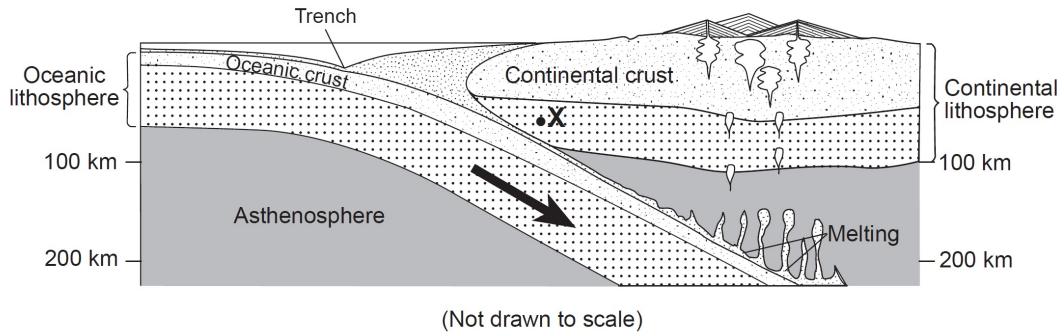


1. In which area of Earth's interior is the pressure most likely to be 2.5 million atmospheres?

- A) asthenosphere      B) stiffer mantle  
C) inner core          **D) outer core**

Base your answers to questions 2 and 3 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.



2. 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

3. Point X is located in which Earth layer?

- A) rigid mantle**    B) stiffer mantle    C) asthenosphere    D) outer core

4. Which temperature is inferred to exist in Earth's plastic mantle?

- A) 2000°C**      B) 3000°C  
C) 5000°C      D) 6000°C

5. In which layer of Earth's interior is the pressure inferred to be 1.0 million atmospheres?

- A) outer core      B) inner core  
C) rigid mantle      **D) stiffer mantle**

6. The source of energy for the high temperatures found deep within the Earth is

- A) tidal friction  
B) incoming solar radiation  
**C) decay of radioactive materials**  
D) meteorite bombardment of the Earth

7. As depth within the Earth's interior increases, the

- A) density, temperature, and pressure decrease  
**B) density, temperature, and pressure increase**  
C) density and temperature decrease, but pressure increases  
D) density decreases, but temperature and pressure increase

