CHAPTER 2: The Way the Earth Works: Plate Tectonics

MULTIPLE CHOICE

1. Wegener's evidence for a united Pangaea was so compelling that virtually all geologists agreed with the idea of continental drift during his lifetime.
   a. true
   b. false

   ANS: B DIF: Easy REF: 2.1 TOP: I.B
   MSC: Applied

2. Without plate tectonics, we would not have _____.
   a. plates in constant motion
   b. mountain building
   c. formation of new oceans
   d. All of the above are correct.

   ANS: D DIF: Medium REF: 2.1 TOP: I
   MSC: Conceptual

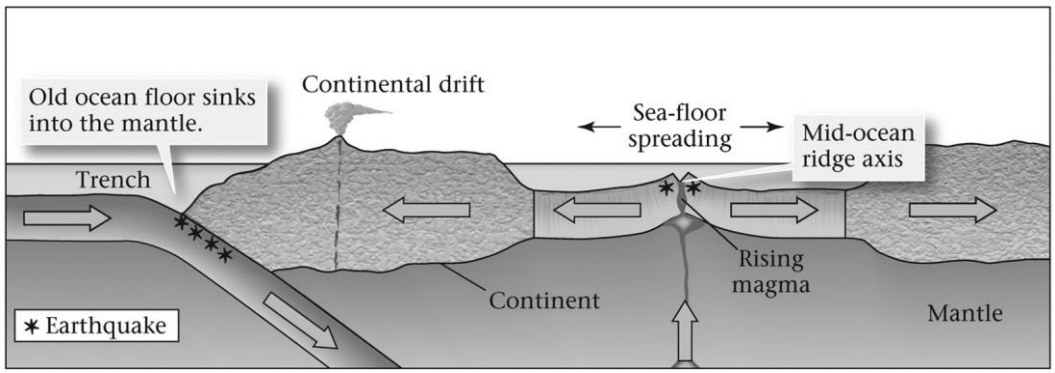
3. Evidence for a united Pangaea comes from the fossil record of which type(s) of organisms?
   a. various plant types
   b. large terrestrial animals
   c. freshwater animals
   d. All of the above are correct.

   ANS: D DIF: Medium REF: 2.1 TOP: I.A
   MSC: Factual

4. Currently, most geologists _____.
   a. continue to reject continental drift
   b. agree that continental drift occurs, but they still do not understand why it occurs
   c. agree that continental drift occurs; the mechanisms that drive drift are at work in the ocean basins and upper mantle and were unknown in Wegener's time
   d. agree that continental drift occurs; the mechanisms that drive drift are at work in the lower mantle and outer core and were unknown in Wegener's time

   ANS: C DIF: Medium REF: 2.1 TOP: I.B
   MSC: Applied

5. The term and concept of sea-floor spreading (see figure below) was developed by _____.



a. Hess and Dietz
b. Hess and Wegener
c. Wegener and Dietz
d. Wegener

ANS: A DIF: Medium REF: 2.1 TOP: I.C
MSC: Factual

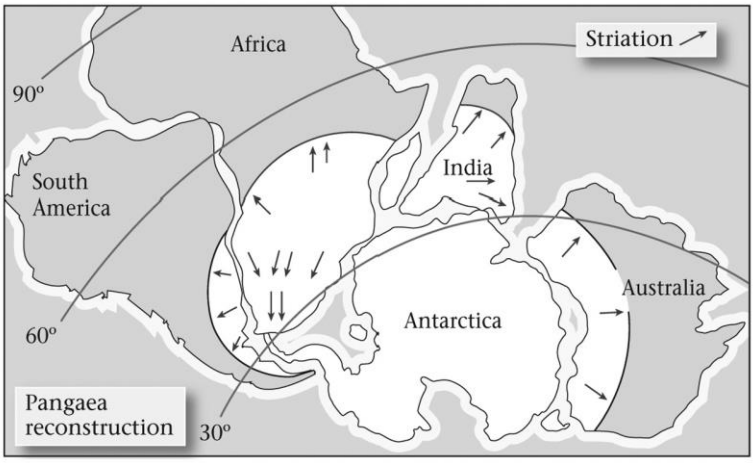
6. The theory of plate tectonics is a theory because it _____.
a. was discovered so long ago
b. is widely accepted
c. is not widely accepted
d. is commonly regarded as correct

ANS: D DIF: Medium REF: 2.1 TOP: I.D
MSC: Conceptual

7. According to Wegener, puzzle pieces are to a jigsaw puzzle as _____ is/are to Pangaea.
a. continental drift
b. continents
c. faults
d. plate tectonics

ANS: B DIF: Easy REF: 2.2 TOP: II.A
MSC: Factual

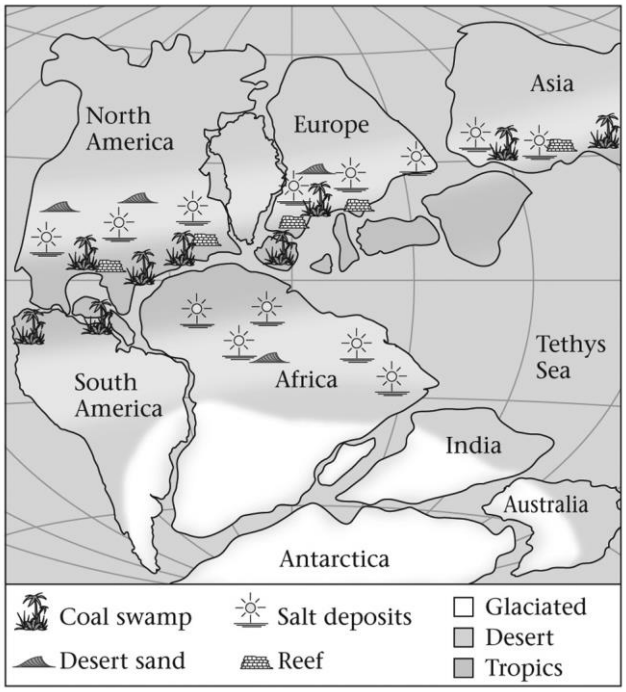
8. Late Paleozoic glacial deposits are NOT found in which of the following places?



a. India
b. southern Africa
c. North America
d. South America

ANS: C DIF: Easy REF: 2.2 TOP: II.B
MSC: Factual

9. Consult the figure below. Abundant swamps led to the formation of coal during the Late Paleozoic in which of the following places?



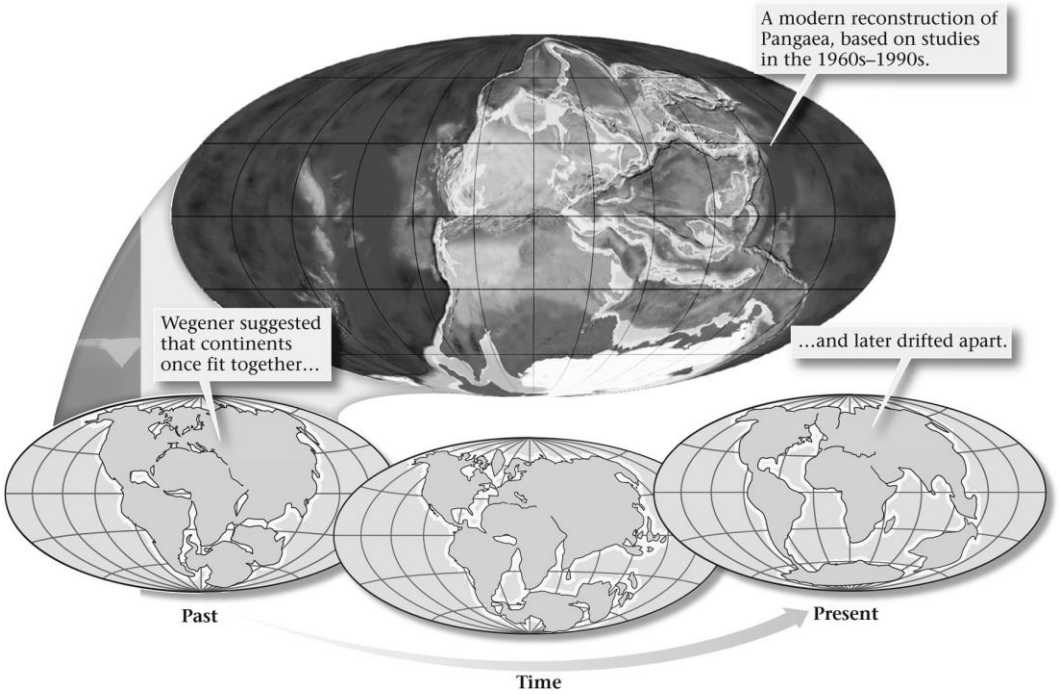
a. India
b. southern Africa
c. North America
d. South America

