Review - Unit 4 Plate Tectonics

1. A model of Earth's internal structure is shown below.

Analysis of which type of data led to the development of this model?

A) seismic waves  
B) depth of Earth's oceans  
C) electromagnetic radiation  
D) isobar gradients

2. Which two Earth layers are separated by the Moho boundary?

A) rigid mantle and plastic mantle  
B) outer core and stiffer mantle  
C) stiffer mantle and asthenosphere  
D) crust and rigid mantle

3. Which part of Earth’s interior is inferred to have convection currents that cause tectonic plates to move?

A) rigid mantle  
B) asthenosphere  
C) outer core  
D) inner core

4. Earth’s outer core is best inferred to be

A) liquid, with an average density of approximately 4 g/cm$^3$  
B) liquid, with an average density of approximately 11 g/cm$^3$  
C) solid, with an average density of approximately 4 g/cm$^3$  
D) solid, with an average density of approximately 11 g/cm$^3$

5. Why is Earth’s outer core inferred to be a liquid?

A) $P$-waves can pass through the outer core.  
B) $P$-waves cannot pass through the outer core.  
C) $S$-waves can pass through the outer core.  
D) $S$-waves cannot pass through the outer core.

6. From the top of the stiffer mantle to the center of Earth, the rock material is inferred to be

A) solid all the way to the center of the inner core  
B) solid, then liquid to the center of the inner core  
C) solid, then liquid, then solid again to the center of the inner core  
D) solid, then liquid, then gaseous to the center of the inner core

7. The rock between 2,900 kilometers and 5,200 kilometers below the Earth's surface is inferred to be

A) an iron-rich solid  
B) an iron-rich liquid  
C) a silicate-rich solid  
D) a silicate-rich liquid

8. The fact that $S$-waves are unable to travel through the Earth's outer core supports the inference that the outer core is

A) composed of iron and nickel  
B) more dense than the inner core  
C) hotter than the rock's melting point  
D) in the solid state of matter

9. Compared to Earth’s continental crust, Earth’s oceanic crust is

A) thinner and more dense  
B) thinner and less dense  
C) thicker and more dense  
D) thicker and less dense

10. Beneath which surface location is Earth's crust the thinnest?

A) East Pacific Ridge  
B) the center of South America  
C) Old Forge, New York  
D) San Andreas Fault
11. Base your answer to the following question on the cross section below, which shows the paths of seismic waves traveling from an earthquake epicenter through the different layers of Earth's interior.

No $P$-waves or $S$-waves are received in the shadow zone because

A) $P$-waves are absorbed and $S$-waves are refracted by Earth's outer core
B) $P$-waves are refracted and $S$-waves are absorbed by Earth's outer core
C) both the $P$-waves and $S$-waves are refracted by Earth's outer core
D) both the $P$-waves and $S$-waves are absorbed by Earth's outer core

12. Which statement most accurately compares Earth's crust and Earth's mantle?

A) The crust is thinner and less dense than the mantle.
B) The crust is thinner and more dense than the mantle.
C) The crust is thicker and less dense than the mantle.
D) The crust is thicker and more dense than the mantle.

13. Compared to Earth's oceanic crust, Earth's continental crust is

A) thinner and composed of granite
B) thinner and composed of basalt
C) thicker and composed of granite
D) thicker and composed of basalt

14. Where is the thickest part of the Earth's crust?

A) at mid-ocean ridges
B) at transform faults
C) under continental mountain ranges
D) under volcanic islands

15. Which minerals contain the two most abundant elements by mass in Earth's crust?

A) fluorite and calcite
B) magnetite and pyrite
C) amphibole and quartz
D) galena and sulfur

16. Which element is most abundant in Earth's crust?

A) nitrogen
B) hydrogen
C) oxygen
D) silicon

17. The basaltic bedrock of the oceanic crust is classified as

A) felsic, with a density of 2.7 g/cm$^3$
B) felsic, with a density of 3.0 g/cm$^3$
C) mafic, with a density of 2.7 g/cm$^3$
D) mafic, with a density of 3.0 g/cm$^3$

18. The observed difference in density between continental crust and oceanic crust is most likely due to differences in their

A) composition
B) thickness
C) porosity
D) rate of cooling
Base your answers to questions 19 and 20 on the cross section below, which shows the boundary between two lithospheric plates. Point $X$ is a location in the continental lithosphere. The depth below Earth's surface is labeled in kilometers.

