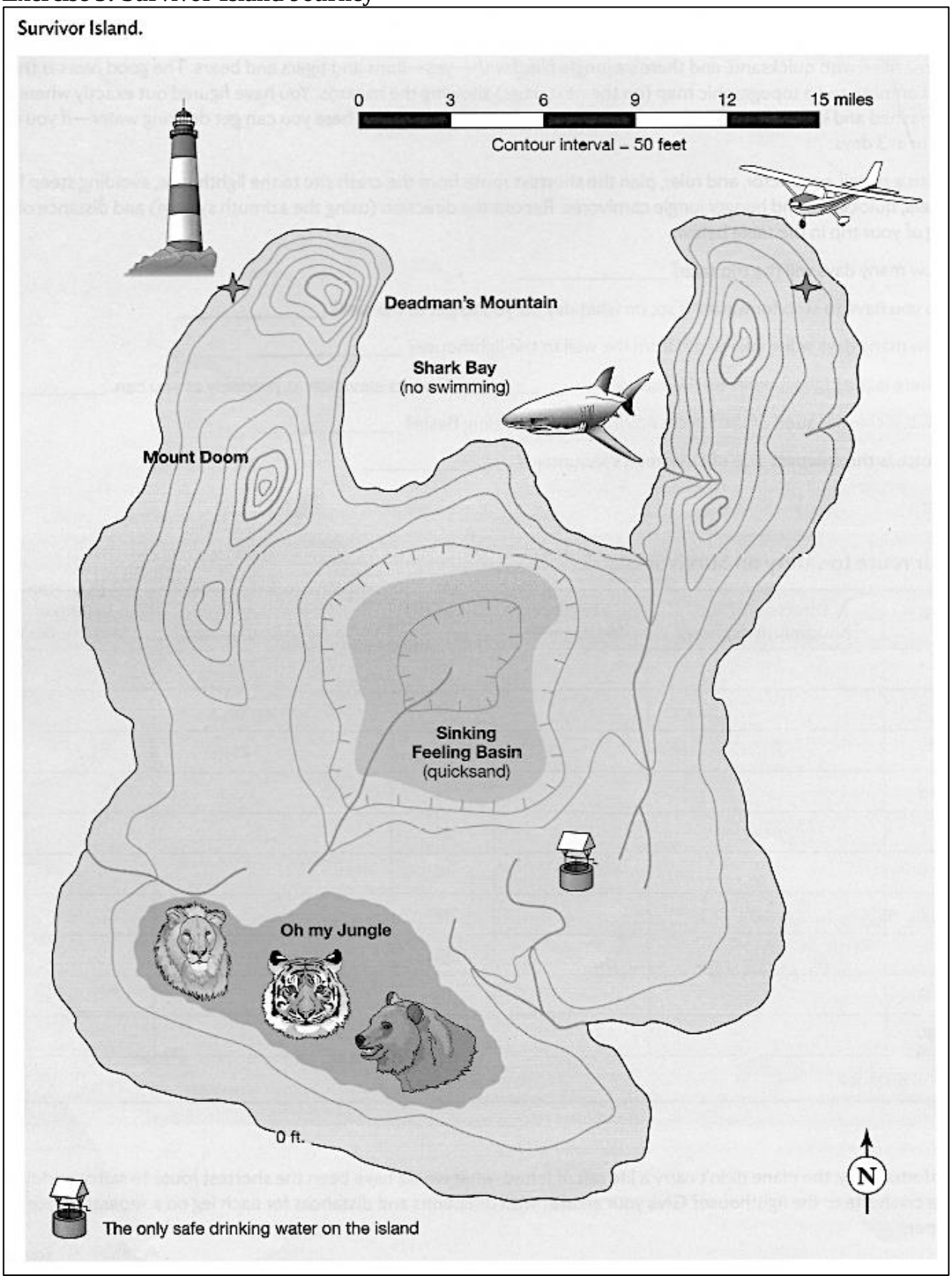
21) _____

Exercise 2: Build your own topographic map





Exercise 3: Survivor Island Journey



2.

Time	**Leg #**	**Leg Distance**	**Time**	**Leg #**	**Leg Distance**
Day 1	1		*Day 4*	1	
	2			2	
	3			3	
	4			4	
Total Distance Day 1			**Total Distance Day 4**		
Day 2	1		*Day 5*	1	
	2			2	
	3			3	
	4			4	
Total Distance Day 2			**Total Distance Day 5**		
Day 3	1		*Day 6*	1	
	2			2	
	3			3	
	4			4	
Total Distance Day 3			**Total Distance Day 6**		

Quest	*Response*
3	
4	
5	

Quest	*Response*
6	
7	
8	