

Chapter 2—Plate Tectonics: A Unifying Theory

ESSAY

1. What were the major lines of evidence for continental drift as presented by Wegener in the early 20th century?

ANS:

The glaciations on the Gondwana continents could only have occurred if the continents were joined since the centers of the glaciers would have been in the ocean if they were not. Also, the continents, such as South America and Africa, match like a jigsaw puzzle. Similar fossil plant and animals are separated by oceans leading to the assumption that they must have lived in adjacent regions when they were alive. Finally, similar rock sequences and mountain ranges could be connected across oceans.

PTS: 1

REF: 2.3. What is the Evidence for Continental Drift?

2. Explain how mountain ranges can be used as evidence to support continental drift.

ANS:

A mountain range forms under the same geological conditions along its length. This means that the same or nearly the same rock types are found along the range's length in the same or nearly the same sequence. The processes that form mountain ranges tend to create somewhat linear, elevated features. So a mountain range that has been split, even if it has been separated by an ocean, is fairly easy to recognize.

PTS: 1

REF: 2.3. What is the Evidence for Continental Drift?

3. How does fossil evidence support continental drift?

ANS:

The distribution of fossils is such that it would be impossible for the plants and animals not to have lived in contiguous land areas. *Glossopteris* seeds are too heavy to be dispersed by wind and would not have remained viable if they had traveled far across the oceans. The plants associated with *Glossopteris* do not match the climate zones the fossils are found in. As for the animals, it's hard to imagine a freshwater reptile like *Mesosaurus* swimming across the Atlantic. And the land-dwelling reptiles, *Lystrosaurus* and *Cynognathus*, could not have swum at all!

PTS: 1

REF: 2.3. What is the Evidence for Continental Drift?

4. Briefly explain why apparent polar wandering is "apparent."

ANS:

Paleomagnetic studies of ancient rocks point to different locations for the North Pole at different times. When this is mapped out, it makes the pole appear to wander over time. The alternative to a wandering magnetic pole, for which there is no other evidence at all, is that the continents move and with them the rocks that contain the paleomagnetic data.

PTS: 1

REF: 2.6. Paleomagnetism and Polar Wandering

5. Briefly explain why the movement of continents over geologic time was the best explanation for polar wandering.

ANS:

Since the Earth has only one magnetic north pole now, it was extremely unlikely that there would have been more than one in the past, though this would have been required to explain the different polar wander paths of the different continents. The only other possible explanation is that the continents were once joined and have since moved apart.

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

6. Briefly explain how magnetic reversals in oceanic crust and fossils in ocean sediments are used to construct a magnetic time scale.

ANS:

A terrestrial sequence of magnetic reversal in volcanic deposits was dated radiometrically. These dates were extrapolated to regions which were not dated, but showed the same pattern of normal and reversed magnetic polarities. Ages of ocean-floor basalts lying within a zone of normal or reversed polarity are dated by the ages of the fossils found in the sediments which directly overlie the basaltic crust. These fossils have already been incorporated within a biostratigraphic zone.

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

7. How are hot spots used for determining the absolute motions of plates?

ANS:

Hot spots appear to be fixed in the mantle relative to each other so they can be used as a reference frame. If the age of a basalt and its distance from the hotspot is determined, then the rate of movement of that rock can be calculated. If a number of these samples are taken from various distances from the hotspot, the calculation can be quite accurate.

PTS: 1 REF: 2.10. Hot Spots and Mantle Plumes

8. Describe how the two models for the driving force of plate motion are the same. How are they different?

ANS:

Both models involve thermal convection in the mantle. In both models, where two adjacent convection cells have upwelling limbs, there is a divergent plate boundary. Where there is a descending limb of a convection cell, there is a convergent boundary. The models differ in the location of the convection cells. In one, the convection cells are restricted to the asthenosphere. In the other, the convection cells take up the entire mantle.

PTS: 1 REF: 2.12. The Driving Mechanism of Plate Tectonics

9. Briefly explain the roles of magma and hydrothermal activity in forming ore deposits along convergent and divergent plate boundaries.