ANS: C DIF: Easy REF: 2.2 TOP: II.C
MSC: Factual

10. Wegener's idea of continental drift was rejected by American geologists because _____.
    a. his English was too poor to be understood by them
    b. he could not conceive of a valid mechanism that would cause continents to shift positions
    c. he had relatively little evidence supporting the existence of a supercontinent
    d. the apparent fit of continental coastlines is blurred when the margins are defined by the edges of continental shelves rather than sea level

    ANS: B DIF: Medium REF: 2.2 TOP: II
    MSC: Applied

11. Wegener proposed continental drift after he observed evidence from fossils, glacial deposits, and the fit of the continents that suggested all of the continents were once _____.



a. aligned north to south along the prime meridian during the Late Cenozoic
b. aligned east to west along the equator during the Late Mesozoic through the Cenozoic
c. combined to form a supercontinent (he termed *Rodinia*) in the Proterozoic
d. combined to form a supercontinent (he termed *Pangaea*) in the Late Paleozoic through the Mesozoic

ANS: D DIF: Medium REF: 2.2 TOP: II
MSC: Conceptual

12. In Wegener's evidence for continental drift, continents were proposed to fit together, such as the east coast of South America with the _____ and the upper west coast of Africa with the _____.

a. west coast of Europe; east coast of South America
b. lower west coast of Africa; east coast of South America
c. west coast of Europe; east coast of North America
d. lower west coast of Africa; east coast of North America

ANS: D DIF: Medium REF: 2.2 TOP: II.A
MSC: Factual

13. Evidence that glaciers once covered an area might include _____.

a. till and striations
b. backwash and striations
c. till and grabens
d. backwash and grabens

ANS: A DIF: Medium REF: 2.2 TOP: II.B
MSC: Factual

14. If we mentally align the continents to fit Wegener's concept of Pangaea, evidence of Late Paleozoic glacial deposits _____.

a. is more difficult to explain than in the modern continental configuration
b. is much more readily explained than in the modern continental configuration
c. makes very little sense in either the Pangaea configuration or the modern configuration

ANS: B DIF: Medium REF: 2.2 TOP: II.B
MSC: Conceptual

15. If a geologist discovered coal in a modern-day cold, snowy location, he or she could conclude that _____.
a. a meteorite must have struck the area
b. the area was once covered with swamps and/or jungles
c. the area was once covered with an ocean
d. this discovery was anomalous

ANS: B DIF: Medium REF: 2.2 TOP: II.C
MSC: Applied

16. Limestone reefs and salt deposits are important rocks in the reconstruction of Earth history because they _____.
a. can be used to infer the ancient climate of the Earth; they are deposited in environments that are restricted to warm climate
b. automatically provide age information; all such deposits occurred between 200 and 400 million years ago
c. are deposited in warm climates today, but there is good reason to think that they were deposited in cold climates millions of years ago
d. imply that ancient human societies had access to good snorkeling and premium margaritas

ANS: C DIF: Medium REF: 2.2 TOP: II.E
MSC: Applied

17. Distinctive rock sequences on South America terminate at the Atlantic Ocean but reappear on the continent of _____.
a. Africa
b. Europe
c. North America
d. Australia

ANS: A DIF: Difficult REF: 2.2 TOP: II.E
MSC: Factual

18. Which plant genus dominated glaciated regions during the Late Paleozoic and Early Mesozoic?
a. *Ginkgo*
b. *Glossopteris*
c. *Neuropteris*
d. *Quercas*

ANS: B DIF: Difficult REF: 2.2 TOP: II.D
MSC: Factual

19. What mineral is integral to paleomagnetism?
a. magnetite
b. iron
c. quartz
d. potassium feldspar

ANS: A DIF: Easy REF: 2.3 TOP: III
MSC: Factual

20. Evidence of paleomagnetism can be found in _____.
    a. basalt that has cooled from lava
    b. any rock with magnetic minerals present
    c. sedimentary rocks where minerals form from ion-bearing groundwater
    d. All of the above are correct.

    ANS: D DIF: Easy REF: 2.3 TOP: III
    MSC: Factual

21. Without paleomagnetism, _____ .
    a. our compasses today would not point to what we think of as North
    b. a compass 90 million years ago would point to the same North we know today
    c. we would not know that the continents themselves move, not the poles
    d. All of the above are correct.

    ANS: D DIF: Medium REF: 2.3 TOP: III
    MSC: Conceptual

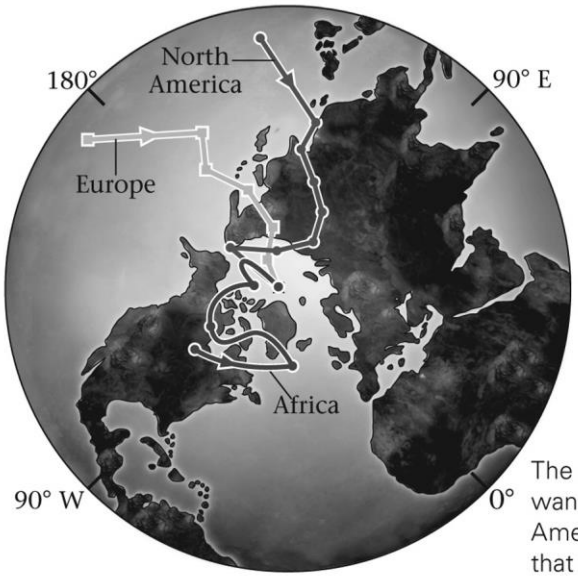
22. The magnetic field of Earth in the geologic past is _____.
    a. unknown, but it is assumed to have been identical to today's
    b. known to have been constant through geologic time, due to remnant magnetization of iron-rich minerals in rocks
    c. known to have experienced numerous polarity reversals, due to remnant magnetization of iron-rich minerals in rocks
    d. known to have been constant through time, on the basis of theoretical calculations

    ANS: C DIF: Easy REF: 2.3 TOP: III.A
    MSC: Applied

23. The apparent tendency of the north (or south) magnetic pole to vary in position over time is termed _____.
    a. Dipole
    b. magnetic declination
    c. magnetic inclination
    d. polar wander

    ANS: D DIF: Easy REF: 2.3 TOP: III.B
    MSC: Factual

24. Why does each continent below have a different polar wander path?



The apparent polar-wander path of North America is not the same as that of Europe or Africa.

a. Wegener was right: continents move.
b. The poles move.
c. Both the poles and continents move.

