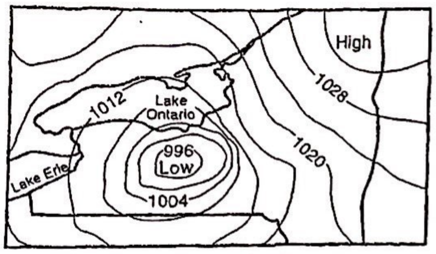
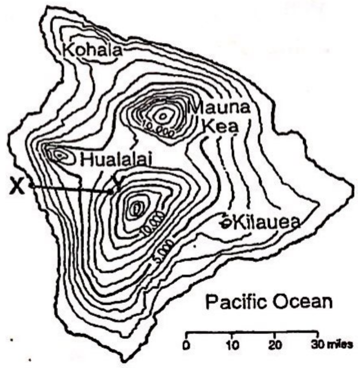
Key

Gradient



$$\text{Gradient} = \frac{\text{change in field value}}{\text{distance}}$$



Overview:

A field is an area in which measurements can be obtained at any point within the field. Some examples of fields are: an elevation field, as shown on a topographic map containing contour lines; an air pressure field measured in millibars (mb), that is displayed on a weather map using isobars; or temperatures connected by isotherms. The gradient equation gives the average change within the field from two given points or positions. The gradient may indicate the steepness of a land surface, or show the strength (magnitude) of an air pressure field that could indicate the potential of a severe weather situation.

The Equation:

The change in field value is the difference between two values. These values may be given to you, or you might have to determine their values from two points on some type of field map. If the problem involves a field (showing isolines), use the isoline interval to obtain the value of the two given points within the field. For the distance between the two points, use the distance scale usually located at the base of the field map. Divide to get the answer. No credit will be awarded if the proper units are not given.

Example: A river starts at an elevation of 110 meters above sea level.
Five kilometers downstream the river's elevation is 65 meters.
What is the gradient of this river?

Solution: The change in field value is 110 m – 65 m = 45 m. The distance is 5 km.

$$G = \frac{110\text{ m} - 65\text{ m}}{5\text{ km}} \qquad G = \frac{45\text{ m}}{5\text{ km}} = 9\text{ m/km}$$

This answer shows that for every kilometer, the river drops an average of 9 meters.

Additional Information:

- When isolines become closer, the gradient is increasing.
- Contour lines that are spaced closely on a topographic map indicate a steep slope (a hill, or mountain, etc.).
- When isobars on a weather map are close, the pressure gradient is strong, and that area will be experiencing windy conditions.
- Sea level is always at an elevation of 0.

Copyright © 2011
Topical Review Book Company

Scanned with CamScanner

1. Which equation can be used to correctly calculate the air-pressure gradient between two locations?

   (1) $\text{gradient} = \dfrac{\text{change in air pressure (mb)}}{\text{average air temperature (°F)}}$

   (2) $\text{gradient} = \dfrac{\text{change in air pressure (mb)}}{\text{distance (km)}}$

   (3) $\text{gradient} = \dfrac{\text{change in distance (km)}}{\text{air pressure interval (mb)}}$

   (4) $\text{gradient} = \dfrac{\text{change in air pressure (mb)}}{\text{air pressure interval (mb)}}$

   1 2

2. A topographic map shows two locations, *X* and *Y*, one half mile apart. From the contour lines, the elevation of *X* is 800 feet and *Y* is 750 feet. What is the gradient between the two locations?

   $\dfrac{800-750\text{ ft}}{0.5\text{ mi}}$

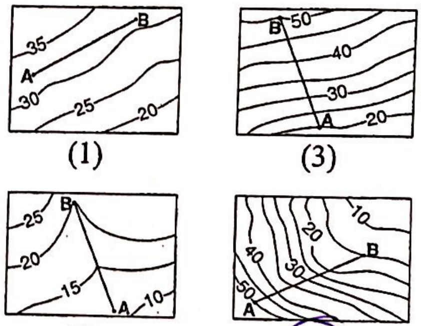
   (1) 12.5 ft/mi (3) 50 ft/mi
   (2) 25 ft/mi (4) 100 ft/mi 2 4

3. Point *A* and point *B* are locations 0.24 mile apart on a ski slope in northern New York. Point *A* has an elevation of 1,560 feet and point *B* has an elevation of 1,800 feet. What is the gradient between these points?

   (1) 60 ft/mi (3) 500 ft/mi
   (2) 240 ft/mi (4) 1,000 ft/mi 3 4

   $\dfrac{1800-1560\text{ ft}}{0.24\text{ mi}}$

4. On each topographic map below, the straight-line distance from point *A* to point *B* is 5 kilometers. Which topographic map shows the steepest gradient between *A* and *B*?