ANS:

Magma contains valuable elements, some of which leave the magma in gases and fluids. These substances transport the elements and facilitate their exchange for other elements in the surrounding rock. The surrounding rock may then have enough of the valuable elements to become an ore deposit. At convergent plate boundaries, partial melting at the subducting plate allows magma and valuable minerals to rise up in fluids and erupt as volcanoes or cool beneath the surface as plutons. At divergent plate boundaries, hydrothermal vents form. In these locations, seawater filters past hot magma, picks up valuable elements, and then the hot fluids flow onto the seafloor and drop their valuable elements.

PTS: 1 REF: 2.13. Plate Tectonics and the Distribution of Natural Resources

10. What are four of the many things that plate tectonics theory explains?

ANS:

Plate tectonics explains, at least to some extent, all of the following phenomena: the distribution of earthquakes and volcanoes, the locations of ore deposits and mountain systems, climate and ocean circulation patterns, and the geographic distribution, evolution, and extinction of life forms.

PTS: 1 REF: various

11. Briefly explain why there is so much oil in the Persian Gulf region.

ANS:

During the Mesozoic, the Persian Gulf was a broad, stable marine shelf. Countless microorganisms lived in the surface water and their remains accumulated in the bottom sediments and were buried. The collision between Arabia and Iran has tilted the Arabian plate and crumpled rocks on the edges of both plates. The tilting of Arabia allows oil to migrate upslope to accumulate in traps created by folding.

PTS: 1 REF: 2.13. Plate Tectonics and the Distribution of Natural Resources

12. How does the introduction of a geographic barrier encourage the evolution of species?

ANS:

A population that is not separated will interbreed, and so there will be little opportunity for different species to form. If a barrier separates that population, and if conditions are different on either side of the barrier, natural selection will favor certain traits over others, and over time the two different populations of organisms may evolve to become different species.

PTS: 1 REF: 2.14. Plate Tectonics and the Distribution of Life

SHORT ANSWER

1. What was the principal reason why Wegener's theory of continental drift was rejected?

ANS:

Wegener lacked a plausible mechanism to explain how continental crust could move through the sea floor.

PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

2. Why were glacially deposited strata important in the development of continental drift theory?

ANS:

The glacial deposits indicated that all southern continents must have been contiguous and closer to the South Pole. Glaciers cannot form in the middle of an ocean, which is where they would have originated if the continents were not together.

PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

3. What was the principal reason why Wegener's theory of continental drift was rejected?

ANS:

Wegener lacked a plausible mechanism to explain how continental crust could move through the sea floor.

PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

4. Describe the features of oceanic trenches. For what geological reasons do the trenches appear like this?

ANS:

Oceanic trenches are long, steep sided depressions on the seafloor. They are found near convergent plate boundaries. The deep trench is caused by subduction of oceanic lithosphere beneath an oceanic or continental plate.

PTS: 1 REF: 2.4. Features of the Seafloor

5. What are the three possible explanations for the distribution of paleomagnetic data?

ANS:

(1) The continent remained fixed and the north magnetic pole moved; (2) the north magnetic pole stayed still and the continent moved; (3) both the continent and north magnetic pole moved.

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

6. What evidence is there that ocean basins are young and old oceanic crust must be destroyed?

ANS:

The maximum age for oceanic crust is 180 million years, but the continents contain rocks both younger and much older than 180 million years, so the older oceanic crust must go somewhere.

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

7. What is one geologic method for determining the average rate of seafloor spreading?

ANS:

The strips of oceanic crust can be dated by reference to the ages of reversals in lava flows on land which have been radiometrically dated. Then the age with distance from the spreading ridge can be used to calculate the rate of plate motion and hence seafloor spreading.

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

8. Briefly explain how convection transfers heat.

ANS:

When a material is heated, it expands, and its density decreases so it rises. After having risen some distance, it begins to cool, contract, and become denser. Thus the material sinks and returns to the original level where it will eventually be heated and rise again.

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

9. Briefly describe what happens when divergent plate boundaries form within a continent.

ANS:

High heat flow elevates the continent and a rift valley forms, with normal faults and a central valley called a graben. Magma is intruded into fractures. As the plates diverge, basalt erupts in the rift, creating new ocean crust. Ultimately, as the plates continue to diverge, a new ocean basin forms.

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

10. Draw a cross-section of an oceanic-oceanic convergent plate boundary. Show the directions of relative plate motion. Put stars for the locations of earthquakes. Put triangles with smoke out the top for the locations of volcanoes. Label the trench, back arc basin, and subduction complex.

