

Name: \_\_\_\_\_ Date: \_\_\_\_\_

# UNIT THREE

2D and 3D models of the natural world

\*Dedicated to \_\_\_\_\_

### **ABSTRACT AND RATIONALE**

A topographic map is a type of map that depicts the detail and quantitative representation of an area that is both natural and human made. Government agencies, hikers, environmental consultants, military officials, oil companies all use topographic map for long range planning and finding natural resources. The first topographic map was made in the 1800s by USGS (US geologic survey) and continues to remain an indispensable tool for the science classrooms.

### **TASK STATEMENT/PROBLEM BASED LEARNING/REAL WORLD PROBLEM:**

You have been asked by the Bedford Planning Commission to design a hiking trail system. These criteria must be followed exactly for your proposal to be accepted by the Planning Commission. In other words, your grade on this project depends on how well you follow the criteria and how detailed your plan is. Good luck and happy planning!

#### **Criteria for planning your hiking trail system:**

- Trails must have easy access from the road
- Trails must have an area next to the road for a parking lot
- The trails must cover at least four different habitats (stream

#### **Beginner trail must:**

- Be no longer than 5 miles (use the map scale provided)
- Be a looping trail (begin and end at the same spot)
- Have a gradient no greater than 150 feet per mile
- Travel through or near at least three different habitats

#### **Intermediate/Advanced trail must:**

- Be between 5 and 10 miles long
- Begin and end at a road with a park access
- Have a gradient of no greater than 500 feet per mile
- Travel through or near at least four different habitats

**Plan requirements:** For full credit your plan must include the following items to be handed in

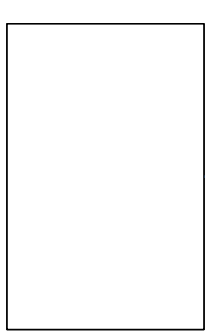
1. The map with all trails, parking lot and picnic areas drawn and labeled
2. A data sheet describing your trails including
  - a. length of trail
  - b. maximum gradient
  - c. number of times a stream is crossed (number of bridges to be built)
  - d. habitats that are crossed
  - e. any other interesting feature

### *Anticipation Guideline (Topographic Map)*

Read page#53-56 in your Earth Science Textbook. Base on the reading; **decide** whether or not each statement below is true (yes) or False (no). If the statement is no, please **indicate** the page# and line# where the correct answer is located in the text. In addition, be sure to **correct** the wrong word in the statement with the correct vocabulary. You may only fill out yes or no on one side of the table. The other side of the table will be done by you after hurricane topics.

Yes	No	Statements	Yes	No	Page# Line#
		Topographic Map depicts features of a landform through the use of contour lines			
		The relief of a map shows the symbols of Earth's surface			
		The scale of 1: 63,360 is for 7.5 minute map			
		Contour lines connect areas of the same pressure			
		The difference in elevation between two consecutive contour lines is call contour interval			
		Benchmark is a location whose approximate elevation is shown			
		If the contour lines are far apart, the land would be flat			
		Contour lines may form circles or ovals, these indicate hills, ridges, or mountains			
		Topographic maps can be used to determine the direction of river flow as well.			

Read page #53-56 in your Earth Science Textbook. Find the vocabularies in the text, and then define each of the vocabulary in your own words. The images below are there to provide you with mental imageries. Find the definition of these words AND label them on the diagram.



1. Contour Lines
2. Contour interval
3. Index Contour lines



Label on the map an area of high relief and low relief

4. Relief



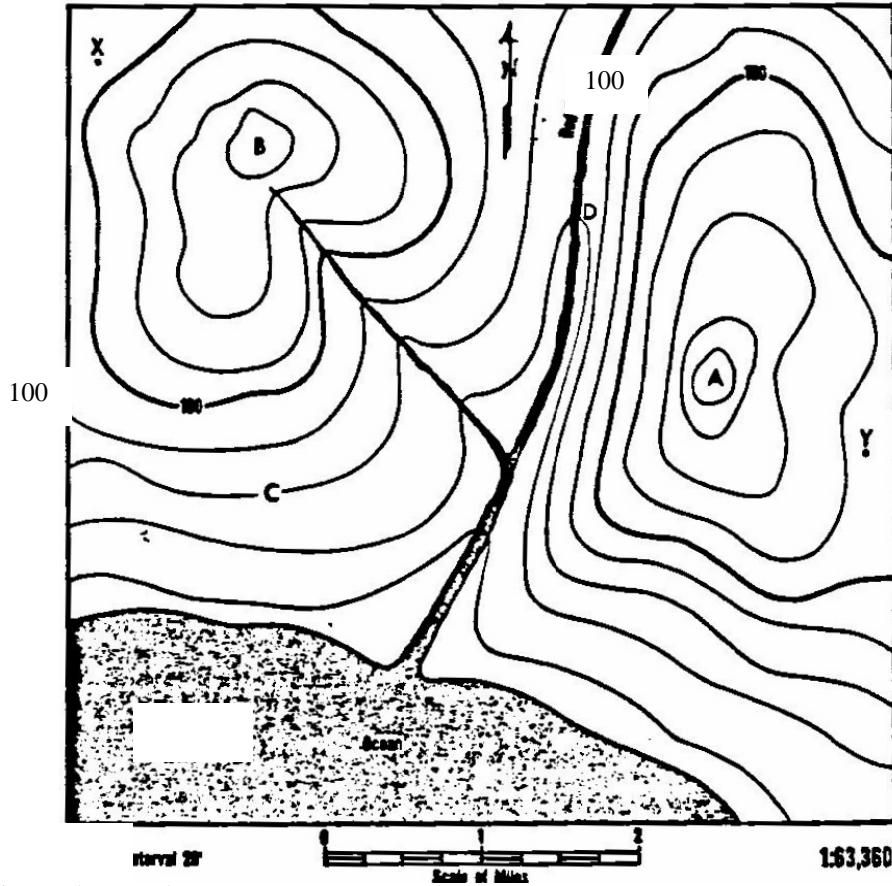
5. Magnetic Declination



6. Slope/Gradient

7. 7.5 minute map vs. 15 minute map

Red River Contours



1. Label all the contour lines values on the map.
2. What is the contour interval of this map? \_\_\_\_\_ (unit please!!!!)
3. What is the highest possible elevation at location B? \_\_\_\_\_ (unit please)
- 4a) Which of the two hills is higher? \_\_\_\_\_
- 4b) How much higher? \_\_\_\_\_ (unit please!!!!)
5. By means of the map scale, measure the distance from the top of hill B to the top of hill A. \_\_\_\_\_ (unit please!!!!)
6. Which side of hill A has the steepest slope? \_\_\_\_\_
7. How can you tell whether a land form has steep or gentle slopes? \_\_\_\_\_
8. In what direction from hill A is hill B? \_\_\_\_\_
9. What is the elevation above sea level of hill A? \_\_\_\_\_ (unit please!!!!)
10. In what direction is the Red River flowing? \_\_\_\_\_
11. How does a contour map show the direction in which a river is flowing? \_\_\_\_\_
12. Shade the area on the map which would be under water if the sea level rose 40 feet.
13. Calculate the gradient of the Red River from point D to the ocean.