(1) (3)
(2) (4) 4 4

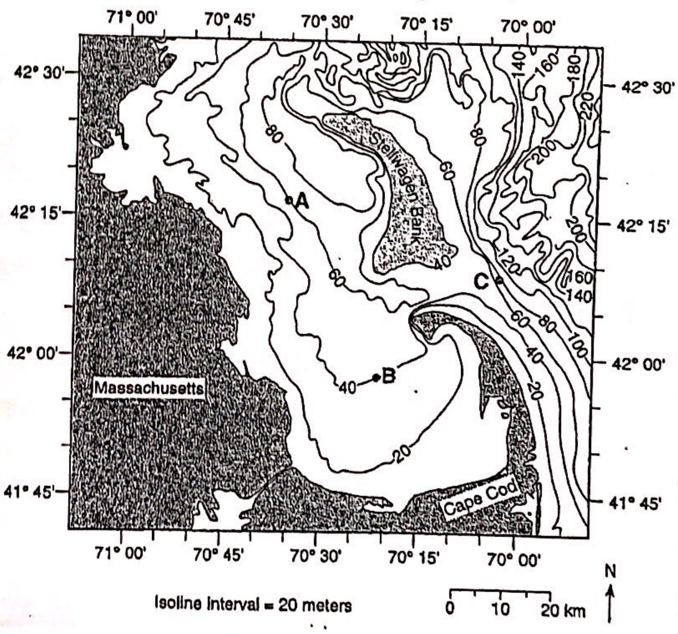
Base your answer to question 5 on the accompanying map showing ocean depths, measured in meters, off the coast of Massachusetts. Points *A*, *B*, and *C* represent locations on the ocean floor.

5. Calculate the average ocean-floor gradient between point *A* and point *B*. Label your answer with the correct units.

$\dfrac{60-40\text{ m}}{40\text{ km}} = \dfrac{20\text{ m}}{40\text{ km}}$

Gradient $= 0.5$ m/km

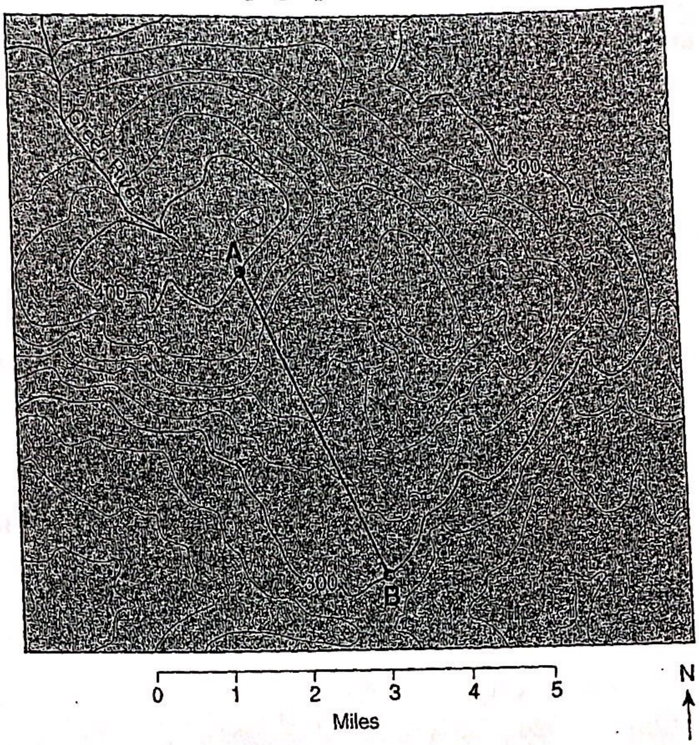
Whale Watchers' Map



Copyright © 2011

Scanned with CamScanner

Base your answers to questions 6 and 7 on the topographic map below. Elevations are in feet. Points *A* and *B* are locations on the map.



$\frac{100 \text{ ft}}{4 \text{ miles}} = 25 \text{ ft/mi}$

6. What is the gradient along the straight line between points *A* and *B*?

(1) 10 ft/mi (2) 20 ft/mi (3) 25 ft/mi (4) 35 ft/mi

6 3

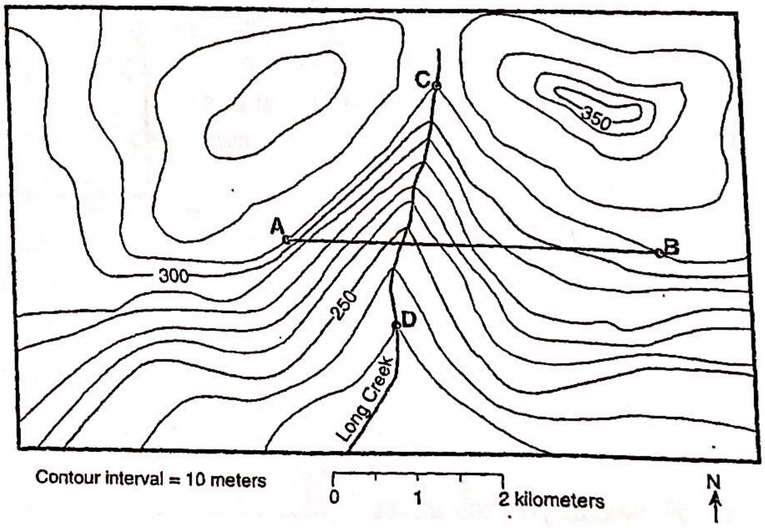
7. Which direction is Green River flowing?

