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# Answer Key

## Directed Reading A

### SECTION: VOLCANIC ERUPTIONS

1. 10,000
2. molten rock
3. lava
4. volcano
5. C
6. nonexplosive
7. lava
8. B
9. ash
10. closer to the volcano
11. An explosive eruption can demolish a mountainside within seconds.
12. B
13. A
14. the composition of the magma; the silica, water, and gas content of the magma
15. Magma underground is under intense pressure, so water in magma stays dissolved. If the magma moves quickly to the surface, the pressure suddenly decreases and the water and other compounds become gases. As the gases expand rapidly, an explosion can result.
16. pumice
17. Silica-rich magma is stiff, and hardens in a volcano's vent and plugs the vent. As more magma pushes up, pressure increases, causing an explosive eruption. Stiff magma also prevents water vapor and other gases from escaping. Gas bubbles trapped in magma can expend until they explode, blasting ash and pumice from the vent.
18. Magma with less silica has a more fluid, runnier consistence, and gases can escape more easily.
19. lava
20. pyroclastic material
21. lava
22. pyroclastic material
23. Lava with high viscosity is stiff, and flows slowly. Lava with low viscosity is more fluid, and flows more quickly.
24. B
25. A
26. C
27. D
28. B
29. A
30. C
31. D
32. pyroclastic flow
33. 200 km/h
34. $700^0$C

### SECTION: EFFECTS OF VOLCANIC ERUPTIONS

1. D
2. A
3. Answers may vary. Sample answer: The Tambora eruption affected the global climate enough to cause food shortages in North America and Europe.
4. B
5. A
6. C
7. C
8. B
9. C
10. C

### SECTION: CAUSES OF VOLCANIC ERUPTIONS

1. Answers may vary. Sample answers: gases; changes in the volcano's shape
2. B
3. B
4. Because the temperature of the mantle is fairly constant, a decrease in pressure is the most common cause of magma formation.
5. Magma often forms at the boundary between separating tectonic plates where pressure is decreased.
6. Like air bubbles in a jar of honey, magma rises slowly toward the surface.
7. A large number of volcanoes lie directly on tectonic plate boundaries.
8. Tectonic plate boundaries are areas where tectonic plates either collide, separate, or slide past one another.

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9. At tectonic plate boundaries magma may form and travel to the surface.
10. B
11. D
12. D
13. Mantle material rises to fill space opened by separating tectonic plates. As the pressure decreases the mantle begins to melt.
14. Because magma is less dense than the surrounding rock, it rises to the surface and forms new crust on the ocean floor.
15. D
16. C
17. A
18. Combined increase of heat and pressure causes the water in oceanic crust to be released. The water mixes with the mantle rock, lowering the rock's melting point and causing it to melt. This body of magma can rise to form a volcano.
19. B
20. volcanically active places on the Earth's surface that are far from plate boundaries
21. columns of rising magma
22. C
23. B
24. A
25. The number and intensity of earthquakes increase, and the occurrence of quakes may be continuous.
26. Changes in the ratio may indicate changes in the magma chamber below.
27. Magma moving upward may cause a bulge in the side of a volcano.
28. Scientists may use a tiltmeter or the Global Positioning System (GPS).
29. Infrared satellite images record changes in surface temperature and gas emissions of a volcano over time. If a site gets hotter, the magma is probably rising.

# Directed Reading B

## SECTION: VOLCANIC ERUPTIONS

1. C
2. A
3. D
4. C
5. B
6. B
7. C
8. B
9. C
10. D
11. A
12. C
13. B
14. B
15. C
16. A
17. D
18. B
19. A
20. D
21. C
22. pyroclastic
23. hurricane
24. temperature

## SECTION: EFFECTS OF VOLCANIC ERUPTIONS

1. C
2. B
3. C
4. B
5. A
6. crater
7. caldera
8. rift

## CAUSES OF VOLCANIC ERUPTIONS

1. D
2. A
3. B
4. C
5. B
6. C
7. B
8. C
9. B
10. D
11. B
12. C
13. convergent boundary
14. subduction
15. A
16. hot spot
17. mantle plumes
18. C
19. B
20. A
21. A
22. B
23. D
24. B

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# Summary

## SECTION: VOLCANIC ERUPTIONS

1. volcano: a vent or fissure in the Earth's surface through which magma and gases are expelled
2. magma chamber: the body of molten rock that feeds a volcano
3. vent: an opening at the surface of the Earth through which volcanic material passes