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## Working with Contour Maps



Figure A

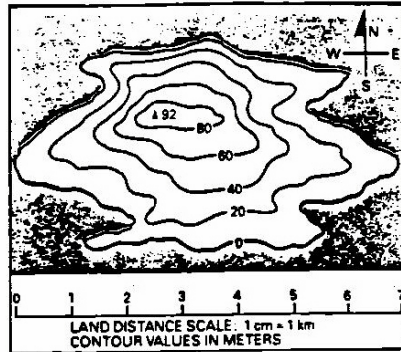


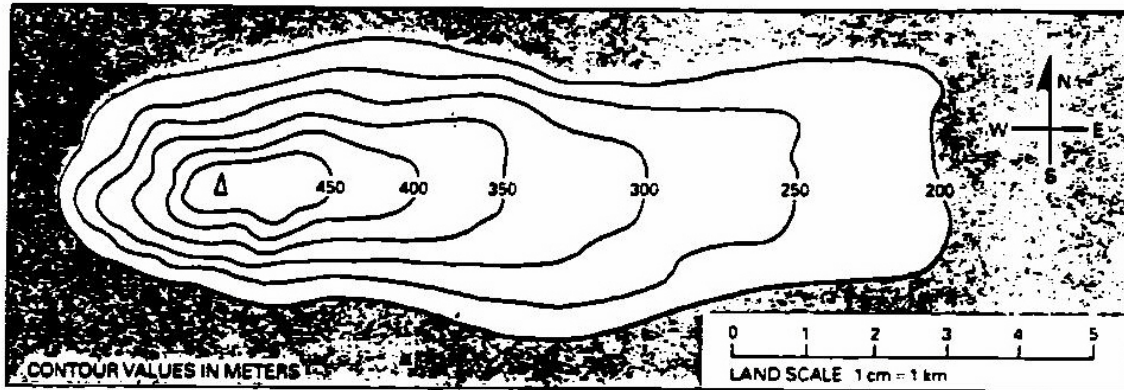
Figure B

**Figure A shows an island. Figure B shows a contour map of this island.**

Answer the questions below by studying the contour map

1. a) How long is this island? \_\_\_\_\_
1. b) The long part runs which direction? \_\_\_\_\_
2. a) How wide is this island? \_\_\_\_\_
2. b) The wide part runs which direction? \_\_\_\_\_
3. This island starts at sea level. How do you know? (Look only at the contour map.)  
\_\_\_\_\_
4. What is the contour interval of this map? \_\_\_\_\_
- 5 a) Which side of the island has the steepest slope? \_\_\_\_\_
- 5 b) How do you know which side of the island is steepest? \_\_\_\_\_  
\_\_\_\_\_
- 6 a) Which side of the island has the gentlest slope? \_\_\_\_\_
- 6 b) How do you know which side of the island is gentlest? \_\_\_\_\_  
\_\_\_\_\_
7. How high is the peak of this island? \_\_\_\_\_
- 8. Compare the drawing of the island with the contour map**
  - a) Which one gives more information? \_\_\_\_\_
  - b) Which one is more accurate? \_\_\_\_\_
  - c) Which one is more useful? \_\_\_\_\_

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By compass direction...

- 9a) the \_\_\_\_\_ side of this landform has the steepest slope.  
 9b) the \_\_\_\_\_ side of this landform has the gentlest slope.  
 10. The contour interval of this map is \_\_\_\_\_ meters.  
 11. The lowest elevation shown is \_\_\_\_\_ meters.  
 12. Which of these heights could be the exact elevation of the peak?  
 a) 520 meters    b) 420 meters    c) 475 meters

$$\text{Gradient} = \frac{\text{change in elevation}}{\text{distance}}$$

13. What is the change in elevation between point a to point b? \_\_\_\_\_  
 14. What is the distance between a and b? \_\_\_\_\_  
 15. Which is the gradient between point a and b? \_\_\_\_\_

**STREAMS**

The head of a stream is the place where it starts. The place where it ends, in a lake or ocean, is called the mouth. Look at the figure D below for the following questions.

16. What letter is at  
 a) the head of the stream? \_\_\_\_\_  
 b) the mouth of the stream? \_\_\_\_\_
17. Where contour lines “cross” a stream, they \_\_\_\_\_
18. At a stream, contour lines seem to form “arrows.” Each “arrow” points...  
 a) toward the \_\_\_\_\_ (head, mouth) of the stream.  
 b) \_\_\_\_\_ (upstream, downstream)  
 c) \_\_\_\_\_ (toward, away from) the direction of flow.

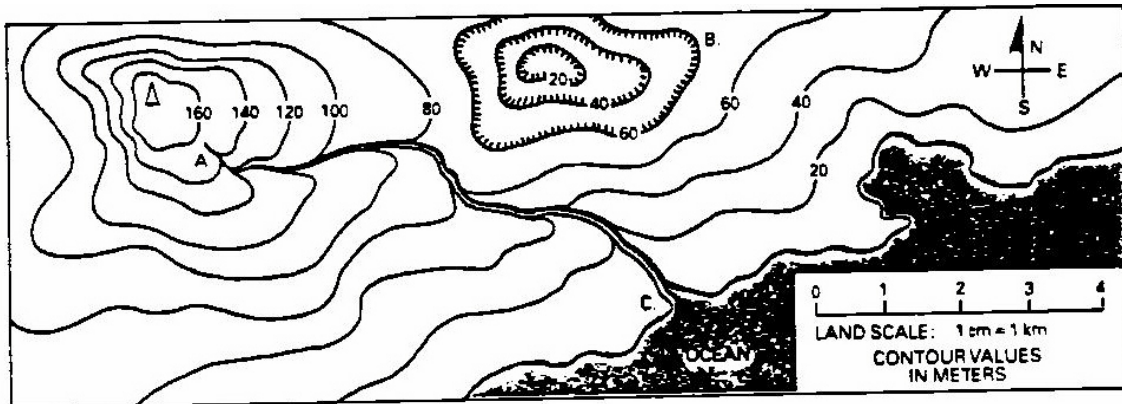
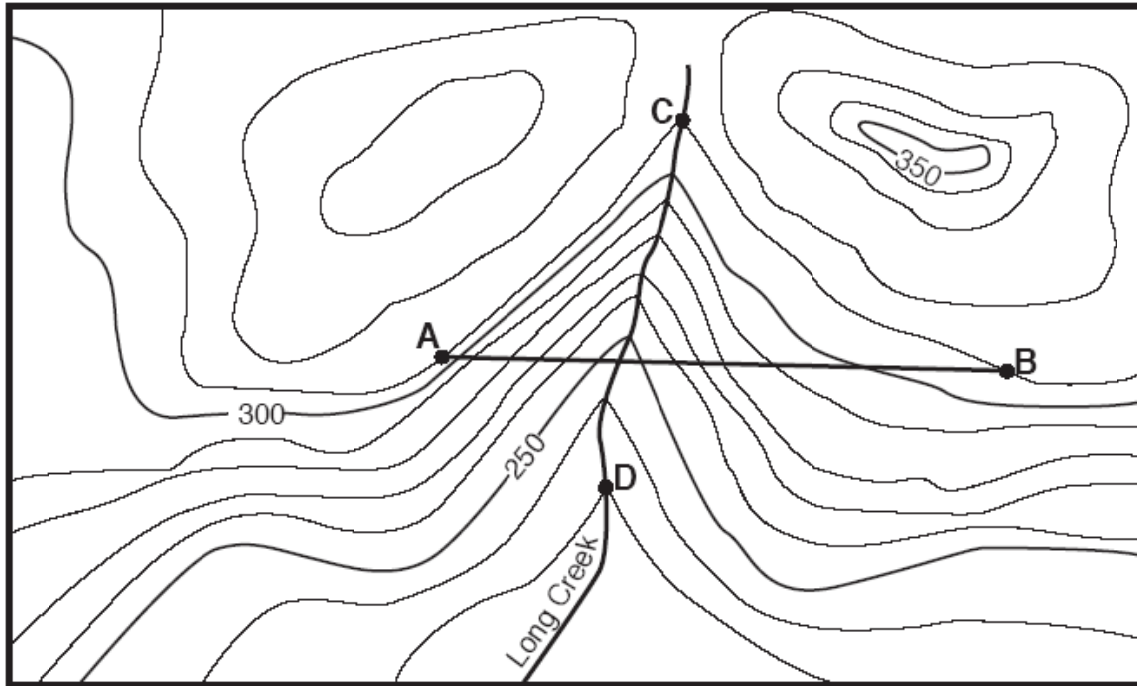