ANS: A DIF: Easy REF: 2.3 TOP: III.B
MSC: Applied

25. The apparent polar wander path obtained from magnetite crystals in basalts on the North American continent is now interpreted to be the result of _____.
a. wandering of the geomagnetic North Pole
b. drifting of the North American continent

ANS: B DIF: Easy REF: 2.3 TOP: III.B
MSC: Applied

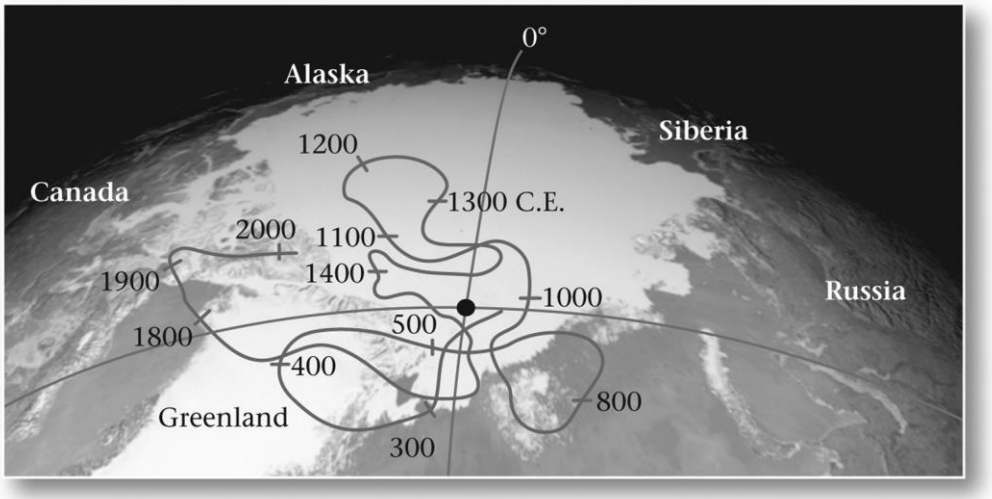
26. A compass today points directly to geographic north.
a. true
b. false

ANS: B DIF: Medium REF: 2.3 TOP: III.A
MSC: Factual

27. An average everyday compass depicts inclination.
a. true
b. false

ANS: B DIF: Medium REF: 2.3 TOP: III.A
MSC: Factual

28. According to the figure below, Earth's magnetic poles move constantly, but don't seem to stray farther than about _____ from the geographic poles.



A map of the magnetic pole position during the past 1,800 years shows that the pole moves, but stays within high latitudes.

a. 500 km
b. 1,000 km
c. 1,500 km
d. 2,000 km

ANS: C DIF: Medium REF: 2.3 TOP: III.A
MSC: Factual

29. If you were using both a compass and a map marked with latitude and longitude to navigate, you might note the angle difference between your compass and what is marked on the map, called _____.

a. magnetic inclination
b. magnetic declination
c. magnetic dipole
d. magnetic reversal

ANS: B DIF: Medium REF: 2.3 TOP: III.A
MSC: Applied

30. It is not the continents that move relative to a fixed pole, but rather it is the pole that moves relative to fixed continents.

a. true
b. false

ANS: B DIF: Medium REF: 2.3 TOP: III.B
MSC: Factual

31. Where Earth's magnetic dipole intersects with the surface of the planet is called the _____.

a. magnetic inclination
b. geographic pole
c. magnetic dipole
d. magnetic pole

ANS: D DIF: Difficult REF: 2.3 TOP: III.A
MSC: Factual

32. The deep-ocean floor is flat and nearly featureless.

a. true
b. false

ANS: B DIF: Easy REF: 2.4 TOP: IV.A
MSC: Factual

33. Sea-floor spreading is driven by volcanic activity _____.

a. in the middle of abyssal plains
b. along mid-ocean ridges
c. at the edges of continental shelves
d. along fracture zones

ANS: B DIF: Easy REF: 2.4 TOP: IV.A.i
MSC: Factual

34. Within the sea floor, the rate of geothermal heat flow is greatest _____.

a. along mid-ocean ridges
b. along fracture zones
c. at the edges of ocean basins
d. in the center of abyssal plains

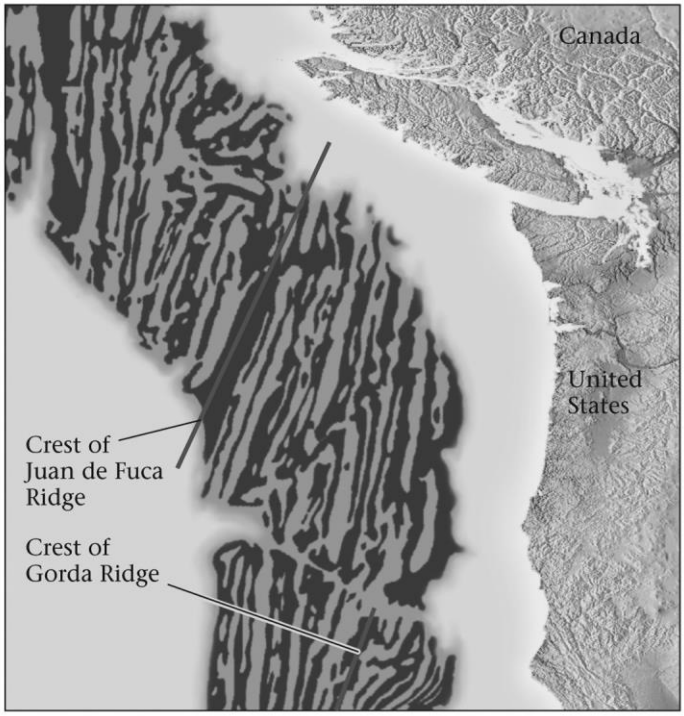
ANS: A DIF: Easy REF: 2.4 TOP: IV.A.i
MSC: Applied

35. Volcanoes that have submerged beneath the surface of the sea are termed _____.

a. mid-ocean ridges
b. guyots
c. fracture zones
d. continental rises

ANS: B DIF: Easy REF: 2.4 TOP: IV.A.iii
MSC: Factual

36. According to the figure below, fracture zones lay roughly _____ to mid-ocean ridges.

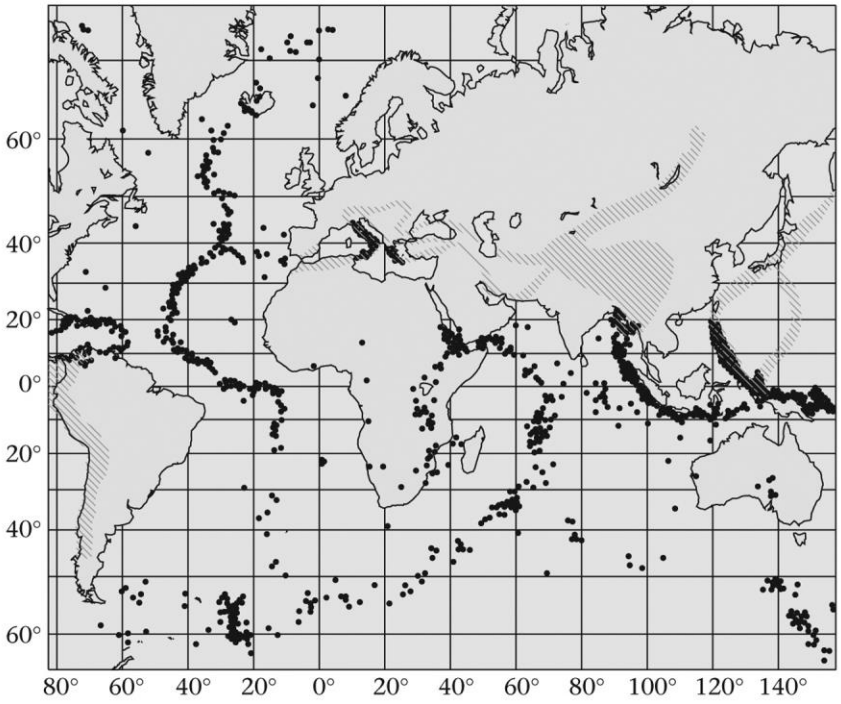


a. perpendicular
b. parallel
c. adjacent
d. at an obtuse angle

ANS: A DIF: Easy REF: 2.4 TOP: IV.A.iv
MSC: Factual

37. This map depicts earthquakes, which coincide with areas where _____.

A 1953 map showing the distribution of earthquake locations in the ocean basins. Note that earthquakes occur in belts.



a. volcanoes also regularly occur
b. movements of the crust take place
c. rocks break and move
d. All of the above are correct.

