Specific Heats Of Common Materials

1 A city located on the coast of North America has warmer winters and cooler summers than a city at the same elevation and latitude located near the center of North America. Which statement best explains the difference between the climates of the two cities?

(1) Ocean surfaces change temperature more slowly than land surfaces.
(2) Warm, moist air rises when it meets cool, dry air.
(3) Wind speeds are usually greater over land than over ocean water.
(4) Water has a lower specific heat than land.

2 A city located on the coast of North America has warmer winters and cooler summers than a city at the same elevation and latitude located near the center of North America. Which statement best explains the difference between the cities' climates?

(1) Ocean surfaces change temperature more slowly than land surfaces.
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(3) Wind speeds are usually greater over land surfaces than over ocean surfaces.
(4) Ocean surfaces have a lower specific heat than land surfaces.

3 The map below shows the area that, at one time, was covered by ancient Lake Bonneville. Evidence of ancient shorelines indicates that, near the end of the last ice age, Lake Bonneville existed in western Utah and eastern Nevada. The Great Salt Lake in Utah is a remnant of the former Lake Bonneville.

Which material that was formerly on the bottom of Lake Bonneville is most likely exposed on the land surface today?

(1) folded metamorphic bedrock
(2) flat-lying evaporite deposits
(3) coarse-grained coal beds
(4) fine-grained layers of volcanic lava

Base your answers to questions 4 on the map and the passage below and on your knowledge of Earth science. The map shows four different locations in India, labeled A, B, C, and D, where vertical sticks were placed in the ground on the same clear day. The locations of two cities in India are also shown.

Monsoons in India

A monsoon season is caused by a seasonal shift in the wind direction, which produces excessive rainfall in many parts of the world, most notably India. Cherrapunji, in northeast India, received a record 30.5 feet of rain during July 1861. During the monsoon season from early June into September, Mumbai, India averages 6.8 feet of rain. Mumbai's total average rainfall for the other eight months of the year is only 3.9 inches.

Monsoons are caused by unequal heating rates of land and water. As the land heats throughout the summer, a large low-pressure system forms over India. The heat from the Sun also warms the surrounding ocean waters, but the water warms much more slowly. The cooler air above the ocean is more dense, creating a higher air pressure relative to the lower air pressure over India.

4 The unequal heating rates of India's land and water are caused by

(1) land having a higher density than water
(2) water having a higher density than land
(3) land having a higher specific heat than water
(4) water having a higher specific heat than land

5 Equal masses of basalt, granite, iron, and copper received the same amount of solar energy during the day. At night, which of these materials cooled down at the fastest rate?

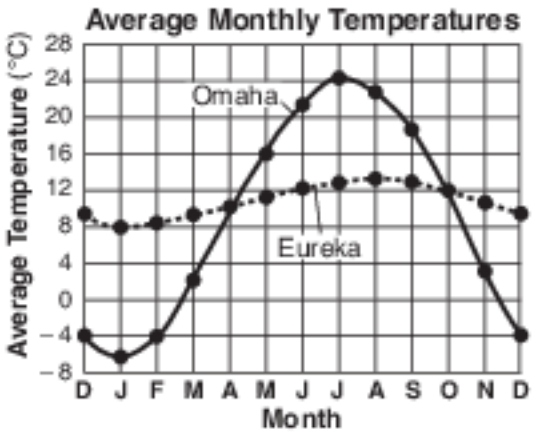
(1) basalt
(2) granite
(3) iron
(4) copper

6 Which group of substances is arranged in order of decreasing specific heat values?
(1) iron, granite, basalt
(2) copper, lead, iron
(3) dry air, water vapor, ice
(4) liquid water, ice, water vapor

7 Equal masses of granite, iron, copper, and lead are placed in sunlight. Based on specific heat, which material will warm up the fastest?
(1) granite (3) copper
(2) iron (4) lead