Figure D



**Making a Profile**

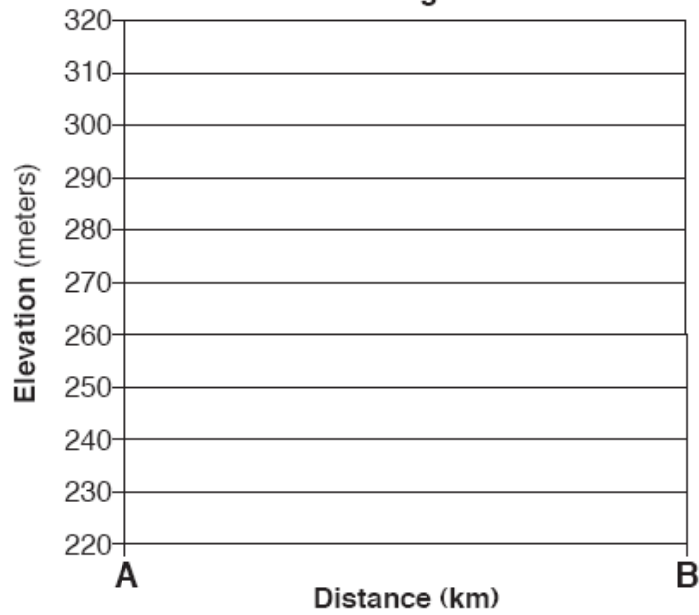


Contour interval = 10 meters

0 1 2 kilometers

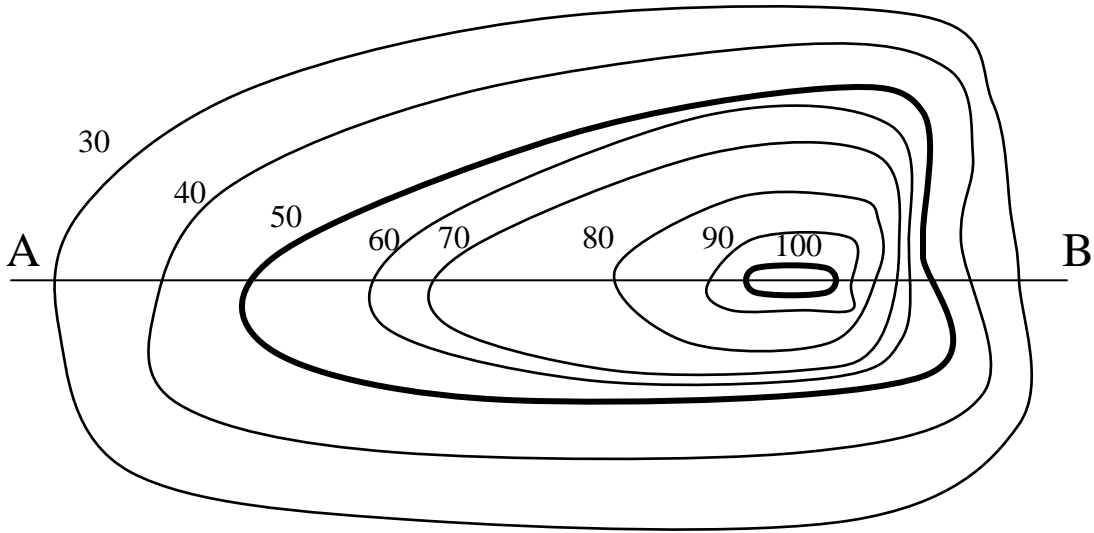


**Profile Along Line AB**



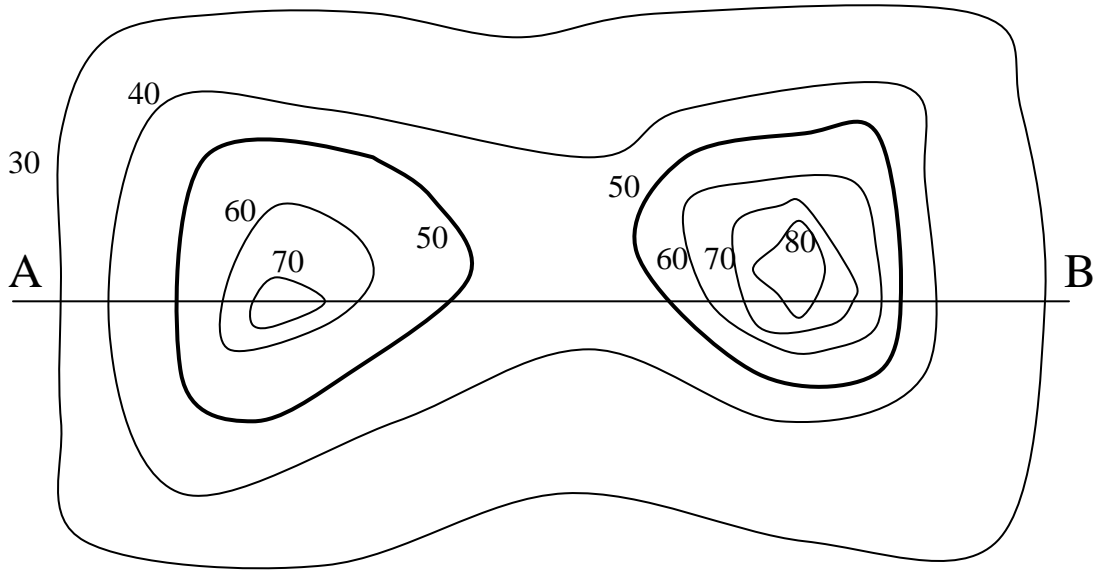
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# Making A Topographic Profile I



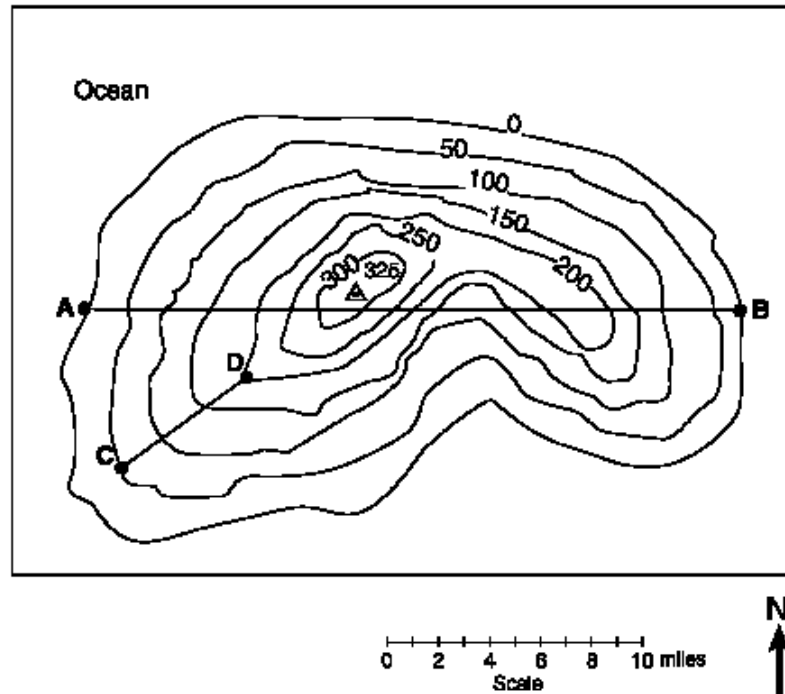
Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Making A Topographic Profile II



Name: \_\_\_\_\_ Date: \_\_\_\_\_

The topographic map of an island is shown below. Elevation is expressed in feet. Points A, B, C and D are locations on the island. A **triangulation point** shows the highest elevation on the island.



On the grid below, construct a topographic profile representing the cross-sectional view between point A and point B, following the directions below.