## SECTION: EFFECTS OF VOLCANIC ERUPTIONS

1. crater: a funnel-shaped pit near the top of the central vent of a volcano
2. caldera: a large, semicircular depression that forms when the magma chamber below a volcano partially empties and causes the ground above to sink
3. lava plateau: a wide, flat landform that results from repeated nonexplosive eruptions of lava that spread over a large area

## SECTION: CAUSES OF VOLCANIC ERUPTIONS

1. rift zone: an area of deep cracks that forms between two tectonic plates that are pulling away from each other
2. hot spot: a volcanically active area of Earth's surface far from a tectonic plate boundary

# Section Review

## SECTION: VOLCANIC ERUPTIONS

1. Sample answer: A volcano is a vent or fissure through which magma and gases are expelled. A magma chamber is the body of molten rock that feeds a volcano. A vent is an opening in the Earth’s surface through which lava or pyroclastic material passes.
2. D
3. Lava is classified by its surface texture. The way that lava flows may also be used to help classify it. Pyroclastic material is classified by size and how it forms. Four types of lava are aa, pahoehoe, blocky lava, and pillow lava. Aa flows quickly and has a slowly and has a wrinkled surface. Pillow lava erupts underwater and forms rounded lumps. Blocky lava is cool, stiff lava that does not travel far from the erupting vent.
4. an explosive eruption
5. The presence of water increases the chance of an explosive eruption because, as the magma body moves toward the surface, the water changes to a gas and expands rapidly. This rapid expansion causes an explosion. Silica-rich magma tends to trap volcanic gases and plug vents because of its high velocity. The resulting pressure increase can cause an explosive eruption.
6. A pyroclastic flow is a cloud of very hot ash, dust, and gases that flows from a volcano.
7. 64/100 = 32/50 = 16/25
8. Magma and soda have carbon dioxide dissolved in them. When the pressure on the magma and the soda is reduced, the carbon dioxide becomes a gas and expands rapidly.
9. Because aa and pillow lava have low viscosity, they must have a low silica content. Because blocky lava has a high viscosity, it must have a high silica content.
10. Students should conclude that Indonesian and Italian volcanoes are more likely to erupt explosively than Hawaiian volcanoes.

## SECTION: EFFECTS OF VOLCANIC ERUPTIONS

1. crater
2. caldera
3. A
4. Cinder cone volcanoes are made of pyroclastic material, which is thick and piles up like sand around the volcano. Shield volcanoes are made from lava that is thin and runny and that spreads out over large areas.
5. A volcano’s crater tends to get larger over time because the vent may collapse after an eruption. In addition, if the lava hardens in the crater after an eruption, the next eruption may blast the hardened lava away, making the crater larger and deeper.

6. Yes, the horse could outrun the lava flow.
   60 km/h × 0.621 mi/km = 37.26 mi/h
   48 mi/h > 37.26 mi/h
7. It took a year for the effects of the Tambora eruption to be experienced in New England because the ash and gases from the eruption had to be circulated by global winds.

### SECTION: CAUSES OF VOLCANIC ERUPTIONS

1. Sample answer: A hot spot may form above a mantle plume. A rift zone is a series of cracks that form along a divergent plate boundary.
2. B
3. D
4. The Ring of Fire is a group of volcanoes that are located on convergent plate boundaries in the Pacific Ocean.
5. At convergent boundaries a plate is subducted. The subducted plate is heated and releases water. The water causes the melting point of the rock to decrease, forming magma. At divergent boundaries, mantle rock rises to fill the gap created by separating tectonic plates. As the rock rises, pressure decreases and the rock melts, forming magma.
6. Scientists monitor seismic activity associated with the volcano. If seismic activity increases, magma might be moving in the magma chamber. Scientists study the composition and volume of gases released from the volcano. If the composition of gases changes, an eruption may be imminent. Scientists also study the slope and temperature of volcanoes. If the slope or surface temperature change, an eruption might be imminent.
7. Oceanic plates tend to subduct because they are denser than continental plates.
8. 100 km ÷ 2 km/million years = 50 million years
9. New crust is constantly being created, but it is also being subducted at convergent boundaries.
10. The youngest layers would most likely be at the top because they were deposited over the older layers.