19. Point $X$ is located in which Earth layer?
   A) rigid mantle   B) stiffer mantle   C) asthenosphere   D) outer core

20. The temperature of the asthenosphere at the depth where melting first occurs is inferred to be approximately
   A) 100°C   B) 1300°C   C) 4200°C   D) 5000°C

21. The inferred temperature at the interface between the stiffer mantle and the asthenosphere is closest to
   A) 1000°C   B) 2500°C   C) 4500°C   D) 5000°C

22. Which temperature is inferred to exist in Earth’s plastic mantle?
   A) 2000°C   B) 3000°C   C) 5000°C   D) 6000°C

23. What is Earth’s inferred interior pressure, in millions of atmospheres, at a depth of 3500 kilometers?
   A) 1.9   B) 2.8   C) 5500   D) 6500

24. Earth’s inner core is inferred to be solid based on the analysis of
   A) seismic waves   B) crustal rocks   C) radioactive decay rates   D) magnetic pole reversals

25. A $P$-wave takes 5 minutes to travel from the epicenter of an earthquake to a seismic station. Approximately how many minutes will it take an $S$-wave to travel that same distance?
   A) 15 min   B) 12 min   C) 9 min   D) 4 min

26. The cross section below shows a portion of Earth's crust.

Which observation provides the most direct evidence that crustal plate collision has occurred near this region?
   A) alternating layers of shale and limestone bedrock
   B) absence of an igneous intrusive rock
   C) different thicknesses of the sedimentary layers
   D) folding of the sedimentary layers

27. What is the approximate $P$-wave travel time from an earthquake if the $P$-wave arrives at the seismic station 8 minutes before the $S$-wave?
   A) 4 minutes 20 seconds
   B) 6 minutes 30 seconds
   C) 10 minutes 0 seconds
   D) 11 minutes 20 seconds
28. Base your answer to the following question on the passage and cross section below and on your knowledge of Earth science. The cross section represents one theory of the movement of rock materials in Earth's dynamic interior. Some mantle plumes that are slowly rising from the boundary between Earth's outer core and stiffer mantle are indicated.

**Hot Spots and Mantle Plumes**

Research of mantle hot spots indicates that mantle plumes form in a variety of sizes and shapes. These mantle plumes range in diameter from several hundred kilometers to 1000 kilometers. Some plumes rise as blobs rather than in a continuous streak; however, most plumes are long, slender columns of hot rock slowly rising in Earth's stiffer mantle. One theory is that most plumes form at the boundary between the outer core and the stiffer mantle. They may reach Earth's surface in the center of plates or at plate boundaries, producing volcanoes or large domes.

Compared to the surrounding material, mantle plumes rise toward Earth's surface from the core-mantle boundary because they are

A) cooler and less dense  B) cooler and more dense  
C) hotter and less dense  D) hotter and more dense

29. Fossils of marine plants and animals are found in the bedrock of mountains many thousands of feet above sea level. The most likely reason for this observation is that

A) the mountains were part of a mid-ocean ridge  
B) the ocean level has dropped several thousand feet  
C) forces within the Earth caused uplift  
D) transported materials were deposited at high elevations

30. On which plate is the Hawaii Hot Spot located?

A) South American  B) Antarctic  
C) Nazca  D) Pacific

31. How long after receiving the first P-wave from an earthquake centered 4000 kilometers away does a seismic station receive its first S-wave from the same earthquake?

A) 1 minute  
B) 5 minutes 35 seconds  
C) 7 minutes  
D) 12 minutes 40 seconds
32. Base your answer to the following question on the diagram below, which shows models of two types of earthquake waves.