ANS: D DIF: Easy REF: 2.4 TOP: IV.A.iv
MSC: Applied

38. The age of oceanic crust _____ with increasing distance from a mid-ocean ridge.
a. increases
b. decreases

ANS: A DIF: Easy REF: 2.4 TOP: IV.B
MSC: Factual

39. A great boost in sea-floor exploration and a greater understanding of sea-floor bathymetry were a result of _____.
a. scientific advances in the 1950s
b. scientific advances in the 1920s
c. military needs in World War I
d. military needs in World War II

ANS: D DIF: Medium REF: 2.4 TOP: IV
MSC: Factual

40. Deep-ocean trenches are found predominantly along the perimeter of the _____ and can reach depths up to _____, deep enough to swallow Mt. Everest.
a. Pacific Ocean; 4–10 km
b. Pacific Ocean; 8–12 km
c. Atlantic Ocean; 4–10 km
d. Atlantic Ocean; 8–12 km

ANS: B DIF: Medium REF: 2.4 TOP: IV.A.ii
MSC: Factual

41. Beneath a blanket of sediments, oceanic crust is primarily composed of two rocks, _____ and _____.
    a. granite; diorite
    b. gabbro; basalt
    c. sandstone; shale
    d. slate; gneiss

ANS: B DIF: Medium REF: 2.4 TOP: IV.B
MSC: Factual

42. The oldest basalts on the ocean floor are about _____ years old.
    a. 50 thousand
    b. 4 billion
    c. 200 million
    d. 2.5 million

ANS: C DIF: Medium REF: 2.4 TOP: IV.B
MSC: Factual

43. The thickness of clay and planktonic microskeletons is greatest _____.
    a. along mid-ocean ridges
    b. along fracture zones
    c. at the edges of ocean basins
    d. in the center of abyssal plains

ANS: C DIF: Medium REF: 2.4 TOP: IV.B
MSC: Applied

44. A layer of sediment composed of tiny shell fragments and dead plankton that gets thicker as it moves away from mid-ocean ridges and covers most of the ocean floor, but is too thin to have been accumulating since the formation of Earth, suggests that _____.
    a. plankton and shelled organisms evolved recently
    b. plankton and shelled organisms do not often die and sink to the bottom of the ocean
    c. the ocean floor is younger toward the mid-ocean ridge
    d. All of the above are correct.

ANS: B DIF: Medium REF: 2.4 TOP: IV.B
MSC: Conceptual

45. Why is preserved oceanic bedrock only composed of primarily basalt?
    a. Magma primarily cools to form basalt.
    b. Oceanic bedrock does not experience changes in heat that produce different rock types.
    c. Oceanic bedrock does not experience changes in pressure that produce different rock types.
    d. All of the above are correct.

ANS: D DIF: Medium REF: 2.4 TOP: IV.B
MSC: Conceptual

46. All basalts younger than 700,000 years old _____.
    a. have normal magnetic polarity
    b. have reverse magnetic polarity

c. are found on the ocean floor very far from mid-ocean ridges
d. are found on the continents

ANS: A DIF: Difficult REF: 2.4 TOP: IV.B
MSC: Applied

47. A “stripe” of a particular magnetic orientation that has a very large width could be indicative of _____ .

a. a great deal of time spent in a particular magnetic regime
b. higher spreading rates than other points in time
c. Both a and b are correct.
d. None of the above are correct.

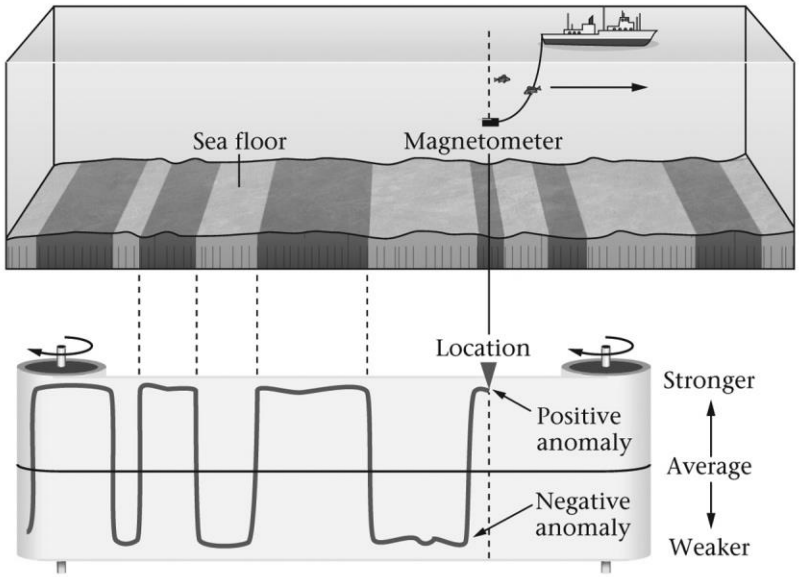
ANS: C DIF: Medium REF: 2.5 TOP: V
MSC: Conceptual

48. Marine magnetic anomaly belts run parallel to _____.

a. mid-ocean ridges
b. fracture zones
c. continental coastlines
d. continental shelves

ANS: A DIF: Easy REF: 2.6 TOP: V.A
MSC: Factual

49. Consult the figure below. Marine magnetic anomaly belts are widest when and where _____.



a. continents are joined to form supercontinents
b. sea-floor spreading rates are relatively rapid
c. sea-floor spreading rates are relatively slow

ANS: B DIF: Easy REF: 2.6 TOP: V.A
MSC: Applied

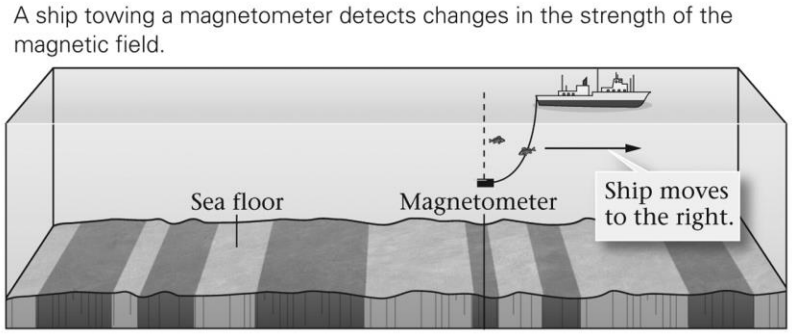
50. Regions of the sea floor with positive magnetic anomalies were formed during times when Earth's magnetic field _____.
    a. was exceptionally strong
    b. was exceptionally weak
    c. had normal polarity
    d. had reversed polarity

    ANS: C DIF: Easy REF: 2.6 TOP: V.A
    MSC: Applied

51. Regions of the sea floor with negative magnetic anomalies were formed during times when Earth's magnetic field _____.
    a. was exceptionally strong
    b. was exceptionally weak
    c. had normal polarity
    d. had reversed polarity

    ANS: D DIF: Easy REF: 2.6 TOP: V.A
    MSC: Applied

52. According to the figure below, the Earth's magnetic reversals are likely due to _____.



    a. meteorite impacts
    b. lightning strikes
    c. changes in circulation patterns in the outer core
    d. changes in circulation patterns in the inner core

    ANS: C DIF: Easy REF: 2.6 TOP: V.A.i
    MSC: Factual

53. Marine magnetic anomalies result from sea-floor spreading in conjunction with _____.
    a. global warming
    b. magnetic storms on the surface of the Sun
    c. magnetic polarity reversals
    d. apparent wander of the magnetic poles

    ANS: C DIF: Easy REF: 2.6 TOP: V.A.i
    MSC: Applied

54. By deep-sea drilling, the *Glomar Challenger* proved the theory that if the model of sea-floor spreading was correct, then sea-floor sediment should be _____ and _____ as one moves away from the spreading axis.
    a. thicker; younger
    c. thinner; younger

b. thicker; older
d. thinner; older

ANS: B DIF: Easy REF: 2.6 TOP: V.B
MSC: Factual

55. Continental lithosphere _____.
a. is thicker than oceanic lithosphere
b. contains more mafic rocks than oceanic lithosphere
c. is denser than oceanic lithosphere
d. contains no crustal material, consisting solely of lithified upper mantle

ANS: A DIF: Easy REF: 2.6 TOP: VI.A
MSC: Factual

56. All lithospheric plates are approximately the same size and contain a combination of oceanic and continental crust.
a. true
b. false

ANS: B DIF: Easy REF: 2.6 TOP: VI.A
MSC: Conceptual

57. Continental coastlines that occur within the interior of a tectonic plate are called _____.
a. internal margins
b. passive margins
c. active margins
d. inert margins