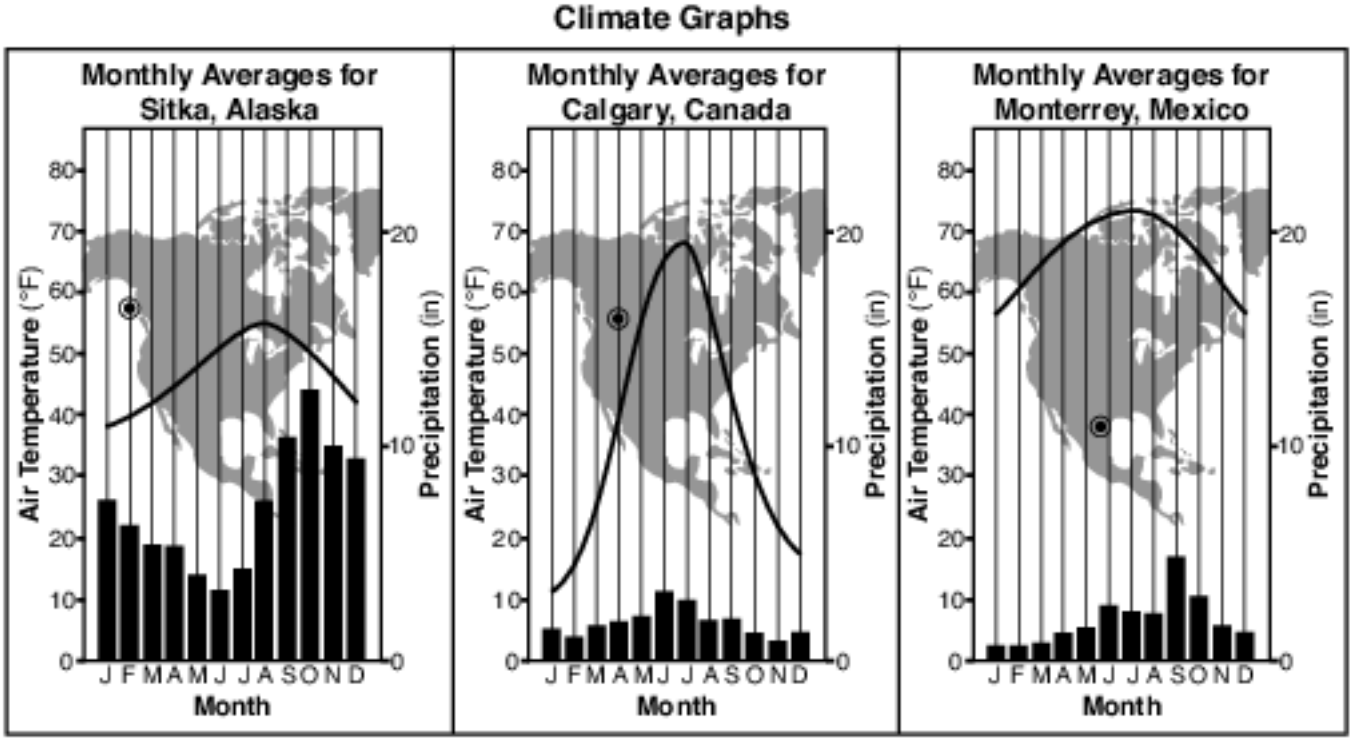
8 Riverhead, New York, has a smaller average daily temperature range than Elmira, New York, because Riverhead is located
(1) near a large body of water
(2) at a lower latitude
(3) at a higher elevation
(4) near a large city

Base your answers to questions 9 on the graph and map below and on your knowledge of Earth science. The average monthly temperatures for Eureka, California, and Omaha, Nebraska, are plotted on the graph. The map indicates the locations of these two cities.



9 Explain why Omaha, which is farther inland, has a greater variation in temperatures throughout the year than Eureka, which is closer to the ocean. [1]

Base your answers to questions 10 on the graphs below and on your knowledge of Earth science. The climate graphs represent data for three different locations in North America. Line graphs show the average monthly air temperatures in degrees Fahrenheit (°F). Bar graphs show the average monthly precipitation in inches (in). A circled dot (■) indicates each location on the maps.



10 State one reason why the annual temperature range of Calgary, Canada, is greater than the annual temperature range in Sitka, Alaska. [1]

Base your answers to questions 11 on the passage and the graph below and on your knowledge of Earth science.