ANS:

See Figure 2.18a

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

11. Draw a cross-section of an ocean-continent convergent plate boundary. Show the directions of relative plate motion. Put stars for the locations of earthquakes. Put triangles with smoke out the top for the locations of volcanoes. Label the trench and subduction complex.

ANS:

See Figure 2.18b

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

12. Draw a cross-section of a continental-continental convergent plate boundary. Show the directions of relative plate motion. Put stars for the locations of earthquakes. Show the location of the mountain range. Label the subduction complex.

ANS:

See Figure 2.18c

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

13. Why is plate tectonic theory so widely accepted?

ANS:

Plate tectonic theory is supported by diverse lines of evidence from many scientific disciplines, such as geology and biology, and it explains many seemingly unrelated geological phenomena.

PTS: 1 REF: various

14. What is a method by which the present rate of motion between two plates can be measured accurately?

ANS:

The travel of a laser beam can be timed from one plate to another by bouncing it from a satellite and by calculating the difference in arrival times of a quasar signal at two plates over a period of time.

PTS: 1 REF: 2.11. Plate Movement and Motion

15. What are the heat sources for each of the two mantle convection models for plate tectonics?

ANS:

With whole mantle convection, the heat source is the core. With convection only in the asthenosphere, the heat source is harder to identify.

PTS: 1 REF: 2.12. The Driving Mechanism of Plate Tectonics

16. How does seafloor spreading explain the movement of the continents?

ANS:

With seafloor spreading, the continents and oceanic crust move together as part of large plates. The plate is pushed by the formation of new ocean crust and pulled by the subduction of old ocean crust. New crust forms due to seafloor spreading.

PTS: 1 REF: 2.12. The Driving Mechanism of Plate Tectonics

17. In what ways does plate tectonics theory have economic applications?

ANS:

By understanding the geologic history of a region, geologists can predict whether it will be a worthwhile place to search for petroleum or ore deposits.

PTS: 1 REF: 2.13. Plate Tectonics and the Distribution of Natural Resources

COMPLETION

1. Paleomagnetism is the study of the _____ magnetism in rocks.

ANS: remnant

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

2. When magma cools, the magnetic iron-bearing minerals align themselves with the Earth's magnetic field and record _____ and _____.

ANS: strength, direction of the North Pole

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

3. The temperature at which iron-bearing minerals gain their magnetic property is the _____.

ANS: Curie point

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

4. Paleomagnetic data plotted on a map suggested that the magnetic pole had moved through time; this phenomenon was called _____.

ANS: apparent polar wandering

PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

5. Magnetic stripes in oceanic basalts are _____ and _____ around ocean ridges.

ANS:

parallel, symmetrical
symmetrical, parallel

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

6. Radiometric dating shows that the oldest ocean crust is _____ years old, and the oldest continental crust is _____ years old.

ANS: 180 million, 3.96 billion

PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

7. At deep sea trenches, _____ is subducted back into the _____.

ANS: lithosphere, mantle

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

8. At mid-oceanic ridges, hot magma rises from the _____ and forms new _____.

ANS: mantle, seafloor

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

9. The three kinds of boundaries there can be between adjacent plates are _____, _____, and _____.

ANS: divergent, convergent, transform

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

10. At divergent plate boundaries, plates are moving _____. At these locations, new _____ forms.

ANS: apart, lithosphere

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

11. Where divergent plate boundaries form beneath continental masses, low areas known as _____ form.

ANS: rift valleys

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

12. At a convergent plate boundary, oceanic crust is _____.

ANS: destroyed

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

13. The three types of convergent plate boundaries are _____ - _____, _____ - _____, and _____ - _____.

ANS: oceanic-oceanic, oceanic-continental, continental-continental

PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

2. Plate tectonic processes have influenced which of the following?
- the distribution of earthquakes and volcanoes
 - the locations of ore deposits and mountain systems
 - climatic patterns and ocean circulation
 - the geographic distribution, evolution, and extinction of life forms
 - all of these

ANS: E PTS: 1 REF: various

3. The first person to suggest that all of the continents had originally been joined together as the supercontinent Pangaea was who?
- Alexander du Toit, 1937
 - Frank Taylor, 1910
 - Alfred Wegener, 1912
 - Snider- Pelligrini, 1858
 - Harry Hess, 1962