ANS: B DIF: Easy REF: 2.6 TOP: VI.B
MSC: Factual

58. Broad, sediment-covered continental shelves are found along _____.
a. active margins
b. passive margins
c. internal margins
d. inert margins

ANS: B DIF: Easy REF: 2.6 TOP: VI.B
MSC: Factual

59. Within the terminology of plate tectonics, an active margin is _____.
a. synonymous with “subduction zone”
b. a 5-mile radius surrounding an active volcano
c. a continental coastline that coincides with a plate boundary
d. anywhere on Earth where earthquakes are especially frequent

ANS: C DIF: Easy REF: 2.6 TOP: VI.B
MSC: Factual

60. Earthquakes are most frequent near coastlines that are termed _____.
a. active margins
b. passive margins
c. aseismic margins
d. geodesic margins

ANS: A DIF: Easy REF: 2.6 TOP: VII
MSC: Applied

61. In a hot-spot volcanic island chain, such as the Hawaiian Islands, all islands possess active volcanoes simultaneously and therefore the risks of volcanic hazards are about the same for all islands.

a. true
b. false

ANS: B DIF: Easy REF: 2.6 TOP: VII
MSC: Applied

62. Spreading rates along mid-ocean ridges have _____.

a. been remarkably constant through time
b. changed through time, but are the same everywhere on Earth today
c. changed through time, and today vary between 1 and 10 m/yr
d. changed through time, and today vary between 1 and 10 cm/yr

ANS: D DIF: Medium REF: 2.6 TOP: V
MSC: Applied

63. Under the theory of plate tectonics, the plates themselves are _____.

a. discrete pieces of lithosphere at the surface of the solid Earth that move with respect to one another
b. discrete layers of lithosphere that are vertically stacked one atop the other
c. composed only of continental rocks that plow through the weaker oceanic rocks
d. very thick (approximately one-quarter of Earth's radius)

ANS: A DIF: Medium REF: 2.6 TOP: VI
MSC: Conceptual

64. The theory of plate tectonics _____.

a. incorporates continental drift but not sea-floor spreading
b. incorporates sea-floor spreading but not continental drift
c. incorporates and explains both sea-floor spreading and continental drift
d. does not incorporate sea-floor spreading or continental drift

ANS: C DIF: Medium REF: 2.6 TOP: VI
MSC: Conceptual

65. The average thickness of continental lithosphere is about _____.

a. 30 km
b. 60 km
c. 150 km
d. 10,000 km

ANS: A DIF: Medium REF: 2.6 TOP: VI.A
MSC: Factual

66. Unlike the lithosphere, the asthenosphere _____.

a. is able to flow over long periods of time
b. has a density similar to the core
c. varies in thickness from place to place
d. is relatively cool

ANS: A DIF: Medium REF: 2.6 TOP: VI.A
MSC: Applied

67. The lithosphere of Earth can be bent and broken, but will not flow because it _____.

a. is too old
c. is too cool
b. is too dense
d. contains radioactive elements

ANS: C DIF: Medium REF: 2.6 TOP: VI.A
MSC: Applied

68. Tectonic plates might consist of _____.

a. continental lithosphere only
b. oceanic lithosphere only
c. oceanic or continental lithosphere, or a combination of both
d. either oceanic or continental lithosphere, but not both

ANS: C DIF: Medium REF: 2.6 TOP: VI.A
MSC: Applied

69. The thickness of oceanic lithosphere is _____.

a. uniformly 100 km
b. greatest at the geographic poles and least near the equator
c. greatest near the mid-ocean ridges and thins out away from the ridges
d. least near the mid-ocean ridges and thickens away from the ridges

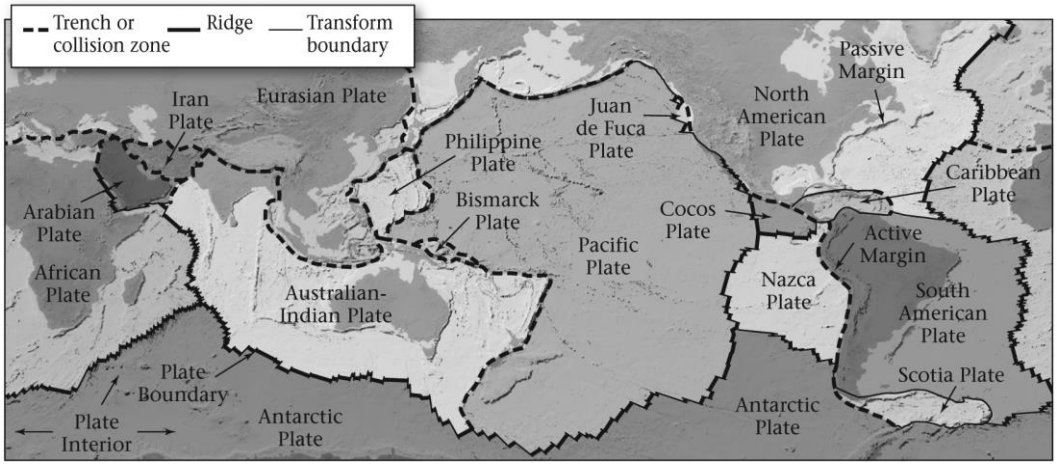
ANS: D DIF: Medium REF: 2.6 TOP: VI.A
MSC: Applied

70. The number of lithospheric plates on the Earth has been variable through geologic time. Hundreds of millions of years ago, there were plates that no longer exist today.

a. true
b. false

ANS: A DIF: Medium REF: 2.6 TOP: VI.A
MSC: Conceptual

71. According to the figure below, every plate boundary can be recognized by _____.



a. the presence of active volcanoes

b. the presence of an earthquake belt
c. a deep chasm that can be seen from space
d. None of the above are correct.

ANS: B DIF: Medium REF: 2.6 TOP: VI.B
MSC: Factual

72. Tectonic plates move at rates that are approximately _____.
a. 1 to 5 cm every 1,000 years
b. 1 to 15 cm/year
c. 1 to 15 m/year
d. 10 to 100 m/year

ANS: B DIF: Medium REF: 2.6 TOP: VI.B
MSC: Factual

73. Deformed (bent, stretched, or cracked) lithosphere occurs _____.
a. randomly over the surface of Earth
b. only at transform plate boundaries
c. on the margins of tectonic plates
d. only at divergent plate boundaries

ANS: C DIF: Medium REF: 2.6 TOP: VI.B
MSC: Applied

74. The pulling forces that produce the most rapid plate velocities are concentrated at _____.
a. mid-ocean ridges
b. ocean trenches
c. continental collision zones
d. stable continental interiors

ANS: B DIF: Medium REF: 2.6 TOP: VII
MSC: Factual

75. Slab pull occurs because subducting slabs are _____.
a. less mafic, and therefore less dense, than surrounding asthenosphere
b. cooler, and therefore more dense, than surrounding asthenosphere
c. hotter, and therefore more dense, than surrounding asthenosphere
d. cooler, and therefore less dense, than surrounding asthenosphere

ANS: B DIF: Medium REF: 2.6 TOP: VII
MSC: Factual

76. The rate of motion of a lithospheric plate with respect to a stationary hot spot is termed _____.
a. relative plate velocity
b. absolute plate velocity
c. lateral plate velocity
d. Velocity of this motion cannot be determined.

