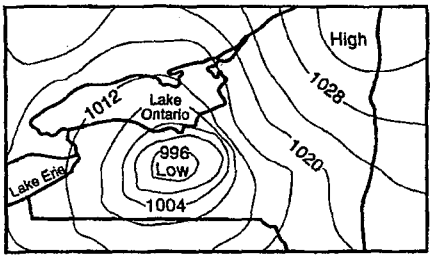
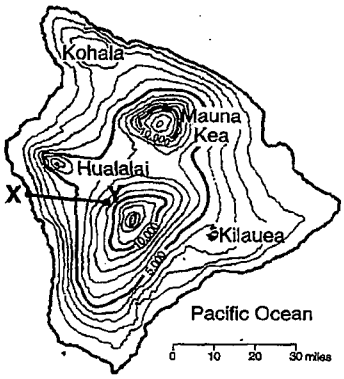
Gradient



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



Overview:

A field is an area in which value measurements can be obtained at any point. The gradient equation gives the average change of two measurements over a given distance within the field. Some examples of fields are: an elevation field as shown on a topographic map using contour lines, an air pressure field measured in millibars (mb), and a temperature field displayed on a weather map using isotherms.

The Equation:

The change in field value is the difference between two values determined from the field map. Use the isoline interval to get the correct value for each measurement. For the distance value use the distance scale located on the field map to determine the actual distance between the two points. Once the change in field is obtained and the distance is determined, the gradient is found by dividing the change in field value by distance. 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 is 110 m – 65 m = 45 m. The distance is 5 km.

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

Additional Information:

- When isolines become closer, the gradient is increasing.
- When contour lines are spaced closely on a topographic map it indicates a steep slope (a hill or mountain, etc.).
- When isobars on a weather map are close, the pressure gradient is great and that area will be experiencing strong wind.

Set 1 — Gradient

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

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

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

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

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

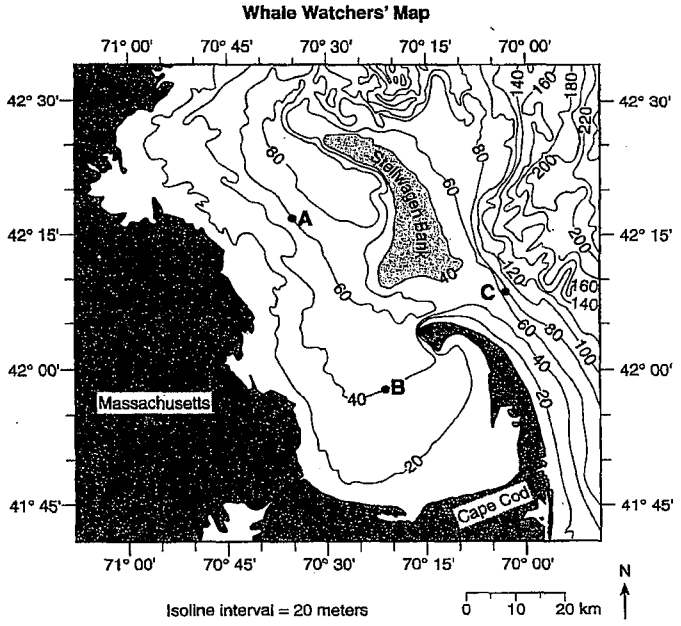
1 _____

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

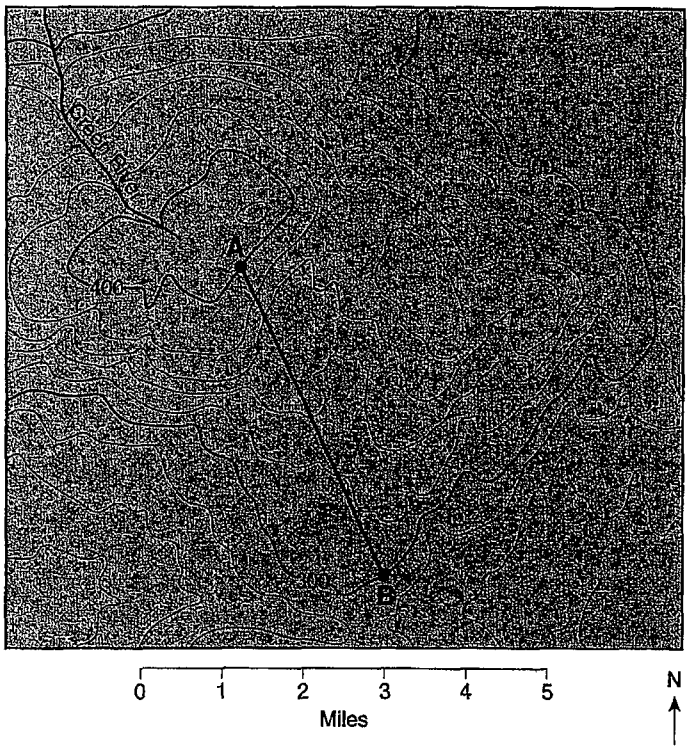
2 _____

Base your answer to question 3 on the accompanying map, and your knowledge of Earth Science. The map shows ocean depths, measured in meters, off the coast of Massachusetts. Points *A*, *B*, and *C* represent locations on the ocean floor.