ANS: C PTS: 1 REF: 2.2. Early Ideas About Continental Drift

4. The name given to the northern supercontinent was ____.
- Laurasia
 - Luentia
 - Laurotia.
 - Laurentia
 - northern Pangaea

ANS: A PTS: 1 REF: 2.2. Early Ideas About Continental Drift

5. The southern supercontinent consisted of which current continents?
- South America, Africa, Australia, Antarctica, and India
 - Africa, South America, Antarctica, and Australia
 - South America, Africa, India, and Australia
 - South Africa, India, Africa, and Australia
 - South America, Central America, India, Antarctica, Africa, and Australia

ANS: A PTS: 1 REF: 2.2. Early Ideas About Continental Drift

6. Which group of fossils is considered evidence for the former existence of Gondwana?
- Glossaurus*
 - Pecopteris*
 - Neuropteris*
 - Glossopteris*
 - Mesopteris*

ANS: D PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

7. Glacially deposited strata were important in the development of continental drift theory because ____.
- the distribution of glacial deposits indicated that the entire Earth must have been glaciated
 - the distribution of coal-swamp deposits indicated that the entire Earth must have been very warm
 - the glacial deposits indicated that there must have been many very large glaciers on several continents
 - the glacial deposits indicated that all of the southern continents must have been closer to the South Pole and contiguous
 - the glacial deposits indicated that climate can change dramatically over geologic time

ANS: D PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

8. That the northern continents were once joined and located along the equator was shown by what?
- the coal-age plant fossils of North America and Europe
 - the *Glossopteris* flora
 - the distribution of mountain ranges
 - the distributions of Permian and Triassic reptiles
 - the distributions of northern hemisphere glacial tillites

ANS: A PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

9. Which of the following was not evidence for Wegener's continental drift hypothesis?
- glacial deposits of Gondwana continents
 - fit of African and South American shorelines
 - paleomagnetic striping of the oceanic crust
 - fossil plant and animal distributions
 - similar rock sequences and mountain ranges

ANS: C PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

10. The proposal that the coastline fit of South America and Africa was evidence of continental drift was criticized because it could have been due to what?
- chance
 - shoreline erosion
 - the sinking of a land bridge
 - ocean currents
 - the distribution of resistant rock types

ANS: B PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

11. If the continents were once joined together, rocks and mountain ranges on the margins of each should have ____.
- formed under the same conditions
 - formed the same sequences
 - formed at the same time
 - the same structural trends and forces
 - all of these

ANS: E PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

12. Two sets of mountain ranges, which are continuous once the continents on either side of the Atlantic are joined, are located where?
- eastern North America and Greenland/ Australia and East Africa
 - east Africa and Europe/ eastern North America and the Soviet Union
 - Australia and Southeast Asia/ Arabia and the Persian Gulf
 - South Africa and Brazil/ eastern North America and Great Britain
 - Central and South America/ Central and North America

ANS: D PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

13. Glacial deposits gave strong evidence of the existence of Gondwana because ____.
- a single continent in high latitudes was more sensible than low latitude glaciation on several continents
 - glacial striations showed that all glaciers on each continent had flowed from a central location

- c. fossil plants indicated tropical climate in the northern continents
- d. a single continent in high latitudes was more sensible than low latitude glaciation on several continents AND glacial striations showed that all glaciers on each continent had flowed from a central location
- e. a single continent in high latitudes was more sensible than low latitude glaciation on several continents AND fossil plants indicated tropical climate in the northern continents

ANS: D PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

14. Fossil evidence linking the Gondwana continents includes which animal fossils?
- a. lake-dwelling *Mesosaurus* and large land-dwelling reptile *Lystrosaurus* and *Cynognathus*
 - b. freshwater *Mesosaurus* and dinosaurs *Brontosaurus* and *Tyrannosaurus*
 - c. freshwater crocodiles and the large amphibian *Eryops*
 - d. reptile *Dimetrodon* and the first bird *Archaeopteryx*
 - e. lake-dwelling *Mesosaurus* and the large land-dwelling reptiles *Dimetrodon* and *Edaphosaurus*

ANS: A PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

15. Fossil evidence of the links among Gondwana continents was compelling because the species ____.
- a. should have been found over wide regions if they were able to migrate among continents
 - b. should have exhibited evidence of tolerance for climatic extremes
 - c. should have shown a mechanism for widespread dispersal
 - d. should have been found over wide regions if they were able to migrate among continents AND should have shown a mechanism for widespread dispersal
 - e. all of these

ANS: E PTS: 1 REF: 2.3. What is the Evidence for Continental Drift?