What is the gradient in feet/mile along the straight line from point C to point D

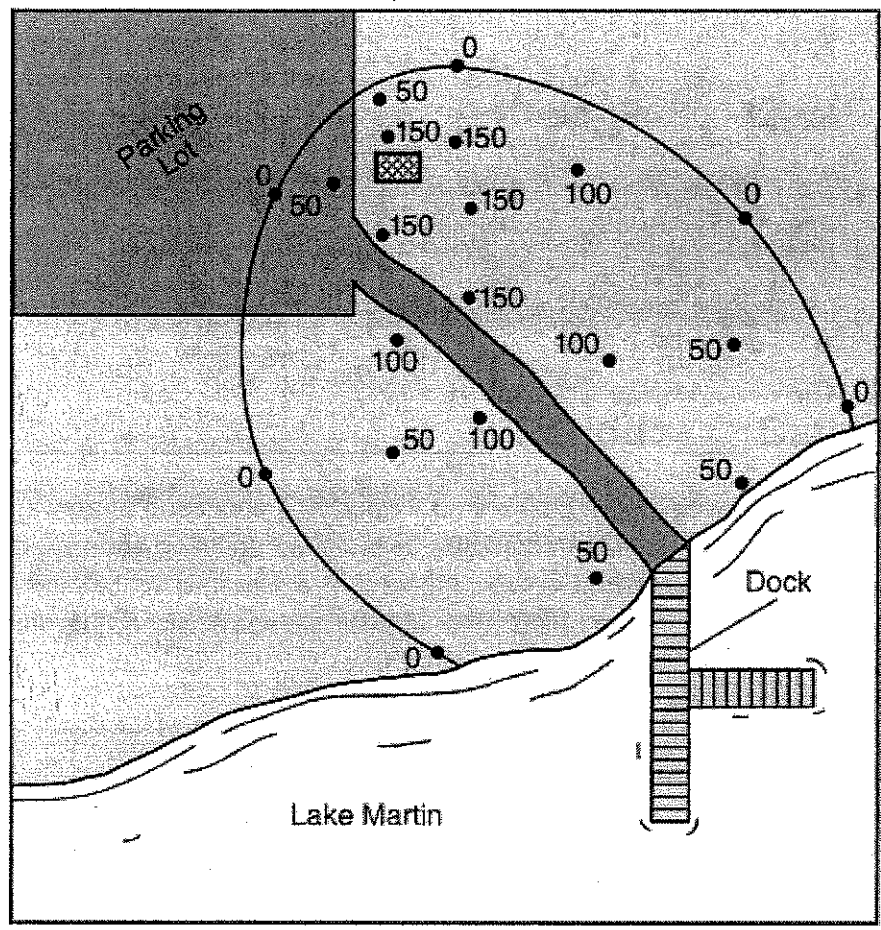
**Write the equation**

**Substitute**

**Solve with units**

Base your answers to questions 1 through 2 on the field map below, which shows an area of a state park where an underground gasoline tank leaked and contaminated the groundwater. Groundwater monitoring wells were installed to determine the extent of the contamination. The concentration of contaminants parts per million (ppm) in each of the wells is indicated on the map.

Area of State Park



Key	
●	Groundwater-monitoring well
▣ (cross-hatched)	Underground gasoline tank

1. On the field map above, draw the 50-ppm, 100-ppm, and 150-ppm isolines. The 0-ppm isoline has been drawn for you.

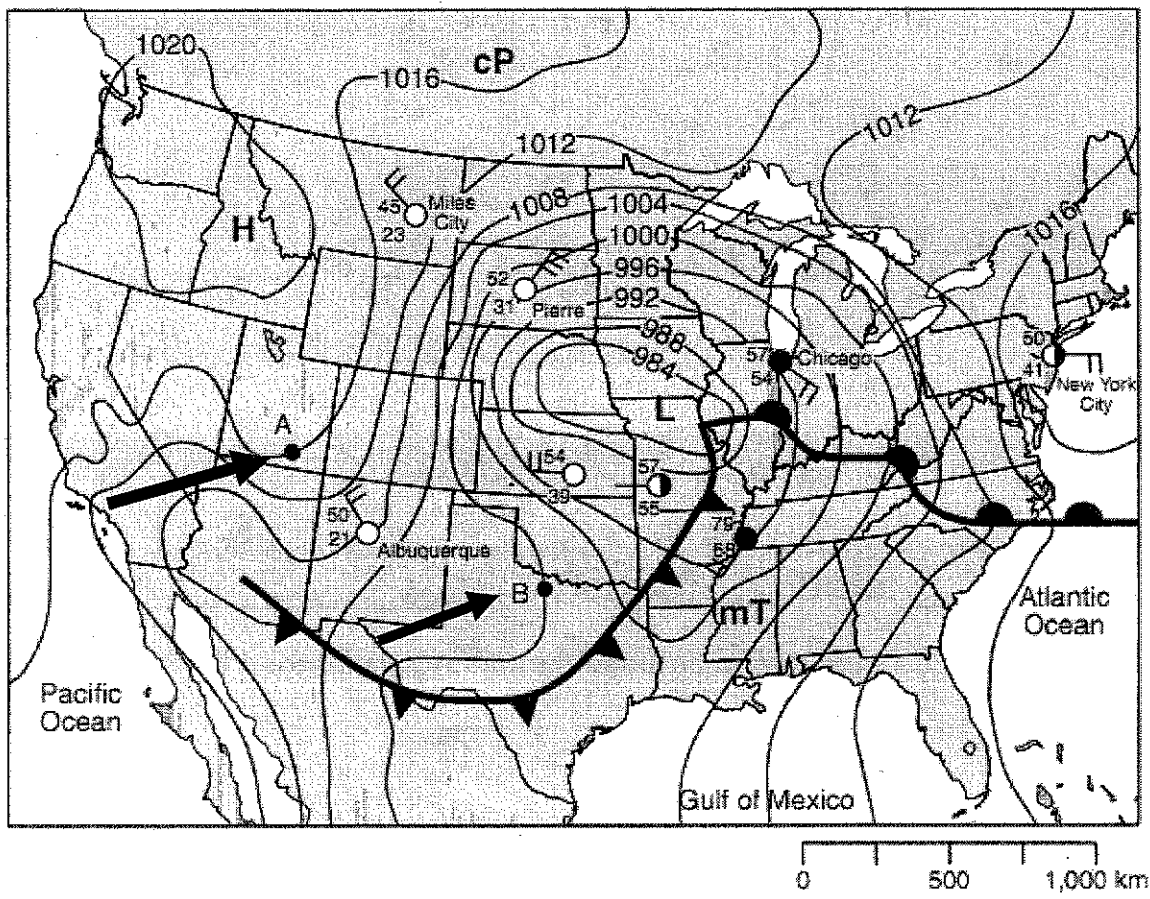
2. State the relationship between the distance from the gasoline tank and the concentration of contaminants in the groundwater.

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The map below shows barometric pressure measured in millibars.



1. Write the equation for gradient below.

2. Calculate the pressure gradient along a straight line between point A and point B on the map above (see arrows above).