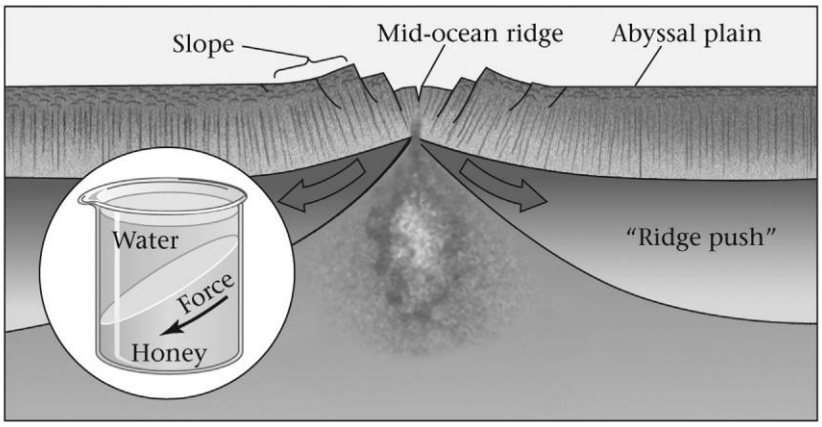
ANS: B DIF: Medium REF: 2.6 TOP: VII
MSC: Factual

77. The lithosphere of the Earth is generally thinnest at and near _____ plate boundaries.
a. Convergent
c. Transform

b. Divergent

ANS: B DIF: Medium REF: 2.6 TOP: VII
MSC: Factual

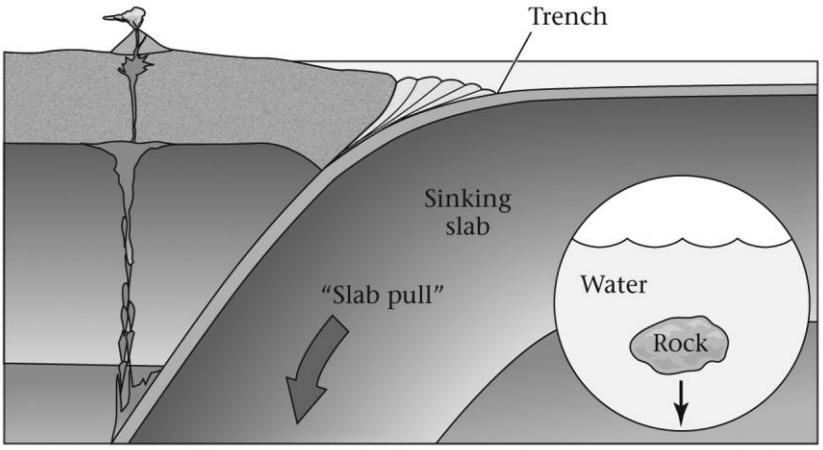
78. Consult the figure below. Most of the pushing force driving plate motion is produced _____.



a. at mid-ocean ridges
b. at subduction zones
c. at collision zones
d. in the interiors of continental plates

ANS: A DIF: Medium REF: 2.6 TOP: VII
MSC: Applied

79. Consult the figure below. Most of the pulling force driving plate motion is produced _____.



a. at mid-ocean ridges
b. at subduction zones
c. at collision zones
d. in the interiors of continental plates

ANS: B DIF: Medium REF: 2.6 TOP: VII
MSC: Applied

80. If mid-ocean spreading was to stop, but subduction continue, which of the following would occur?
a. Continents would begin moving toward each other.
b. The surface area of the Earth would decrease.

c. Sea level would rise.
d. Both a and b are correct.
e. All of the above are correct.

ANS: E DIF: Difficult REF: 2.6 TOP: VI
MSC: Conceptual

81. According to Archimedes' principle of buoyancy, an iceberg sinks until _____.

a. the total mass of the water displaced equals the total mass of the whole iceberg
b. the total mass of the iceberg is underwater
c. about 60% of the iceberg is underwater
d. the total mass of the water displaced equals 80% of the mass of the iceberg

ANS: A DIF: Difficult REF: 2.6 TOP: VI.A
MSC: Factual

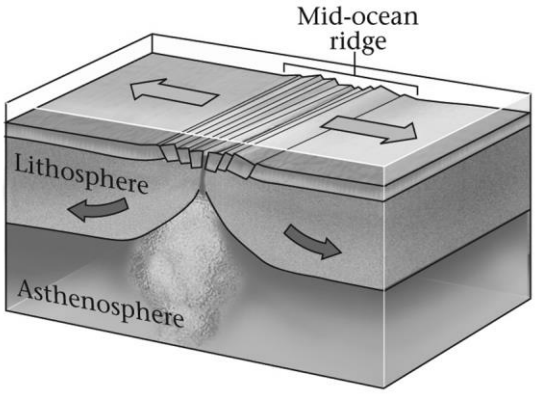
82. The primary difference between lithospheric and asthenospheric mantle that gives rise to numerous divergent patterns of physical behavior is _____.
a. physical state (the lithosphere is solid; the asthenosphere is liquid)
b. chemical composition (the lithosphere is mafic; the asthenosphere is felsic)
c. temperature (the lithosphere is cooler than the asthenosphere)
d. chemical composition (the lithosphere is felsic; the asthenosphere is mafic)

ANS: C DIF: Difficult REF: 2.6 TOP: VI.A
MSC: Conceptual

83. Why don't earthquakes occur everywhere?
a. Rocks break and slip most often along plate boundaries.
b. Plate interiors do not accommodate much movement.
c. Earthquake epicenters speckle the globe randomly.
d. Both a and b are correct.
e. All of the above are correct.

ANS: D DIF: Difficult REF: 2.6 TOP: VI.B
MSC: Conceptual

84. At a divergent plate boundary (shown below), two opposed plates _____.



a. move toward one another
b. move away from one another
c. slide past one another

ANS: B DIF: Easy REF: 2.7 TOP: VII
MSC: Factual

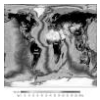
85. All rock produced at the mid-ocean ridges consists of basalt.
a. true
b. false

ANS: B DIF: Easy REF: 2.7 TOP: VII.A
MSC: Factual

86. The youngest sea floor occurs _____.
a. along passive margins
b. along active margins
c. along mid-ocean ridges
d. randomly over the entire ocean basin

ANS: C DIF: Easy REF: 2.7 TOP: VII.A
MSC: Factual

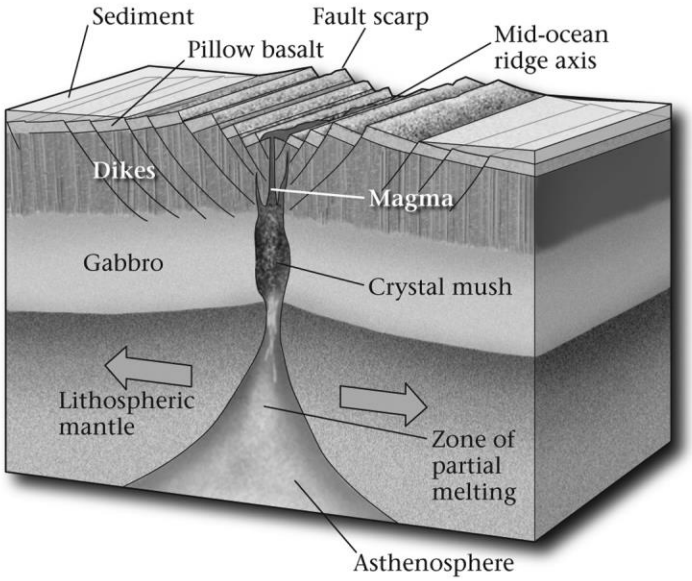
87. The oldest oceanic crust is approximately _____ years old.



a. 1 billion
b. 240 million
c. 120 million
d. 90 million

ANS: B DIF: Medium REF: 2.7 TOP: VII.A
MSC: Factual

88. As compared to a slowly spreading mid-ocean ridge, a rapidly spreading ridge is _____.



a. wider
b. narrower
c. more silicic in lava composition

ANS: A DIF: Medium REF: 2.7 TOP: VII.A
MSC: Applied

89. As compared to the density of the asthenosphere, the oceanic lithosphere is _____.
a. always more dense
b. always less dense
c. initially more dense at the age of formation but eventually becomes less dense
d. initially less dense at the age of formation but eventually becomes more dense

ANS: D DIF: Medium REF: 2.7 TOP: VII.A
MSC: Applied

90. As lithosphere cools to the sides of a mid-ocean ridge, it begins to _____.
a. rise with respect to material located closer to the ridge axis
b. sink with respect to material located closer to the ridge axis