## Chapter Review

1. Sample answer: A caldera forms when the magma chamber below a volcano partially collapses. A crater forms when the material above the main vent of a volcano is blasted out.
2. Sample answer: Magma is hot, liquid rock material beneath Earth's surface. Lava is magma that flows onto Earth's surface.
3. Sample answer: Lava is liquid magma that flows out of a volcanic vent onto the ground. Pyroclastic material is mostly ash and solid rock that is blasted into the air during an explosive volcanic eruption.
4. Sample answer: A vent is a spot in Earth's surface through which lava or pyroclastic material passes. A rift is a long crack in Earth's crust.
5. Sample answer: A cinder cone volcano forms when pyroclastic material erupts and piles up around a volcanic vent. A shield volcano forms when lava spreads out over large areas.
6. A
7. B
8. B
9. A
10. D
11. C
12. B
13. The presence of water in magma tends to cause explosive eruptions.
14. Earthquakes may indicate the movement of magma. Changes in the composition of volcanic gases may indicate changes in the magma chamber that may precede an eruption. Changes in the slope of a volcano may indicate that magma is rising. Finally, satellite data can reveal changes in surface temperature that may indicate that magma is rising.
15. Cinder cones are made from eruptions of pyroclastic materials. They are small and have steep sides. Shield volcanoes are made of lava that spreads over large distances before it solidifies, making very large, gently sloped volcanoes. Composite volcanoes are made of both lava and pyroclastic material.

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Composite volcanoes have large, gently sloping bases and steep sides.

16. Sample answer: Volcanoes form new crust and help create fertile soil.
17. An answer to this exercise can be found at the end of this book.
18. You would be traveling toward the volcano because the larger the pyroclastic material is, the closer it will be to the vent. It takes more energy to move larger particles than it does to move smaller particles.
19. The new island will be located southeast of Hawaii because the Pacific plate is moving toward the northwest.
20. Answers may vary. Students may suggest studying the composition and temperature of rock in the area where a mantle plume is thought to be.
21. The eruption probably happened in 1992 because that year had the lowest below-normal temperature. The volcanic ash that erupted into the atmosphere blocked the sunlight and lowered the temperature.
22. If the temperature were measured once a year, the graph would indicate that 1991 had the lowest temperature. This would indicate that the eruptions happened in 1991 instead of 1992.

## Reinforcement

### A VARIETY OF VOLCANOES

**Composite volcano**

is also known as a stratovolcano
has a broad base and steep sides toward the top
is formed by explosive eruptions that are followed by lava outpourings

**Shield volcano**

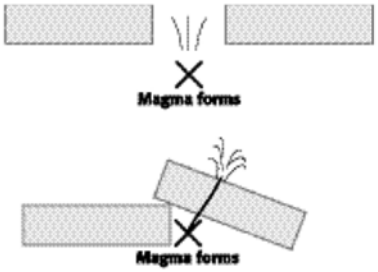
has sides that slope gently
forms from repeated nonexplosive eruptions
is made entirely of runny lava

**Cinder cone volcano**

consists entirely of pyroclastic material
is often found in clusters
erodes very quickly

### PLATE MOVEMENT

1.




2. A rift forms between the diverging plates. Mantle rock rises to fill this rift. Lower pressure at the rift causes the rock to melt and become magma. Lower-density magma rises up through the higher-density crust, and volcanic activity occurs.
3. When the plates collide, one plate moves under the other. The rock of the descending plate begins to melt as the plate sinks deeper. The melted rock rises to the surface, and volcanic activity occurs.

## Critical Thinking

1. Sample answer: The president faces problems concerning the health, safety, and economic welfare of the citizens. She must determine whether the farmers can still grow crops. She must also determine whether there are any health risks to the inhabitants, such as air pollution, water toxicity, or toxic fumes.
2. a. Sample answer: The land buried under 2 m of ash will be useless for years because the ash prevents sunlight from reaching the soil.
   b. Sample answer: Where only 1 cm of ash blankets the land, the ash will fertilize the soil. The land will be enriched for agriculture.
3. The president should not be overly concerned about another eruption. The magma in this volcano has a low water content and a low silica content. This type of magma is pliable, so it is not very likely to block the vent again.
4. Answers may vary. Students should give President Zinnson multiple options, along with the consequence of each option. Answers should address the health, safety, and economy of Zinn's citizenry.