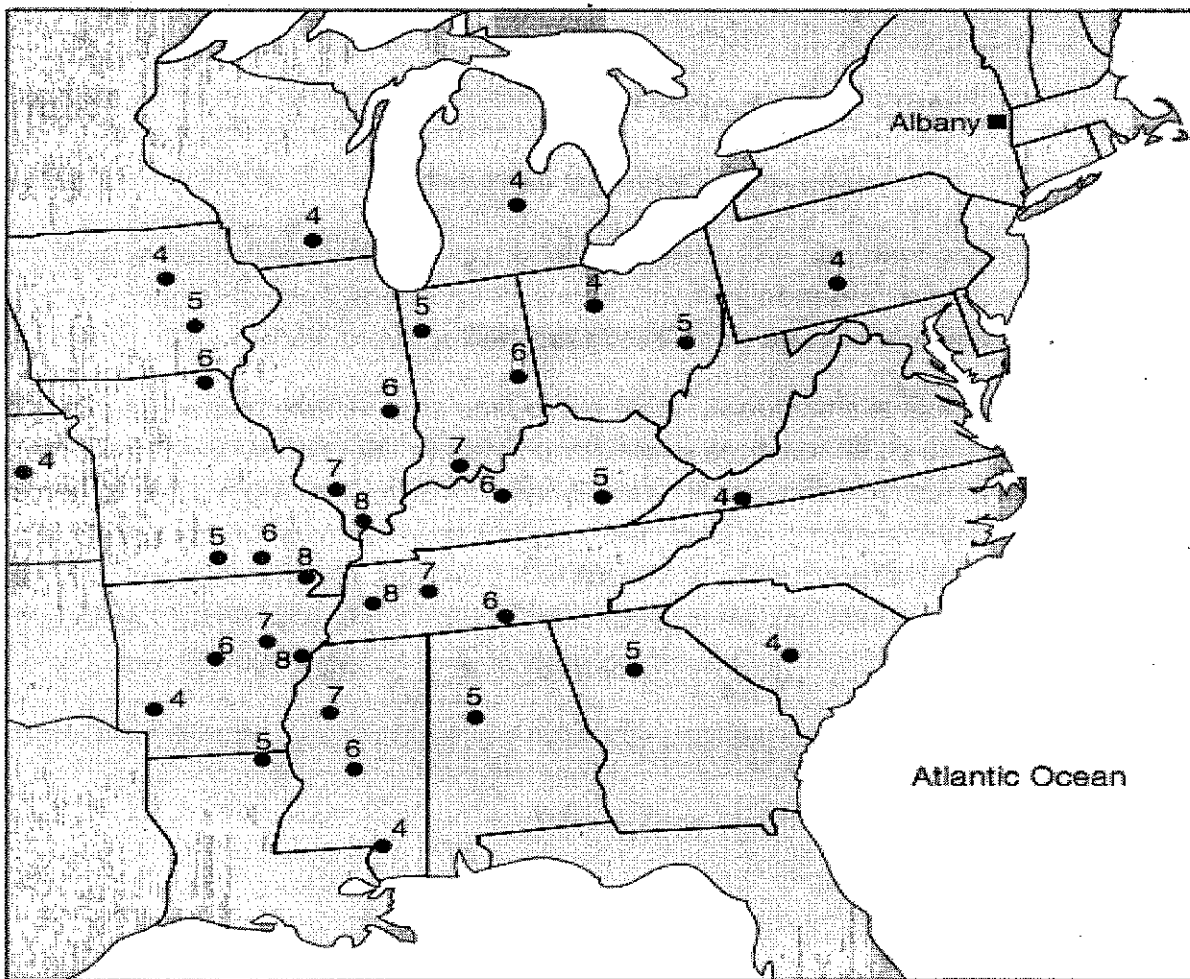
Substitution Step:

3. Final Answer recorded to the *nearest tenths* place with units. \_\_\_\_\_

### The New Madrid Fault System

The passage describes the New Madrid fault system. The numbers on the map show the predicted relative damage at various locations if a large earthquake occurs along the New Madrid fault system. **The higher the number, the greater the relative damage.**

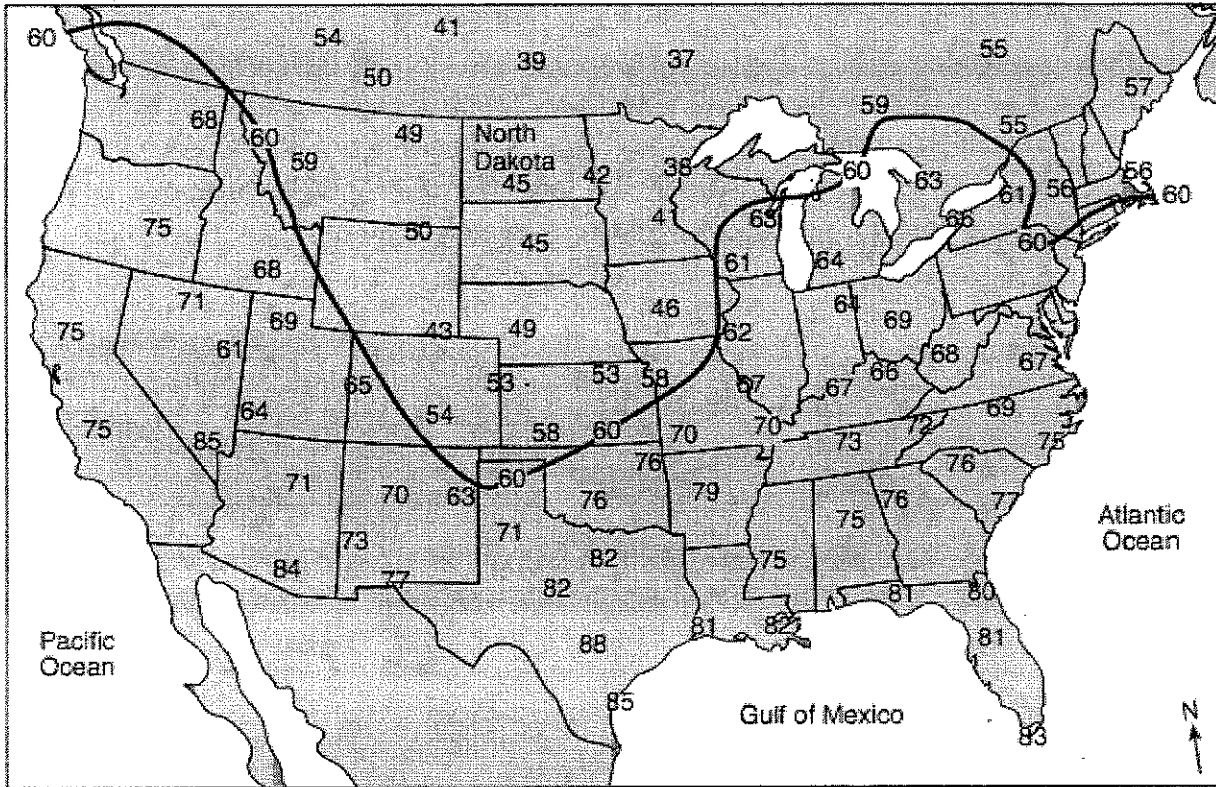
The greatest earthquake risk area east of the Rocky Mountains is along the New Madrid fault system. The New Madrid fault system consists of a series of faults along a weak zone in the continental crust in the midwestern United States. Earthquakes occur in the Midwest less often than in California, but when they do happen, the damage is spread over a wider area due to the underlying bedrock. In 1811 and 1812, the New Madrid fault system experienced three major earthquakes. Large land areas sank, new lakes formed, the course of the Mississippi River changed, and 150,000 acres of forests were destroyed.



1. On the map above, draw the 4, 6, and 8 isolines indicating relative damage.
2. Using the predicted damage numbers, place an X on the map to indicate the area where the New Madrid fault system most likely exists.

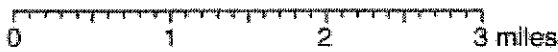
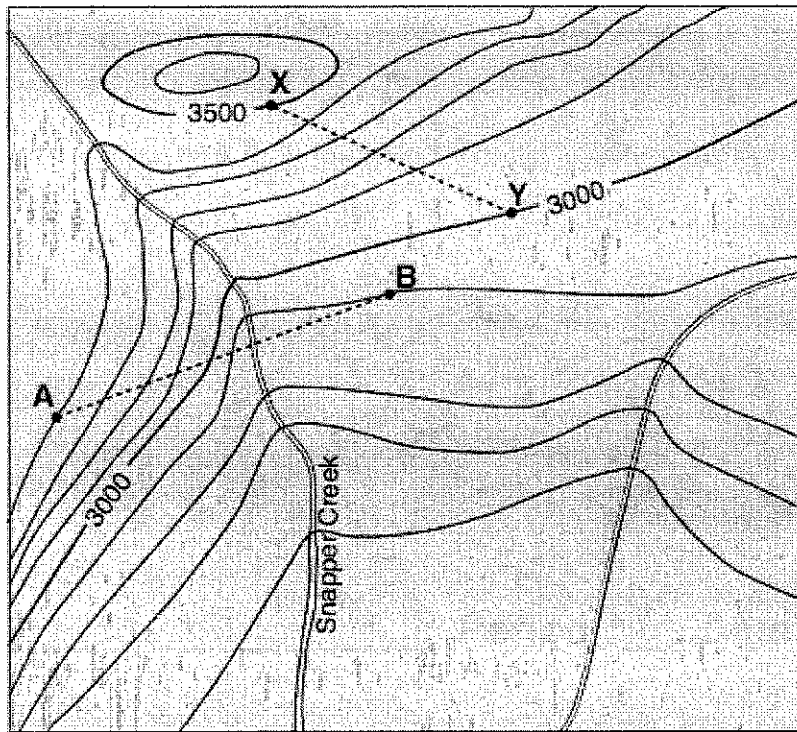
Name: \_\_\_\_\_ Period: \_\_\_\_ Date: \_\_\_\_\_

Base your answers to questions 1 and 2 on the United States map below, which shows recorded temperatures in degrees Fahrenheit for October 2, 2004. The 60°F isotherm has been drawn on the map.