ANS: B DIF: Medium REF: 2.7 TOP: VII.B
MSC: Applied

91. Oceanic lithosphere thickens away from the mid-ocean ridge primarily due to _____.
a. the addition of new crust due to hot-spot volcanism
b. the addition of new crust due to sedimentation
c. the addition of new lithospheric mantle as a result of cooling
d. reasons that geologists cannot determine at present

ANS: C DIF: Medium REF: 2.7 TOP: VII.B
MSC: Applied

92. Summed over the entire surface of Earth, _____.

a. the rate of lithospheric production at ridges is greater than the rate of lithospheric consumption at subduction zones
b. the rate of lithospheric consumption at subduction zones is greater than the rate of lithospheric production at ridges
c. rates of lithospheric production and consumption are equal

ANS: C DIF: Medium REF: 2.7 TOP: VII.B
MSC: Conceptual

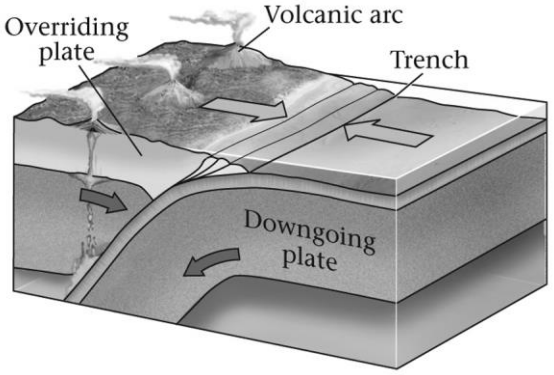
93. Why is the ocean deeper over older ocean floor than younger ocean floor?
a. The deeper ocean floor is below 1,280°C.
b. The deeper ocean floor is older than 80 million years old.
c. The deeper ocean floor is thick and dense.
d. All of the above are correct.

ANS: D DIF: Medium REF: 2.7 TOP: VII.B
MSC: Conceptual

94. Iceland is one of the few places in the world that is both above sea level and situated atop a _____ plate boundary.
a. convergent
b. divergent
c. transform

ANS: B DIF: Difficult REF: 2.7 TOP: VII.B
MSC: Applied

95. At a convergent-plate boundary (shown below), two opposed plates _____.



a. move toward one another
b. move away from one another
c. slide past one another

ANS: A DIF: Easy REF: 2.8 TOP: VIII
MSC: Factual

96. Deep-oceanic trenches are features of _____-plate boundaries.
a. convergent
b. divergent
c. transform

ANS: A DIF: Easy REF: 2.8 TOP: VIII
MSC: Factual

97. Large, thick, nonvolcanic mountain belts, like the Himalayas, have features associated with _____-plate boundaries.
    a. convergent
    b. divergent
    c. transform

ANS: A DIF: Easy REF: 2.8 TOP: VIII
MSC: Applied

98. The volcanoes of the Cascades Mountains are related to melting of rock associated with a _____-plate boundary.
    a. convergent
    b. divergent
    c. transform

ANS: A DIF: Easy REF: 2.8 TOP: VIII
MSC: Applied

99. Mid-ocean ridges are _____.
    a. convergent-plate boundaries
    b. divergent-plate boundaries
    c. transform-plate boundaries

ANS: B DIF: Easy REF: 2.8 TOP: VIII
MSC: Applied

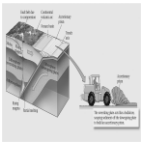
100. At a subduction zone, the downgoing (subducting) plate _____.
    a. is always composed of continental lithosphere
    b. is always composed of oceanic lithosphere
    c. may be composed or either oceanic or continental lithosphere

ANS: B DIF: Easy REF: 2.8 TOP: VIII.A
MSC: Factual

101. At a subduction zone, the overriding plate _____.
    a. is always composed of continental lithosphere
    b. is always composed of oceanic lithosphere
    c. may be composed of either oceanic or continental lithosphere

ANS: C DIF: Easy REF: 2.8 TOP: VIII.A
MSC: Factual

102. Consult the figure below. Subduction zones are _____.



    a. convergent-plate boundaries
    b. divergent-plate boundaries
    c. transform-plate boundaries

ANS: A DIF: Easy REF: 2.8 TOP: VIII.A
MSC: Applied

103. Virtually all of the sediment atop a downgoing plate becomes subducted into the mantle along with the plate.

a. true b. false

ANS: B DIF: Easy REF: 2.8 TOP: VIII.A.ii
MSC: Applied

104. The lithosphere of the Earth is generally thickest at and near _____-plate boundaries.

a. convergent c. transform
b. divergent

ANS: A DIF: Medium REF: 2.8 TOP: VIII
MSC: Factual

105. Why does the surface area of Earth remain constant throughout time?

a. Subduction occurs.
b. Rates of sea-floor spreading are equal to sea-floor consumption.
c. Plates slip past each other.
d. Both a and b are correct.
e. Both b and c are correct.

ANS: D DIF: Medium REF: 2.8 TOP: VIII
MSC: Conceptual

106. Subducted slabs have never been detected below the Wadati-Benioff zone.

a. true b. false

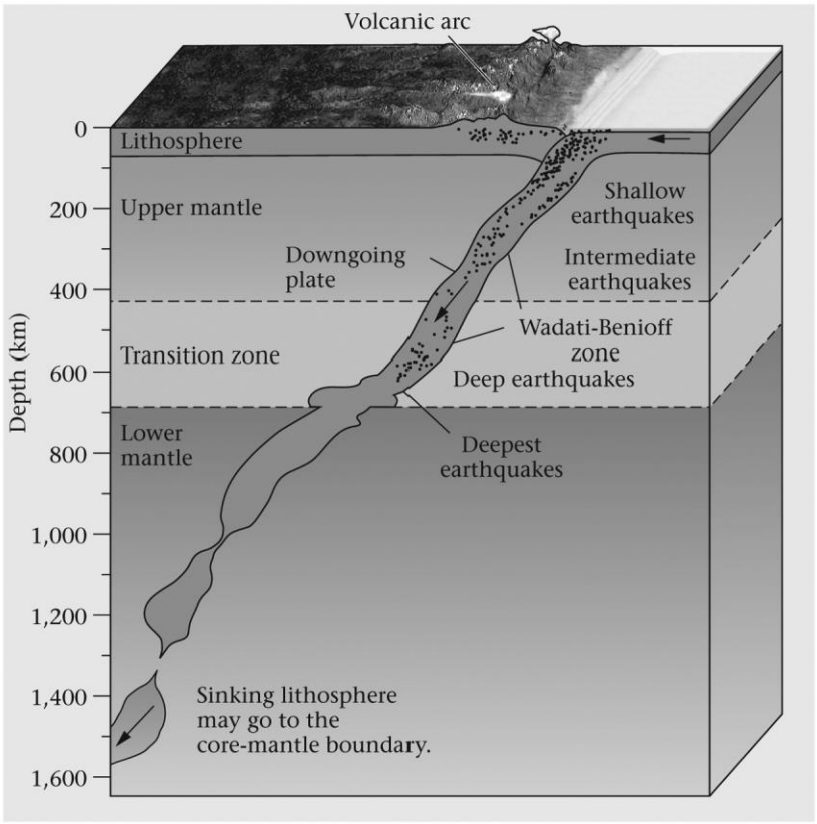
ANS: B DIF: Medium REF: 2.8 TOP: VIII.A
MSC: Factual

107. The Wadati-Benioff zone extends down within the mantle to a maximum depth of _____.

a. 30 km c. 670 km
b. 150 km d. 990 km

ANS: C DIF: Medium REF: 2.8 TOP: VIII.A
MSC: Factual

108. Consult the figure below. The Wadati-Benioff zone is a belt of earthquakes found _____.



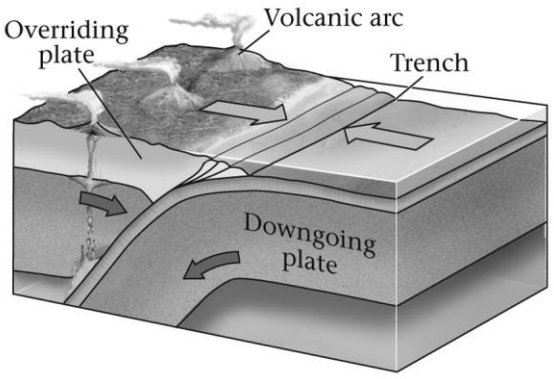
a. within an otherwise stable continental interior
b. within an overriding plate at a subduction zone
c. within a downgoing plate at a subduction zone
d. along mid-ocean ridges