Model A best represents the motion of earthquake waves called

A) \( P \)-waves (compressional waves) that travel faster than \( S \)-waves (shear waves) shown in model \( B \)
B) \( P \)-waves (compressional waves) that travel slower than \( S \)-waves (shear waves) shown in model \( B \)
C) \( S \)-waves (shear waves) that travel faster than \( P \)-waves (compressional waves) shown in model \( B \)
D) \( S \)-waves (shear waves) that travel slower than \( P \)-waves (compressional waves) shown in model \( B \)

33. The Himalaya Mountains are located along a portion of the southern boundary of the Eurasian Plate. At the top of Mt. Everest (29,028 feet) in the Himalaya Mountains, climbers have found fossilized marine shells in the surface bedrock. From this observation, which statement is the best inference about the origin of the Himalaya Mountains?

A) The Himalaya Mountains were formed by volcanic activity.
B) Sea level has been lowered more than 29,000 feet since the shells were fossilized.
C) The bedrock containing the fossil shells is part of an uplifted seafloor.
D) The Himalaya Mountains formed at a divergent plate boundary.

34. The epicenter of an earthquake is located 6,500 kilometers away from a seismic station. If the first \( S \)-wave arrived at this seismic station at 1:30 p.m., at what time did the first \( P \)-wave arrive?

A) 1:20 p.m. B) 1:22 p.m. C) 1:38 p.m. D) 1:40 p.m.

35. The arrival time of the first earthquake \( P \)-wave at a seismograph station was 10:11:20 (hours:minutes:seconds). If the epicenter of the earthquake is 8000 km away, what was the approximate arrival time of the first \( S \)-wave from this earthquake?

A) 10:02:00 B) 10:09:20 C) 10:20:40 D) 10:32:00

36. What is the approximate time difference between the first \( P \)-wave and the first \( S \)-wave recorded at a seismic station located 8000 kilometers from an earthquake’s epicenter?

A) 8 minutes 40 seconds B) 9 minutes 20 seconds C) 11 minutes 20 seconds D) 20 minutes 40 seconds

37. The first \( S \)-wave arrived at a seismograph station 11 minutes after an earthquake occurred. How long after the arrival of the first \( P \)-wave did this first \( S \)-wave arrive?

A) 9:55:00 B) 10:05:40 C) 10:07:05 D) 10:12:40

38. A seismic station 4000 kilometers from the epicenter of an earthquake records the arrival time of the first \( P \)-wave at 10:00:00. At what time did the first \( S \)-wave arrive at this station?

A) 5 min 40 sec B) 7 min 0 sec C) 12 min 40 sec D) 13 min 20 sec

39. How long would it take for the first \( S \)-wave to arrive at a seismic station 4,000 kilometers away from the epicenter of an earthquake?

A) 5 min 40 sec B) 7 min 0 sec C) 12 min 40 sec D) 13 min 20 sec
40. An earthquake’s magnitude can be determined by
A) analyzing the seismic waves recorded by a seismograph
B) calculating the depth of the earthquake faulting
C) calculating the time the earthquake occurred
D) comparing the speed of P-waves and S-waves

41. A huge undersea earthquake off the Alaskan coastline could produce a
A) tsunami B) cyclone C) hurricane D) thunderstorm

42. What usually causes tsunamis?
A) hurricanes B) high-pressure weather systems C) undersea earthquakes D) the collision of ocean currents

43. An earthquake's P-wave traveled 4,800 kilometers and arrived at a seismic station at 5:10 p.m. At approximately what time did the earthquake occur?
A) 5:02 p.m. B) 5:08 p.m. C) 5:10 p.m. D) 5:18 p.m.

44. A P-wave reaches a seismograph station 2,600 kilometers from an earthquake epicenter at 12:10 p.m. At what time did the earthquake occur?
A) 12:01 p.m. B) 12:05 p.m. C) 12:15 p.m. D) 12:19 p.m.

45. Rifting of tectonic plates in eastern North America during the Jurassic Period was responsible for the
A) formation of the Catskill delta B) first uplift of the Adirondack Mountains C) Alleghenian orogeny D) opening of the Atlantic Ocean

46. Which surface feature was produced by crustal movements at a transform plate boundary?
A) East African Rift B) Aleutian Trench C) Tasman Hot Spot D) San Andreas Fault

47. Which of the following is located at a converging plate boundary?
A) Southwest Indian Ridge B) Iceland Hotspot C) Marianas Trench D) Sandwich Plate

48. Which observation about the Mid-Atlantic Ridge region provides the best evidence that the seafloor has been spreading for millions of years?
A) The bedrock of the ridge and nearby seafloor is igneous rock.
B) The ridge is the location of irregular volcanic eruptions.
C) Several faults cut across the ridge and nearby seafloor.
D) Seafloor bedrock is younger near the ridge and older farther away.