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# Section Quizzes

### SECTION: VOLCANIC ERUPTIONS

1. C
2. B
3. E
4. F
5. A
6. D
7. C
8. D
9. B
10. B

### SECTION: EFFECTS OF VOLCANIC ERUPTIONS

1. D
2. A
3. B
4. C
5. B
6. C
7. D
8. B
9. C

### SECTION: CAUSES OF VOLCANIC ERUPTIONS

1. C
2. F
3. D
4. E
5. B
6. A
7. C
8. B
9. C
10. C

# Chapter Test A

1. C
2. C
3. D
4. B
5. A
6. C
7. B
8. D
9. C
10. D
11. D
12. C
13. C
14. D
15. A
16. C
17. B
18. B
19. C
20. A
21. B
22. D
23. C
24. E
25. A

# Chapter Test B

1. caldera
2. volcano
3. rift zone
4. hot spots
5. magma
6. C
7. A
8. C
9. B
10. The amount of silica and water in magma determines a volcano's explosiveness. A volcano is more likely to explode if its magma contains high amounts of silica and water.
11. A pyroclastic flow is particularly dangerous because it moves so incredibly fast. A cloud of pyroclastic material can race downhill at speeds faster than 200 km/h. Without warning, it would be impossible to outrun.
12. Blocky lava and aa lava flows are so stiff that the surface of the lava is torn into jagged, sharp fragments.
13. At a divergent boundary, tectonic plates move away from each other. As tectonic plates separate, a set of deep cracks called a rift zone forms between the plates. Mantle rock then rises to fill in the gap. When mantle rock gets closer to the surface, the pressure decreases. The pressure decrease causes the mantle rock to melt and form magma. Because magma is less dense than the surrounding rock, it rises through the rifts. When the magma reaches the surface, it spills out and hardens, creating new crust.
14. As magma moves upward, it may cause the side of a volcano to bulge. By studying the slope, scientists would know when such a bulge occurred and be able to predict an eruption.
15. Sample answer: The volcanic ash reached the upper atmosphere and blocked out enough sunlight to cause a decrease in global temperatures.
16. Sample answer: Volcanoes create some of the most fertile farmland. This farmland could support successful agriculture.
17. Sample answer: The large amounts of hot ash from the eruption could mix with water from melted snow and glaciers and cause dangerous mud flows.
18. a. nonexplosive volcanoes
    b. mantle plume
    c. pyroclastic material
    d. lapilli

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# Chapter Test C

1. C
2. D
3. C
4. A
5. B
6. B
7. B
8. A
9. B
10. B
11. A
12. C
13. D
14. C
15. A
16. B
17. C
18. A
19. B
20. magma
21. blocky lava
22. lapilli
23. landforms
24. hot spot
25. convergent boundary
26. subduction
27. rift zone

# Standardized Test Preparation

### MULTIPLE CHOICE

1. D
2. A
3. A
4. C
5. A
6. B
7. B
8. A
9. B
10. D

### OPEN RESPONSE

11. Full-credit answers should include the following points:
    - Erupting volcanoes can throw volcanic ash and gases high into the upper atmosphere.
    - Winds can move ash and gases around the globe.
    - When much volcanic ash is hurled into the atmosphere, the ash blocks sunlight and briefly lowers the global temperature
12. Full-credit answers should include the following points:
    - A volcanologist studying rock from a volcano could use the composition and texture of the rock to tell whether the volcano had erupted explosively or nonexplosively.
    - The many layers of volcanic deposits would tell the volcanologist how many times the volcano had erupted in the past and how the eruptions changed with time.

# Vocabulary Activity

1. aa
2. ash
3. vent
4. magma
5. slope
6. crater
7. dormant
8. volcano
9. caldera
10. hot spot
11. rift zone
12. Ring of Fire
13. lava plateau
14. magma chamber

# SciLinks Activity

1. The greatest volcanic eruption was on Taupo in New Zealand.
2. Taupo is called the greatest eruption because of the huge amount of rock and raw earth that it blasted into the sky. No other eruption has moved as much rock.
3. Fifty to sixty volcanoes erupt each year.
4. Volcanic danger zones in the United States are in Hawaii, Alaska, Washington, Oregon, and California.
5. Hawaii's most active volcanoes are Kilauea and Mauna Loa.
6. Sample answer: The crust on the top of an apple pie is like the Earth's crust. The apple filling is like magma. When the pie goes in the oven, the filling (magma) heats up and the pressure inside increases. The filling oozes out through the crust. If there are no vents in the crust, the pie might explode. If there are vents, the filling will ooze and bubble out through the vents.