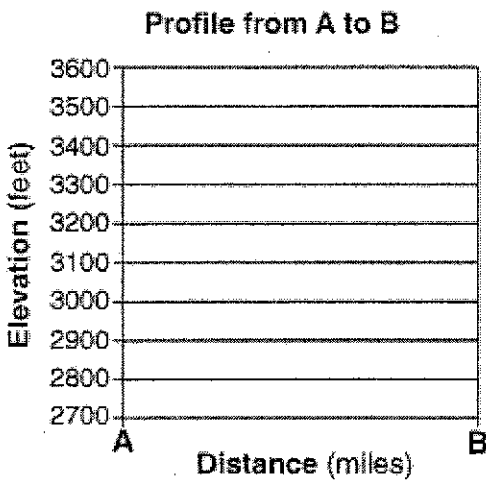
1. On the map above, draw the 70°F isotherm. Extend the isotherm to the edges of the continent.
2. Identify the two-letter weather map symbol for the dry, cold air mass over North Dakota.





Contour interval = 100 feet

1. On the grid below, construct a topographic profile of the land surface along line AB by plotting an X for the elevation of each contour line that crosses line AB. Connect the Xs with a smooth, curved line to complete the profile.



3. Show work for gradient calculation:

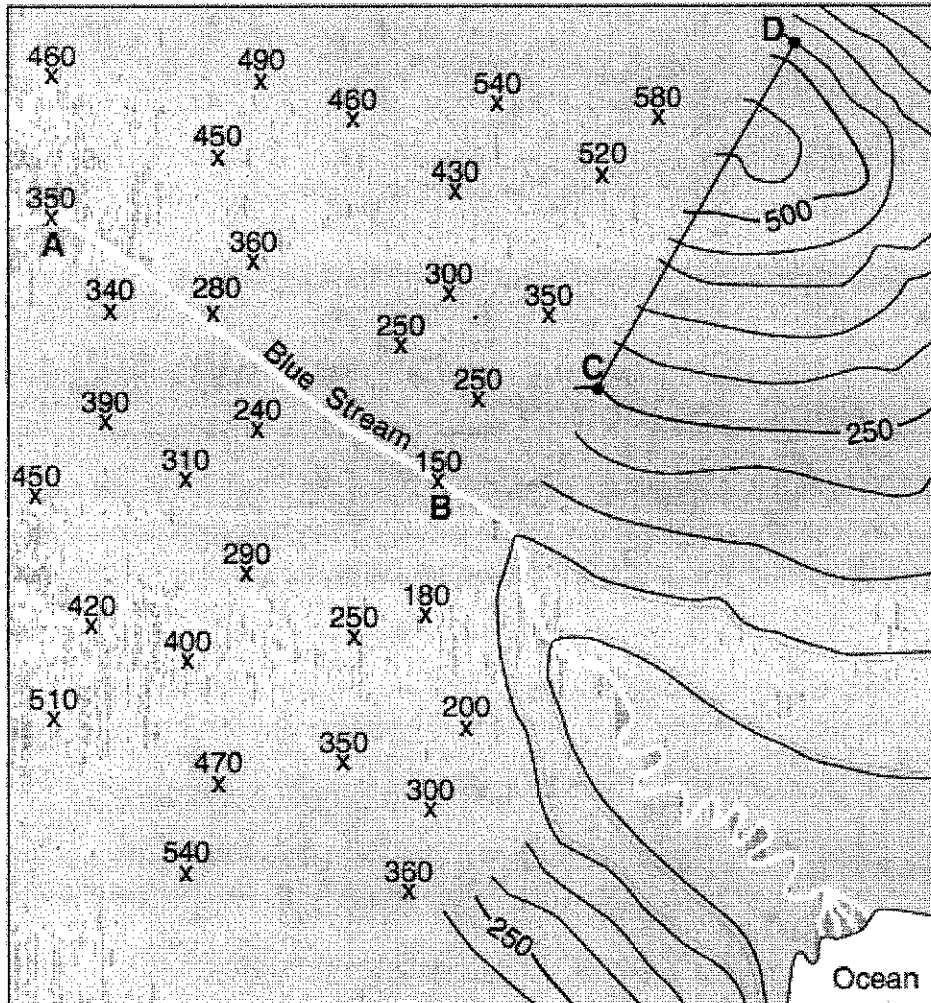
Final Answer: \_\_\_\_\_

2. Toward which compass direction is Snapper Creek flowing?  
\_\_\_\_\_

3. Calculate the gradient between points X and Y. Show your work in the box above. Units must be included in your answer.

Final Answer: \_\_\_\_\_

Base your answers to questions 1 through 4 on the map below, which shows partially drawn contour lines. Xs indicate elevations in meters. Letters A, B, C, and D represent locations on the map.



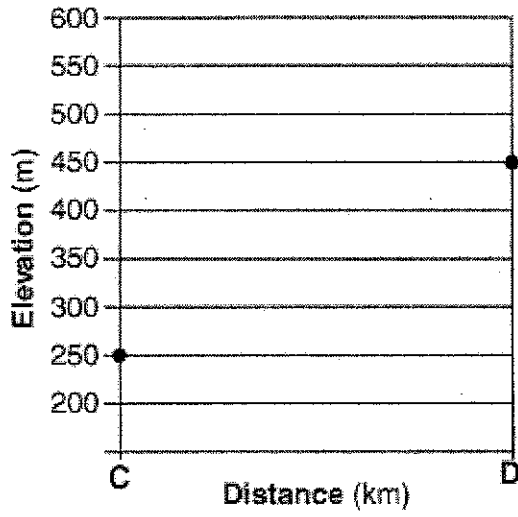
Contour interval = 50 meters



1. On the map above, complete the 250-meter contour line.
2. On the portion of the map showing contour lines, **place an X in an area** where an elevation of 55 meters is located.
3. Calculate the stream gradient from elevation **A** to elevation **B**. Label your answer with the correct units.

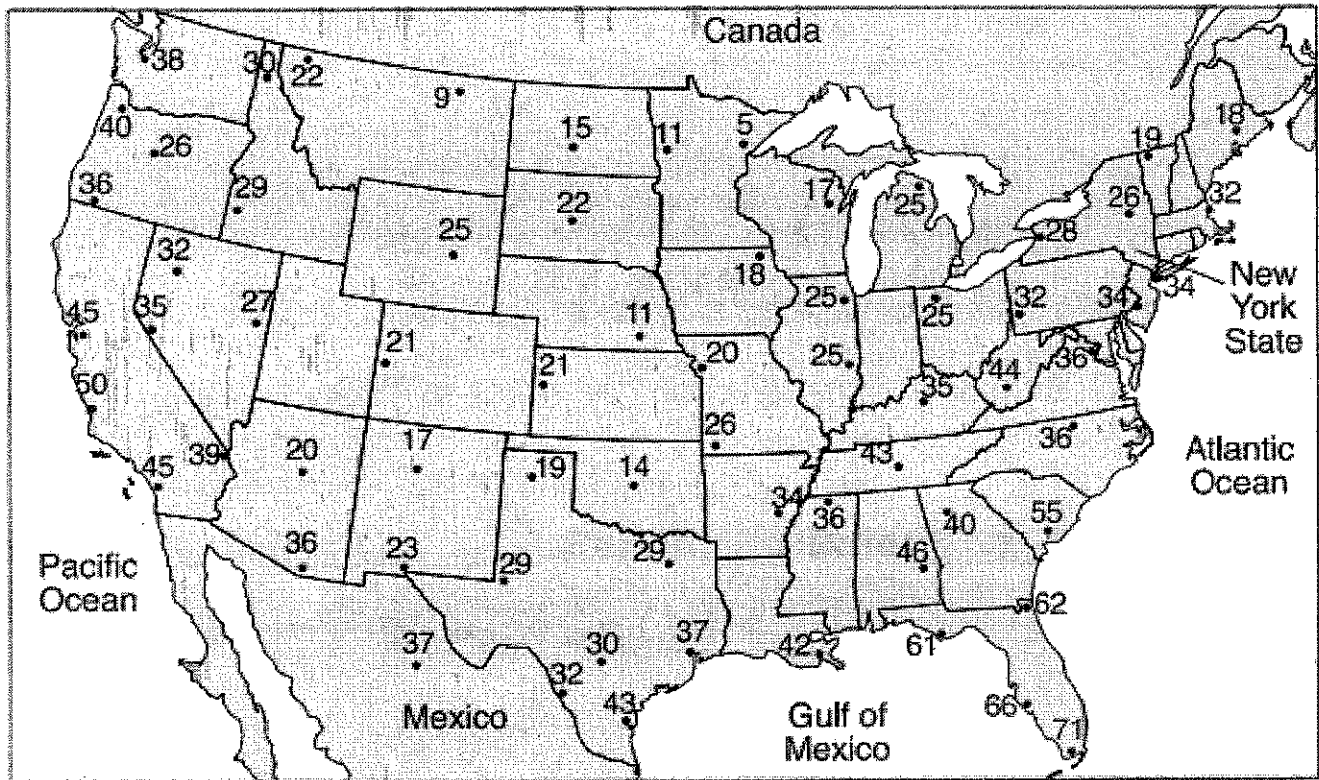
Name: \_\_\_\_\_ Period: \_\_\_\_ Date: \_\_\_\_\_