16. The transition zone from the exposed land to the ocean floor is called the
- a. oceanic trench.
 - b. continental margin.
 - c. continental slope.
 - d. abyssal plain.

ANS: B PTS: 1 REF: 2.4. Features of the Seafloor

17. A volcanic hill that is on the seafloor and has a flat top is best called a
- a. guyot.
 - b. seamount.
 - c. aseismic ridge.
 - d. microcontinent.

ANS: A PTS: 1 REF: 2.4. Features of the Seafloor

18. The Earth's magnetic field is due to ____.
- a. the presence of magnetic iron and nickel in the core
 - b. gravity
 - c. the occurrence of magnetite in all rocks
 - d. convection in the liquid outer core
 - e. none of these

ANS: D PTS: 1 REF: 2.5. Earth's Magnetic Field

19. The study of paleomagnetism is possible because ____.
- a. the magnetic minerals in rocks create the Earth's magnetic field
 - b. most rocks contain no magnetic minerals
 - c. the magnetic minerals in rocks disrupt the Earth's magnetic field
 - d. the magnetic minerals in a cooling lava point toward the north magnetic pole
 - e. none of these

ANS: D PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

20. Certain rock types can be used to determine the locations of past magnetic poles because ____.
- a. the Earth's magnetic poles have reversed many times during its history
 - b. the magnetic poles and geographic poles differ slightly
 - c. iron-bearing minerals align themselves in the direction of the current magnetic field when the rock cools below the Curie point
 - d. lava flows in Europe all showed that the continent was once located in the southern hemisphere
 - e. the north magnetic poles of each continent are identical for each geological period

ANS: C PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

21. What did the differing paleomagnetic records for each continent show?
- a. each continent had its own magnetic pole during successive geological periods
 - b. that the magnetic poles for each continent had moved over geological time
 - c. that the magnetic poles have remained in one location and each of the continents has moved
 - d. that both the poles and the continents have moved over time
 - e. none of these

ANS: C PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

22. What do studies of paleomagnetism show?
- a. the northern and southern hemispheres have reversed position many times
 - b. the ocean basins are young
 - c. each continent once had its own magnetic pole
 - d. the continents remain fixed and the north magnetic pole has moved
 - e. all of these

ANS: B PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

23. Magnetic iron-bearing minerals that crystallize out of magma ____.
- a. align themselves with the Earth's magnetic field and only record direction
 - b. record the strength of the Earth's magnetic fields
 - c. become easily altered and lose their magnetic properties
 - d. record both direction and strength of the Earth's magnetic field at time of crystallization
 - e. none of these

ANS: D PTS: 1 REF: 2.6. Paleomagnetism and Polar Wandering

24. Geologists know that oceanic ridges are geologically very active because they ____.
- a. have high heat flow
 - b. have many small earthquakes
 - c. are the site of recent volcanic eruptions
 - d. have many small earthquakes and are the site of recent volcanic eruptions
 - e. all of these

ANS: E PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

25. That the oceanic crust is geologically young and the parallel magnetic striping pattern of basalts is symmetrical about oceanic ridges was conclusively shown by what?
- a. radiometric dating of oceanic basalts and sequences from continents
 - b. the unusually thin layer of oceanic sediments and ages of contained fossils
 - c. the existence of the same magnetic anomaly patterns in all ocean basins
 - d. radiometric dating of oceanic basalts and sequences from continents AND the unusually

- thin layer of oceanic sediments and ages of contained fossils
e. all of these

ANS: D PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

26. The fact that no oceanic crust older than 180 million years (Jurassic) has been found indicates what?
- The break-up of Pangaea must have occurred before the Jurassic Period.
 - The ocean basins must be older than Jurassic age.
 - The movement of continents must have begun no earlier than the Jurassic Period.
 - The break-up of Pangaea must have begun at about the same time as these oldest basalts were formed.
 - The movement of continents must have begun no earlier than the Jurassic Period AND The break-up of Pangaea must have begun at about the same time as these oldest basalts were formed.