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

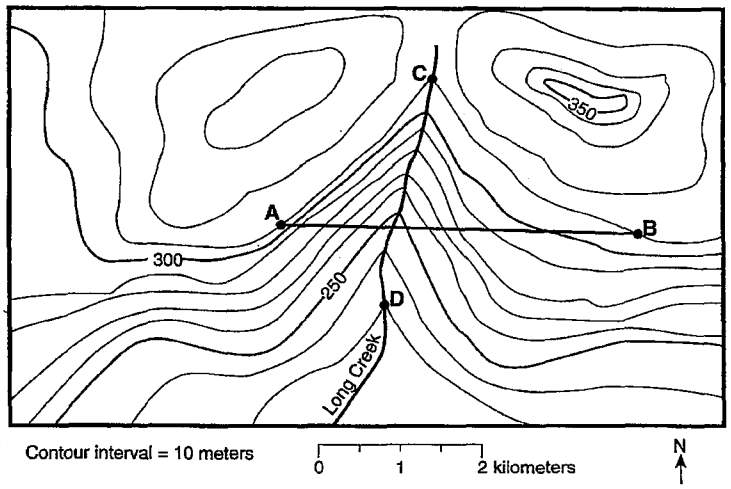
Base your answer to question 4 on the topographic map below. Elevations are in feet. Points *A* and *B* are locations on the map.



4. 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 4 _____

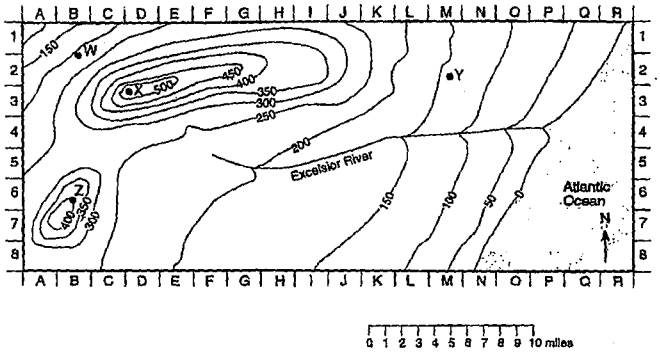
Base your answer to question 5 on the accompanying topographic map. Points *A*, *B*, *C*, and *D* are reference points on the map. Elevations are measured in meters



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

Set 2 — Gradient

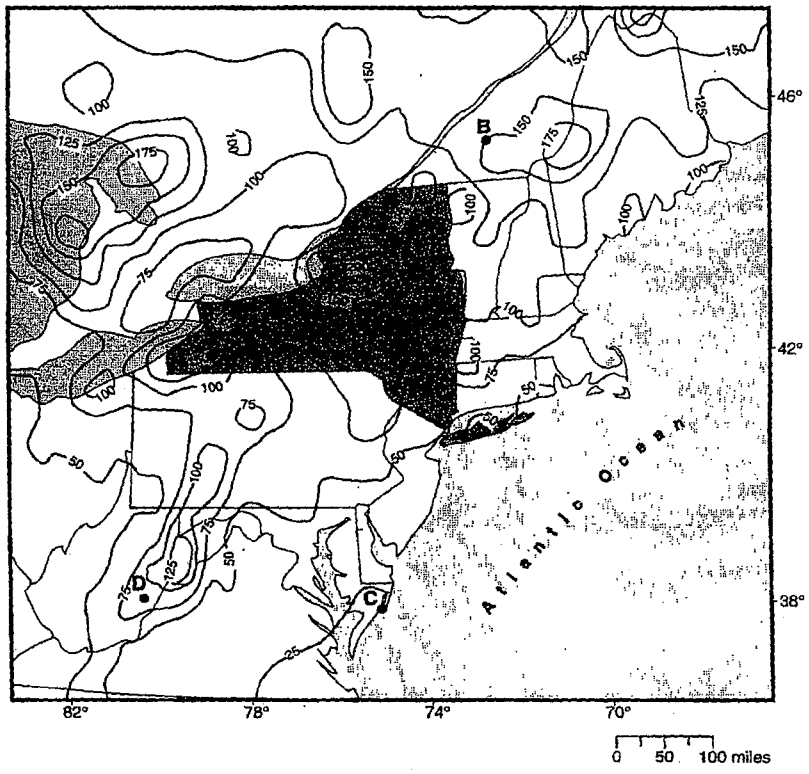
Base your answer to question 6 on the topographic map below. Elevations are expressed in feet.



6. 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 6 _____

Base your answer to question 7 on the accompanying map, and your knowledge of Earth Science. 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. Points *A* through *D* are locations on Earth's surface.



7. 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 7 _____

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

_____

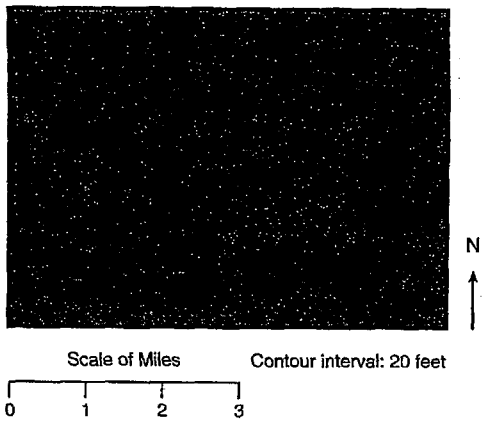
_____

9. The accompanying topographic map shows locations *X* and *Y*.

What is the approximate gradient between *X* and *Y*?

(1) 15 ft/mi
(2) 20 ft/mi
(3) 30 ft/mi
(4) 60 ft/mi

9 _____



Base your answers to question 10*a* and *b* on the weather map below. The isobars show air pressures, in millibars. Points *A* and *B* indicate locations on the map.

10. *a*) Calculate the pressure gradient along a straight line between point *A* and point *B* on the map. Label your answer with the correct units.

b) Describe the evidence shown on the map that indicate strong winds are blowing between Miles City and Pierre.