4. On the grid below, construct a topographic profile along line CD. Plot with an X the elevation of each contour line that crosses line CD. Connect the Xs from C to D with a smooth, curved line to complete the profile. Elevations C and D have already been



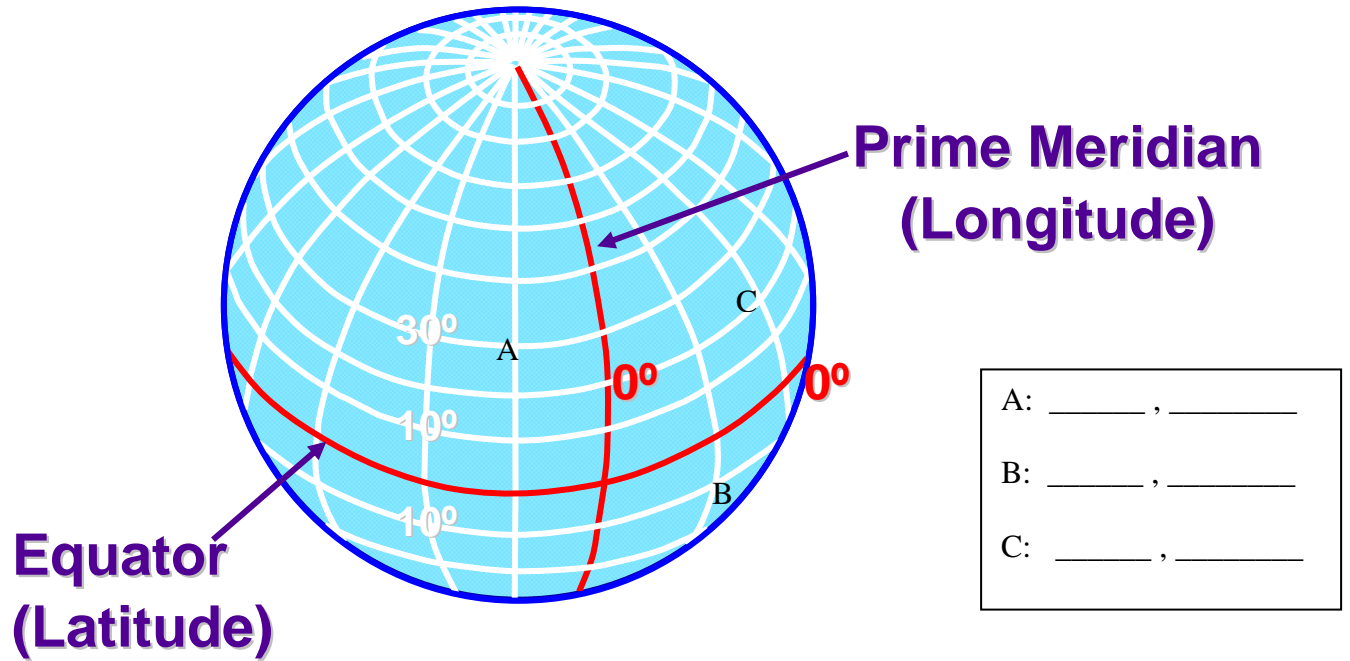
5

Map 1—Temperatures (°F)



1. On the weather map above draw the 32°F isoline.
2. What is this specific type of isoline called ? \_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_