ANS: D PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

27. The seafloor spreading hypothesis indicates what as the primary cause of continental movement?
- volcanism in the ocean crust
 - convergence of tectonic plates
 - the formation and destruction of ocean basins
 - the convection of mantle heat
 - the decay of radioactive isotopes

ANS: C PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

28. Who proposed the idea of seafloor spreading?
- Harry Hess
 - Frederick Vine
 - Oliver and Sykes
 - Fred Taylor
 - Hess and Matthews

ANS: A PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

29. What is the driving mechanism for plate tectonics?
- heat deep within the Earth
 - tidal forces caused by the moon
 - volcanoes and earthquakes at plate boundaries
 - a little man with a steering wheel in Tierra del Fuego
 - none of these

ANS: A PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

30. What was the driving mechanism proposed by Hess to explain sea floor spreading?
- downwelling oceanic currents
 - hydrothermal cells
 - thermal convection cells
 - motions in the outer core
 - thermal convection cells AND motions in the outer core

ANS: C PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

31. Lithospheric plates move on the Earth's surface because ____.
- warm mantle ascends at ridges and cool mantle descends at subduction zones
 - convection occurs only in the asthenosphere

- c. cool mantle ascends at ridges and warm mantle descends at subduction zones
- d. warm mantle ascends at ridges and cool mantle descends at subduction zones AND convection occurs only in the asthenosphere
- e. convection occurs only in the asthenosphere AND cool mantle ascends at ridges and warm mantle descends at subduction zones

ANS: A PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

32. Old, cold, and dense oceanic crust is ____.
- a. created at spreading ridges
 - b. found closest to continental margins
 - c. destroyed at subduction zones
 - d. eventually becomes incorporated into continental crust
 - e. always found on plate margins

ANS: C PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

33. Geologists recognize which three major types of plate boundaries?
- a. resurgent, divergent, and emergent
 - b. convergent, divergent, and transform
 - c. transcurrent, oblique, and resurgent
 - d. emergent, transform, and convergent
 - e. transform, transcurrent, and translateral

ANS: B PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

34. At divergent plate boundaries, what are the operating forces?
- a. compressional
 - b. lateral shearing
 - c. tensional
 - d. thrusting
 - e. normal

ANS: C PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

35. At a mid-ocean ridge spreading center, what happens?
- a. the plates are moving past each other
 - b. the plates are moving away from each other
 - c. the plates are moving toward each other
 - d. one plate is being subducted beneath another
 - e. both plates are being subducted

ANS: B PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

36. Which are **not** associated with a mid-ocean ridge?
- a. old ocean crust
 - b. shallow earthquakes
 - c. volcanic eruptions
 - d. transform faults
 - e. hot water

ANS: A PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

37. Geologists locate plate boundaries ____.
- a. at continental margins
 - b. at volcanoes

- c. by earthquake epicenters
- d. at volcanoes AND by earthquake epicenters
- e. All of these

ANS: C PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

38. The forces operating at continent-continent convergent boundaries are ____.
- a. transpressional
 - b. compressional
 - c. tensional
 - d. lateral shearing
 - e. compressional and tensional

ANS: B PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

39. When a continental plate diverges from another continental plate what happens?
- a. a new ocean basin forms
 - b. a large mountain range forms
 - c. a transform fault forms
 - d. there are no earthquakes
 - e. a subduction zone forms

ANS: A PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

40. At transform plate boundaries, ____.
- a. lithosphere is neither created or destroyed
 - b. plates move laterally past each other
 - c. active volcanism occurs
 - d. plates move laterally past each other AND active volcanism occurs
 - e. all of these

ANS: D PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

41. A transform plate boundary may connect ____.
- a. a spreading ridge and subduction zone
 - b. two spreading ridges
 - c. two subduction zones
 - d. a spreading ridge and subduction zone OR two spreading ridges
 - e. all of these

ANS: E PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

42. The San Andreas Fault that runs through California ____.
- a. is a transform fault
 - b. is a plate boundary
 - c. is the location of large earthquakes
 - d. is a transform fault that is the location of large earthquakes
 - e. all of these

ANS: D PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

43. The Emperor Seamount-Hawaiian Island chain
- a. is a line of active volcanoes.
 - b. is a line of extinct volcanic structures.
 - c. results from volcanism along a mid-ocean ridge.
 - d. records the direction of plate motion.