ANS: C DIF: Medium REF: 2.8 TOP: VIII.A
MSC: Factual

109. A volcanic island arc forms when _____.
a. an oceanic plate subducts beneath continental lithosphere
b. an oceanic plate subducts beneath another oceanic plate
c. continental lithosphere subducts beneath an oceanic plate
d. two oceanic plates collide

ANS: B DIF: Medium REF: 2.8 TOP: VIII.A.iii
MSC: Factual

110. At a transform-plate boundary (shown below), two opposed plates _____.



a. move toward one another
b. move away from one another
c. slide past one another

ANS: C DIF: Easy REF: 2.9 TOP: IX
MSC: Factual

111. At transform-plate boundaries _____.
a. earthquakes are common but volcanoes are absent
b. volcanoes are common but earthquakes do not occur
c. both earthquakes and volcanoes are common

ANS: A DIF: Easy REF: 2.9 TOP: IX
MSC: Applied

112. Segments of the mid-ocean ridge system are offset. Between the offset segments we observe _____.
a. a second series of ridges, perpendicular to the main set
b. deep-ocean trenches
c. transform faults
d. None of the above are correct.

ANS: C DIF: Easy REF: 2.9 TOP: IX
MSC: Applied

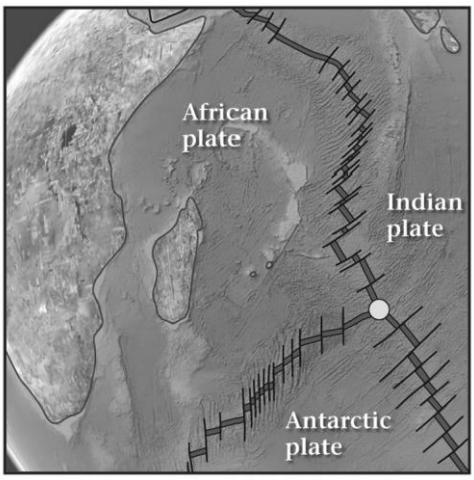
113. The San Andreas Fault zone in southern California is an example of a _____-plate boundary.
a. convergent
b. divergent
c. transform

ANS: C DIF: Easy REF: 2.9 TOP: IX
MSC: Applied

114. All portions of the mid-ocean ridge system have a well-defined axial trough (central rift).
a. true
b. false

ANS: B DIF: Medium REF: 2.9 TOP: IX.A
MSC: Factual

115. A triple junction, like the one shown below, is a place on Earth's surface where _____.



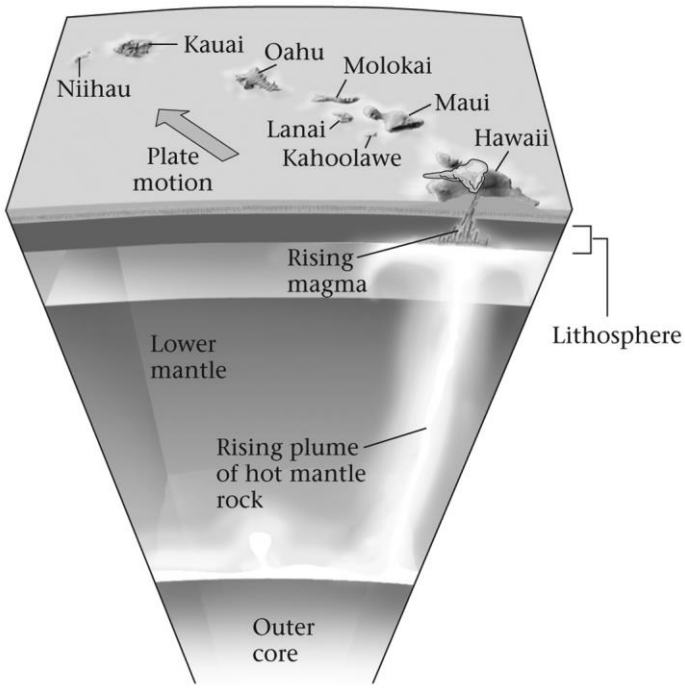
a. three volcanoes form a tight, triangular cluster
b. glacial ice, continental rocks, and the ocean can be found together
c. the boundaries of three lithospheric plates meet at a single point
d. the boundaries of three lithospheric plates meet to form an elongate surface

ANS: C DIF: Easy REF: 2.10 TOP: X.A
MSC: Factual

116. A guyot is _____.
a. any portion of the ocean floor that is topographically higher than surrounding sea floor
b. an extinct oceanic hot-spot volcano that has not yet subsided below sea level
c. an extinct oceanic hot-spot volcano that has subsided below sea level
d. synonymous with the term *hot spot*

ANS: C DIF: Easy REF: 2.10 TOP: X.B
MSC: Factual

117. Consult the figure below. Hawaii is an example of _____.



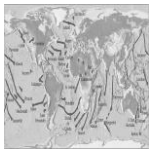
a. hot-spot volcanism
b. mid-ocean ridge volcanism
c. volcanic island arc
d. transform margin

ANS: A DIF: Easy REF: 2.10 TOP: X.B
MSC: Applied

118. Hot spots are caused by _____.
a. friction due to the lithosphere sliding atop the asthenosphere
b. unusually dense concentrations of radioactive isotopes at various points in the crust
c. hot plumes of mantle material that rises up through cooler, denser surrounding rock
d. factors that remain completely unknown at this time

ANS: C DIF: Easy REF: 2.10 TOP: X.B.i
MSC: Factual

119. Consult the figure below. Hot-spot tracks result from moving _____.



a. mantle plumes
b. plates
c. hot spots
d. asthenosphere

ANS: B DIF: Easy REF: 2.10 TOP: X.B.ii
MSC: Factual

120. Hot spots can occur _____.
a. only within continental plates

b. only within oceanic plates
c. within either continental or oceanic plates
d. only when the thickness of the crust is less than 10 km

ANS: C DIF: Medium REF: 2.10 TOP: X.B
MSC: Applied

121. Which of the following would NOT render the volcanoes on Hawaii's big island inactive?
a. the Pacific plate moving farther to the northwest
b. the mantle plume below Hawaii moving farther to the northwest
c. the mantle plume below Hawaii decreasing in temperature
d. All of the other choices would render the volcanoes on Hawaii's big island inactive.

ANS: B DIF: Medium REF: 2.10 TOP: X.B
MSC: Conceptual

122. The mid-ocean ridges are elevated above the surrounding sea floor because _____.
a. ridge rocks are hot and therefore of relatively low density
b. the lithospheric plates are thickest at the ridges so that they stand up taller
c. rising ocean currents leave a vacuum above the ridge
d. ridge rocks are mafic, whereas the ocean basin crust consists of ultramafic rock

ANS: A DIF: Difficult REF: 2.10 TOP: X.B.i
MSC: Conceptual

123. When two bodies of continental lithosphere are pulled together at a convergent boundary, the result is _____.
a. subduction b. collision and mountain formation

ANS: B DIF: Easy REF: 2.11 TOP: XI
MSC: Applied

124. _____ is an example of a continental rift and the _____ is/are the result of collision.
a. The Basin and Range Province; mid-ocean ridge
b. A mid-ocean ridge; Himalayan Mountains
c. The Basin and Range Province; Himalayan Mountains
d. The San Andreas Fault; Himalayan Mountains

ANS: C DIF: Medium REF: 2.11 TOP: XI
MSC: Applied

125. Without which of the following principles would it be impossible to drive plate motion?
a. Plastic material is pushed downslope by the mass of the material at higher elevations.
b. Once plastic material starts to sink, it will bring the entire mass of the material with it.
c. Plastic material always flows away from its source.
d. Both a and b are correct.
e. Both b and c are correct.

ANS: D DIF: Difficult REF: 2.11 TOP: XII
MSC: Conceptual