Latitude: \_\_\_\_\_

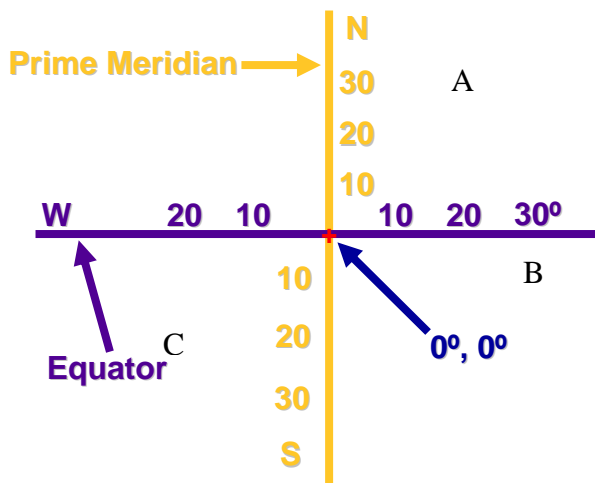
Equator: \_\_\_\_\_

Poles: \_\_\_\_\_

Longitude: \_\_\_\_\_

Prime Meridian: \_\_\_\_\_

International Date Line: \_\_\_\_\_

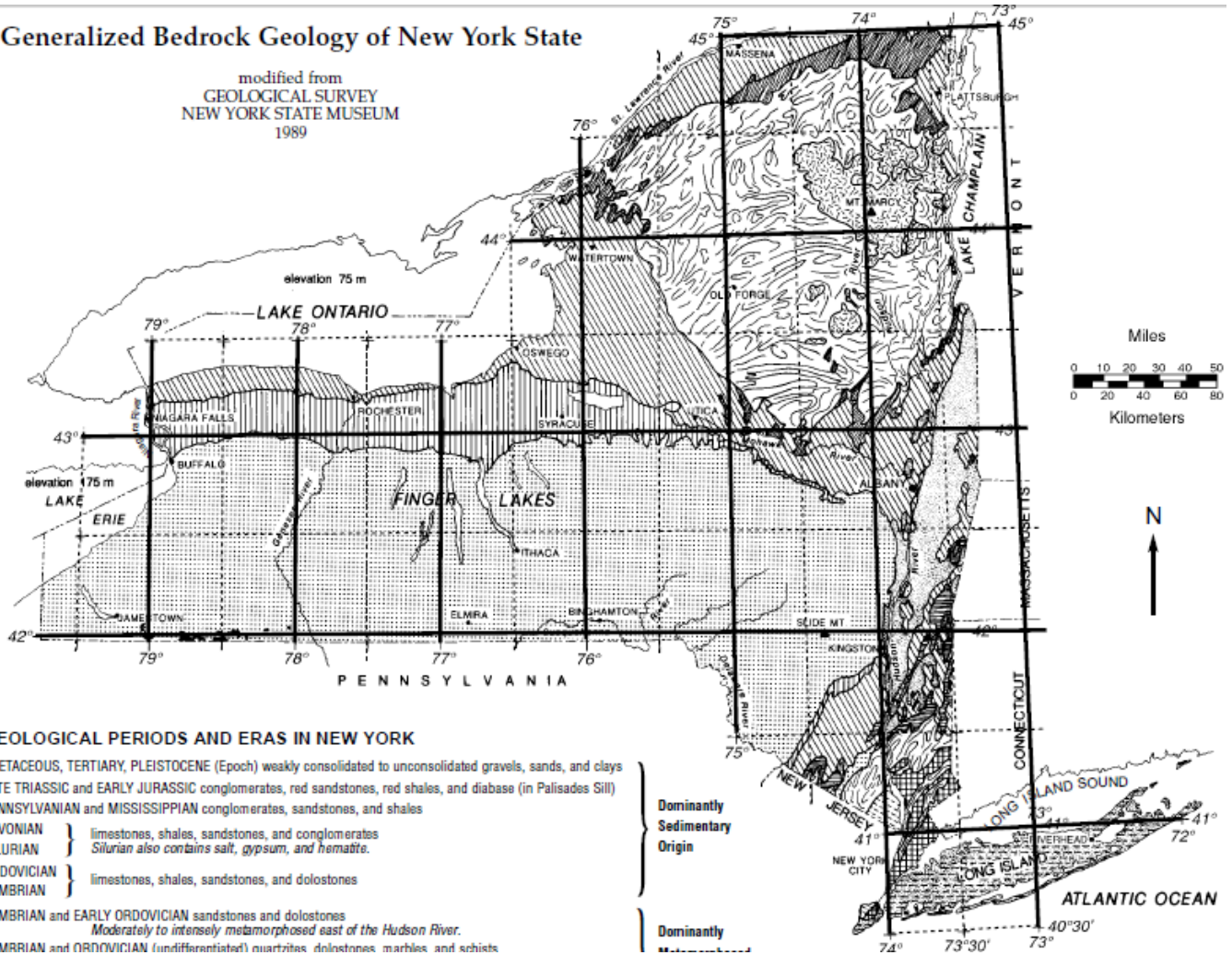


A: \_\_\_\_\_

B: \_\_\_\_\_

**Generalized Bedrock Geology of New York State**

modified from  
GEOLOGICAL SURVEY  
NEW YORK STATE MUSEUM  
1989



Express latitude and longitude to the nearest minutes

BINGHAMTON: \_\_\_\_\_ , \_\_\_\_\_

ALBANY: \_\_\_\_\_ , \_\_\_\_\_

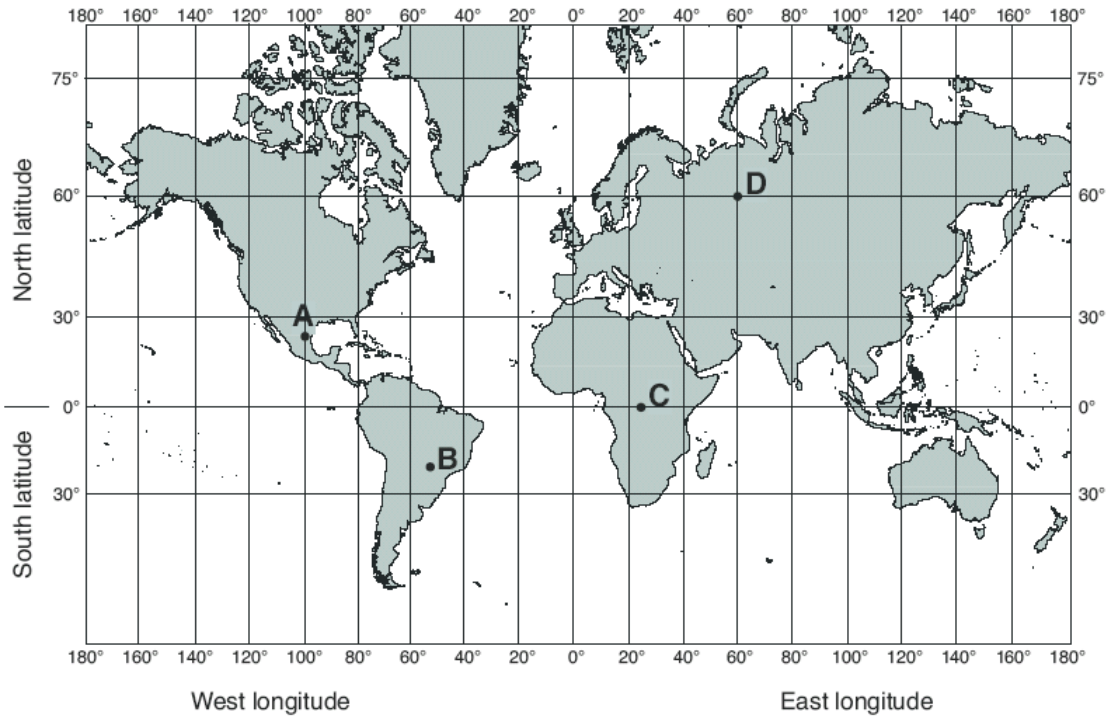
ITHACA: \_\_\_\_\_ , \_\_\_\_\_

43°58'N, 75°58'W: \_\_\_\_\_

42°50'N, 78°54'W: \_\_\_\_\_

42°10'N, 76°52'W: \_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_



1. Give the Latitude and Longitude of the following points based on the above map. Remember to use the proper format

A. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

B. \_\_\_\_\_

2. Use your ESRT (p.3) map of NYS and determine with to the nearest  $\frac{1}{4}$  of a degree the Latitude & Longitude of the following cities:

a. Massena - \_\_\_\_\_

b. Watertown - \_\_\_\_\_

c. Elmira - \_\_\_\_\_

d. Rochester - \_\_\_\_\_

Remember when estimating  
 $\frac{1}{4}$  or  $.25^\circ = 15'$   
 $\frac{1}{2}$  or  $.50^\circ = 30'$   
 $\frac{3}{4}$  or  $.75^\circ = 45'$



## Rubric for Topographic Map Unit

INDICATORS	BEGINNING Novice	DEVELOPING Apprentice	ACCOMPLISHED Practitioner	EMPLEMLARY Expert
<b>Reading contour map</b>	Able to define and explain contour map vocabularies such as contour interval, gradient, index contour and more (see packet for list)	Identify landmarks such as river, mountain, depression, by using contour map features	<ul style="list-style-type: none"> <li><input type="checkbox"/> Using contour lines to identify areas of river flow and the direction of river flow</li> <li><input type="checkbox"/> Identify sea level and highest elevation of a peak</li> <li><input type="checkbox"/> Successfully state contour intervals with correct units</li> <li><input type="checkbox"/> Successfully state latitude and longitude of the map in the nearest degree and minutes</li> <li><input type="checkbox"/> Identify and explain areas of steepest gradient</li> <li><input type="checkbox"/> Accurately label peaks and depression</li> </ul>	<i>All practitioner plus</i> Describe and identify high and low topographic relief of the map Explain in detail the meaning of a 7.5 minute map and 15 minute map List various use of topographic map
<b>Calculating contour maps</b>	Can find the gradient formula on the reference table	Explain the process of greenhouse effect Identify and explain how unnatural climate (human impact) factors affect climate	<ul style="list-style-type: none"> <li><input type="checkbox"/> Able to measure the distance of two points on the map</li> <li><input type="checkbox"/> Able to find the difference in elevation</li> <li><input type="checkbox"/> Able to measure and calculate gradient</li> <li><input type="checkbox"/> Able to measure and calculate gradient for other isoline map</li> </ul>	<i>All practitioner plus</i> Be able to calculate gradient in correct units Convert degree of latitudes into angular distance units.
<b>Creating contour maps</b>	Creating 3D models from contour maps to identify landmarks	Creating elevation profiles and 3D Google Earth tour	<ul style="list-style-type: none"> <li><input type="checkbox"/> Creating 2D profile on the topographic map with a provided and labeled grid</li> <li><input type="checkbox"/> Creating contour maps from field values</li> <li><input type="checkbox"/> Able to create a beginner trail system on a topographic map with given criteria</li> </ul>	<i>All practitioner plus</i> Creating 2D profiles with self-labeled grid. Successfully creating different types of isoline maps Able to create an advanced trail system on a topographic map with given criteria