ANS: D PTS: 1 REF: 2.10. Hot Spots and Mantle Plumes

44. Plate tectonics have affected biological evolution by ____.
- a. causing global climatic change with joining together or breaking apart of large landmasses
 - b. causing more or fewer habitats to develop as continental masses come together or separate
 - c. forming geographic barriers
 - d. forming geographic corridors
 - e. all of these

ANS: E PTS: 1 REF: 2.14. Plate Tectonics and the Distribution of Life

45. Olympus Mars, the largest volcano in the solar system, is
- a. on Venus.
 - b. a shield volcano.
 - c. covered with an ice cap.
 - d. indicative of active plate tectonics.

ANS: B PTS: 1 REF: Geo-Insight. Tectonics of the Terrestrial Planets

46. Jupiter's moon, Io, has no impact craters. This means that the moon
- a. has been protected from meteors by Jupiter
 - b. is geologically active.
 - c. has too little gravity to attract meteors.
 - d. has a liquid sulfur surface.

ANS: B PTS: 1 REF: Geo-Insight. Tectonics of the Terrestrial Planets

TRUE/FALSE

1. The 2004 Indian Ocean tsunami, the 2010 Indonesian volcanic eruptions and the 2011 Japan earthquake and tsunami are all due to plate tectonics.

ANS: T PTS: 1 REF: 2.1. Introduction

2. Oceanic ridges are geologically stable features where sediments are deposited and nothing much else takes place.

ANS: F PTS: 1 REF: 2.4. Features of the Seafloor

3. Earth's magnetic poles, where the lines of force leave and enter the planet, do not coincide with the geographic (rotational) poles).

ANS: T PTS: 1 REF: 2.5. Earth's Magnetic Field

4. The cause of magnetic reversals is a change in the structure of the Earth's inner core.

ANS: F PTS: 1 REF: 2.7. Magnetic Reversals and Seafloor Spreading

5. Earth's lithosphere is divided into seven major plates and numerous smaller ones.

ANS: T PTS: 1 REF: 2.8. Plate Tectonics: A Unifying Theory

6. Many seemingly unrelated geologic features and events are interrelated by plate tectonics processes.

ANS: T PTS: 1 REF: 2.8. Plate Tectonics: A Unifying Theory

7. Active volcanism on Venus indicates that the planet has a geologically active interior.

ANS: F PTS: 1 REF: Geo-Insight. Tectonics of the Terrestrial Planets

8. Features associated with ancient continental rift zones include andesite volcanoes and strike slip faulting.

ANS: F PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

9. During the Triassic, a number of rift related fault basins formed along the eastern margin of North America.

ANS: T PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

10. The west coast of South America is a convergent boundary.

ANS: T PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

11. A transform plate boundary underlies the Alps in southern Europe.

ANS: F PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

12. There is a divergent plate boundary within the region of east Africa.

ANS: T PTS: 1 REF: 2.9. The Three Types of Plate Boundaries

13. There is active volcanism on bodies in the solar system besides Earth but only on other planets.

ANS: F PTS: 1 REF: Geo-Insight. Tectonics of the Terrestrial Planets

14. Hot spots move with continental plates.

ANS: F PTS: 1 REF: 2.10. Hot Spots and Mantle Plumes

15. Volcanic island chains that form along the trace of a hot spot are called aseismic ridges.

ANS: T PTS: 1 REF: 2.10. Hot Spots and Mantle Plumes

16. To determine the rate of plate motion, geologists date the magnetic anomalies on the seafloor and determine the distance from the ridge axis to that magnetic anomaly. Then they divide the age by the distance to determine the rate of movement.

ANS: F PTS: 1 REF: 2.11. Plate Movement and Motion

17. Geologists have an excellent understanding of plate movements since before Pangaea came together.

ANS: F PTS: 1 REF: 2.11. Plate Movement and Motion

18. Slab pull and ridge push facilitate the movement of plates.

ANS: T PTS: 1 REF: 2.12. The Driving Mechanism of Plate Tectonics