49. Which information indicates that new seafloor rock is forming along a mid-ocean ridge and then moving horizontally away from the ridge?
A) Most volcanoes are located under ocean water.
B) Seafloor rock is older than continental rock.
C) Fossils of marine organisms can be found at high elevations on continents
D) The age of seafloor rock increases as the distance from the mid-ocean ridge increases.

50. Based on the theory of plate tectonics, it is inferred that over the past 250 million years North America has moved toward the
A) northwest B) southwest C) southeast D) northeast

51. Which mountain range resulted from the collision of North America and Africa, as parts of Pangea joined together in the late Pennsylvanian Period?
A) Appalachian Mountains B) Acadian Mountains C) Taconic Mountains D) Grenville Mountains

52. During which era did the initial opening of the present-day Atlantic Ocean most likely occur?
A) Cenozoic B) Mesozoic C) Paleozoic D) Late Proterozoic

53. Alternating parallel bands of normal and reversed magnetic polarity are found in the basaltic bedrock on either side of the
A) Mid-Atlantic Ridge B) Yellowstone Hot Spot C) San Andreas Fault D) Peru-Chile Trench
54. Base your answer to the following question on the information, map, and cross section below.

The map represents a portion of Earth's surface in the Pacific Ocean. The positions of islands, earthquake epicenters, active volcanoes, and the Tonga Trench are shown. Lines of latitude and longitude have been included.

The cross section shows earthquakes that occurred beneath line XY on the map. Depth beneath Earth's surface is indicated by the scale along the left side of the cross section, as are the range of depths for shallow, intermediate, and deep earthquakes. Distance from the trench is indicated by the scale along the bottom of the cross section.

The Tonga Trench is located at the tectonic boundary between the Pacific Plate and the

A) Antarctic Plate  B) Philippine Plate
C) Indian-Australian Plate  D) Nazca Plate

55. Base your answer to the following question on the passage below.

**Crustal Activity at Mid-Ocean Ridges**

Mid-ocean ridges are found at one type of tectonic plate boundary. These ridges consist of extensive underwater mountain ranges split by rift valleys. The rift valleys mark places where two crustal plates are pulling apart, widening the ocean basins, and allowing magma from the asthenosphere to move upward. In some cases, mid-ocean ridges have migrated toward nearby mantle hot spots. This explains why mid-ocean ridges and mantle hot spots are found together at several locations.

Which mantle hot spot is located closest to a mid-ocean ridge?

A) Canary Islands  B) Easter Island  C) Hawaii  D) Tasman
56. The map below shows a portion of Earth's surface. Points $X$ and $Y$ are locations on the lithosphere.

Which cross section shows the inferred movement of material in the asthenosphere beneath points $X$ and $Y$?

A) The rocks of the ocean floor and the continents have similar origins.
B) In the ocean floor, rocks near the mid-ocean ridge are cooler than rocks near the continents.
C) The pattern of magnetic orientation of rocks is similar on both sides of the mid-ocean ridge.
D) The density of oceanic crust is greater than the density of continental crust.

57. Which evidence supports the theory of ocean floor spreading?

A) The rocks of the ocean floor and the continents have similar origins.
B) In the ocean floor, rocks near the mid-ocean ridge are cooler than rocks near the continents.
C) The pattern of magnetic orientation of rocks is similar on both sides of the mid-ocean ridge.
D) The density of oceanic crust is greater than the density of continental crust.
58. The diagram below represents the pattern of normal and reversed magnetic polarity and the relative age of the igneous bedrock composing the ocean floor on the east side of the Mid-Atlantic Ridge. The magnetic polarity of the bedrock on the west side of the ridge has been deliberately left blank.

Which diagram best shows the magnetic pattern and relative age of the igneous bedrock on the west side of the ridge?

A) 

B) 

C) 

D)
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Answer Key
Review - Plate Tectonics