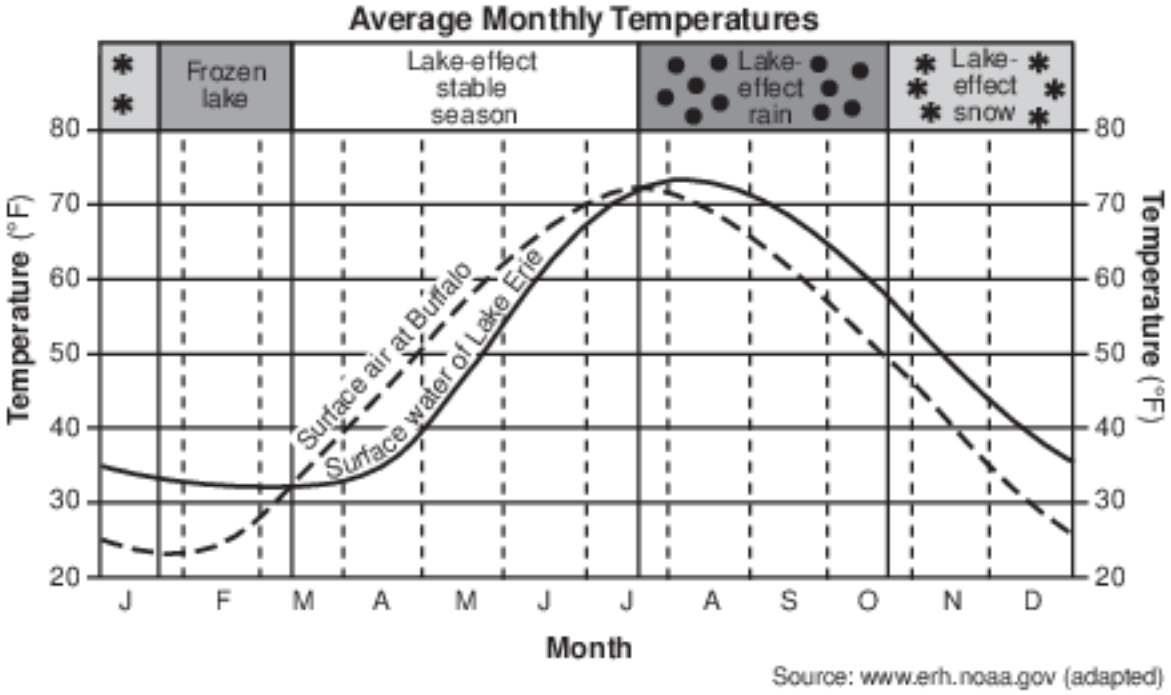
Great Lake Effects

The Great Lakes influence the weather and climate of nearby land regions at all times of the year. Much of this lake effect is determined by the relative temperatures of surface lake water compared to the surface air temperatures over those land areas. The graph below shows the average monthly temperature of the surface water of Lake Erie and the surface air temperature at Buffalo, New York.

In an average year, four lake-effect seasons are experienced. When surface lake temperatures are colder than surface air temperatures, a stable season occurs. The cooler lake waters suppress cloud development and reduce the strength of rainstorms. As a result, late spring and early summer in the Buffalo region tends to be very sunny.

A season of lake-effect rains follows. August is usually a time of heavy nighttime rains, and much of the rainy season is marked by heavy, localized rainstorms downwind from the lake. Gradually, during late October, lake-effect rains are replaced by snows. Generally, the longer the time the wind travels over the lake, the heavier the lake effect becomes in Buffalo.

Finally, conditions stabilize again, as the relatively shallow Lake Erie freezes over, usually near the end of January. Very few lake-effect storms occur during this time period.



11 Explain why the Buffalo surface air temperatures increase faster and earlier in the year than do the surface water temperatures of Lake Erie. [1]

Base your answers to questions 12 on the map below, which shows a portion of New York State and Canada. The arrows represent the direction of the wind blowing over Lake Ontario for several days early one winter.

12 Compared to the average winter air temperature in Watertown, New York, explain why the average winter air temperature in Old Forge, New York, is colder. [1]

Answer Keys

1 1

2 1

3 2

4 4

5 4

6 4

7 4

8 1

9 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Omaha is surrounded by land, which has a low specific heat.
- — The Pacific Ocean moderates the temperature/climate of Eureka.
- — Large bodies of water change temperature more slowly than land does.
- — Water has a higher specific heat than land.
- — The relatively drier air around Omaha has a lower specific heat than the moist air around
- Eureka.
- Note: Do not allow credit for “Eureka is closer to water so temperatures remain constant”
- because this just restates the question without explaining the role that water plays in causing constant temperatures.

10 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Calgary is surrounded by land, which has a lower specific heat than water.
- — Sitka is located near a large body of water, which has a higher specific heat than land
- materials.
- — The large body of water near Sitka moderates the temperature.
- — Calgary has a continental climate, while Sitka has a maritime climate.
- — Calgary is farther inland.

11 Allow 1 credit. Acceptable responses include, but are not limited to:
- — The specific heat of water is greater than the specific heat of land or dry land, so the air
- over the land heats up faster than the air over the lake.
- — More energy is required to heat up the same amount of water than to heat the same amount
- of land.
- — Air has a lower specific heat than water.
- — A lot of energy is used to melt the ice on Lake Erie.
- — Lake Erie is still covered by ice.
- — The darker land surface absorbs greater insolation.
- — Land heats up faster than water.

12 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Old Forge is located in the mountains.
- — Higher elevations have colder temperatures.
- — Watertown is closer to a large body of water that moderates its temperature.