(1) south (2) east (3) northeast (4) northwest

7 4

Base your answer to question 8 on the accompanying topographic map. Points *A*, *B*, *C*, and *D* are reference points on the map. Elevations are measured in meters.

8. Calculate the gradient of Long Creek between points *C* and *D* and label the answer with the correct units.



$\frac{310 - 230 \text{ ft}}{3 \text{ km}} = \frac{80 \text{ ft}}{3 \text{ km}}$

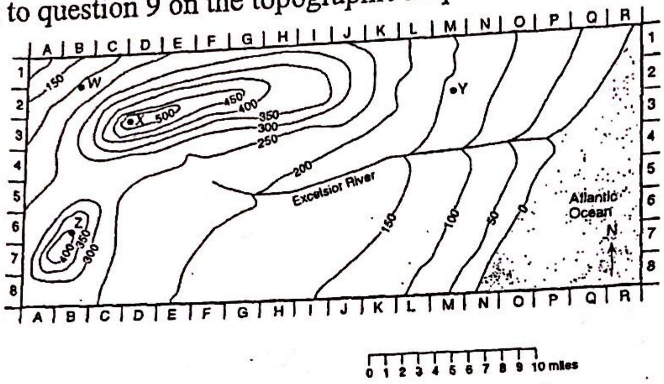
Gradient = 26.7 ft/km

Copyright © 2011
Topical Review Book Company

Scanned with CamScanner

Set 2 — Gradient

Base your answer to question 9 on the topographic map below. Elevations are expressed in feet.



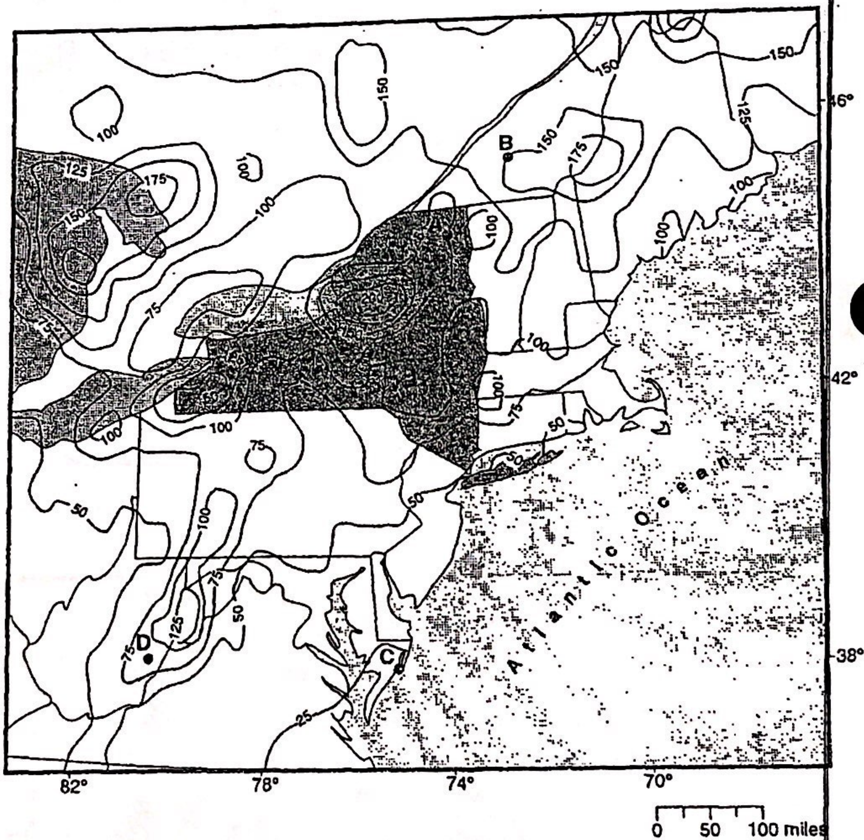
$\frac{225-0}{20}$

9. What is the gradient of the entire length of the Excelsior River?

(1) 0.1 ft/mi (2) 11 ft/mi (3) 24 ft/mi (4) 48 ft/mi

9 2

Base your answers to question 10 on the accompanying map. The map shows a portion of the eastern United States with New York State shaded. The isolines on the map indicate the average yearly total snowfall, in inches, recorded over a 20-year period.



10. *a)* The average yearly snowfall for position *D* is closest to

(1) 75 in (3) 100 in
(2) 85 in (4) 125 in

b) From the given latitude and longitude readings, give the coordinates of the area that has the greatest average yearly total snowfall.

43 °N, 75 °W

c) What is the approximate average yearly total snowfall gradient between locations *A* and *B*?

(1) 0.25 in/mi (2) 2.50 in/mi (3) 0.40 in/mi (4) 4.00 in/mi c ____

$\frac{150-125 \text{ in}}{100 \text{ mi}}$

11. How can you tell a steep gradient on a topographic map?

The lines are closer together

Copyright © 2011

Scanned with CamScanner