8. A part of which zone of the Earth's interior is inferred to have a density of 10.0 grams per cubic centimeter?

- A) crust      B) mantle  
**C) outer core**      D) inner core

9. What is the inferred temperature at the boundary between Earth's stiffer mantle and outer core?

- A) 2,500°C      B) 4,500°C  
**C) 5,000°C**      D) 6,200°C

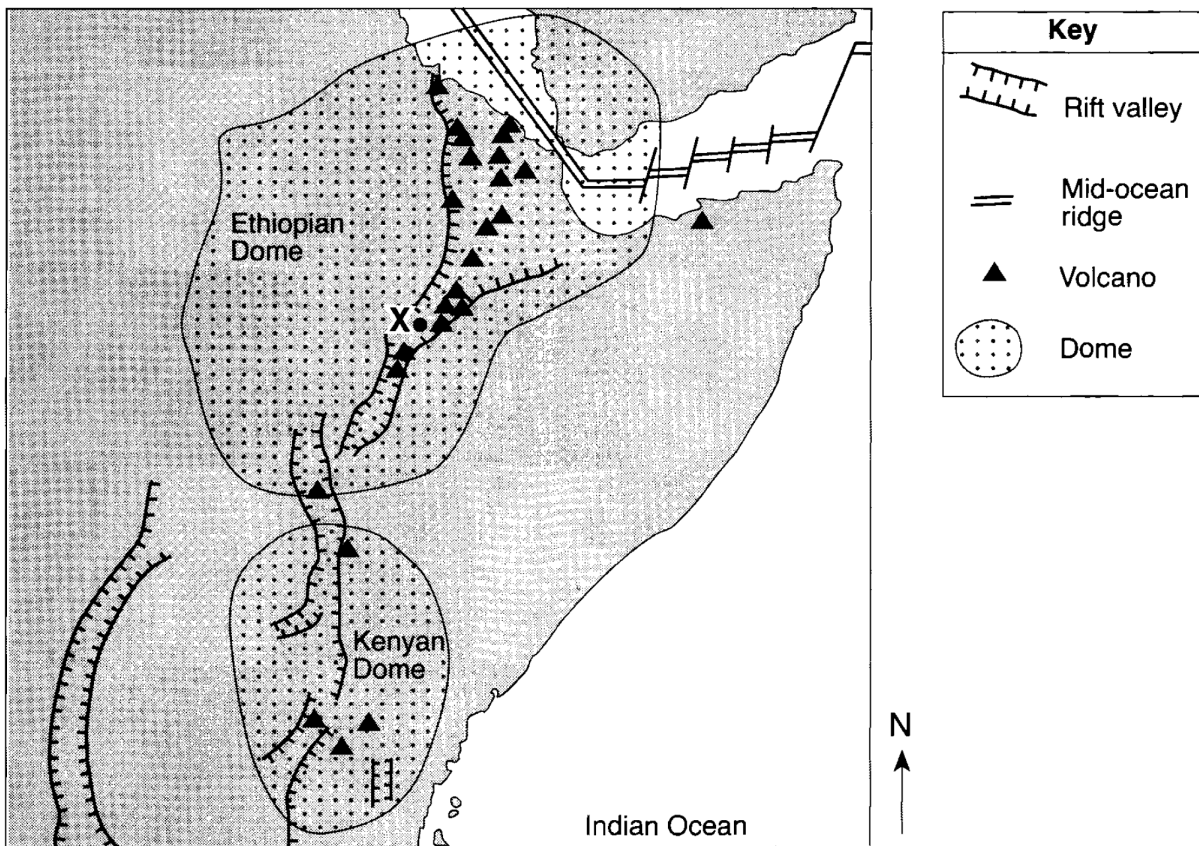
- 
10. The pressure at the interface between the mantle and the outer core of Earth is inferred to be approximately
- A) 1.0 million atmospheres
  - B) 1.4 million atmospheres**
  - C) 3.0 million atmospheres
  - D) 3.4 million atmospheres
11. The inferred temperature at the interface between the stiffer mantle and the asthenosphere is closest to
- A) 1000°C
  - B) 2500°C**
  - C) 4500°C
  - D) 5000°C
12. In which group are the zones of the Earth's interior correctly arranged in order of increasing average density?
- A) crust, mantle, outer core, inner core**
  - B) crust, mantle, inner core, outer core
  - C) inner core, outer core, mantle, crust
  - D) outer core, inner core, mantle, crust
13. Which statement best explains why the direction of some seismic waves changes sharply as the waves travel through the Earth?
- A) The Earth is spherical.
  - B) Seismic waves tend to travel in curved paths.
  - C) The temperature of the Earth's interior decreases with depth.
  - D) Different parts of the Earth's interior have different densities.**
-

14. Base your answer to the following question on the passage and map of a portion of the East African Rift system shown below. Point *X* represents a location on Earth's surface within a rift valley on the Ethiopian Dome.

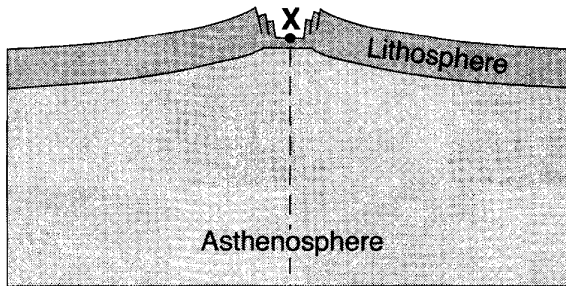
## The Great Rift Valley

Rifting of Earth's crust in eastern Africa began during the Neogene Period as the Ethiopian and Kenyan Domes formed. These two huge domes were created as Earth's mantle pushed up the overlying crust. As the crust was forced upward, the resulting tension cracked the crust, resulting in the eruption of volcanoes and the formation of large rifts. The crust continued to pull apart, forming rift valleys. These valleys have become deeper and are currently becoming filled with sediments, igneous rock, and water.

East African Rift System



On the cross section below, draw *two* curved arrows, one on each side of the dashed line, to show the direction of movement of the convection currents within the asthenosphere that caused the formation of the dome and the rift valley near location *X*.

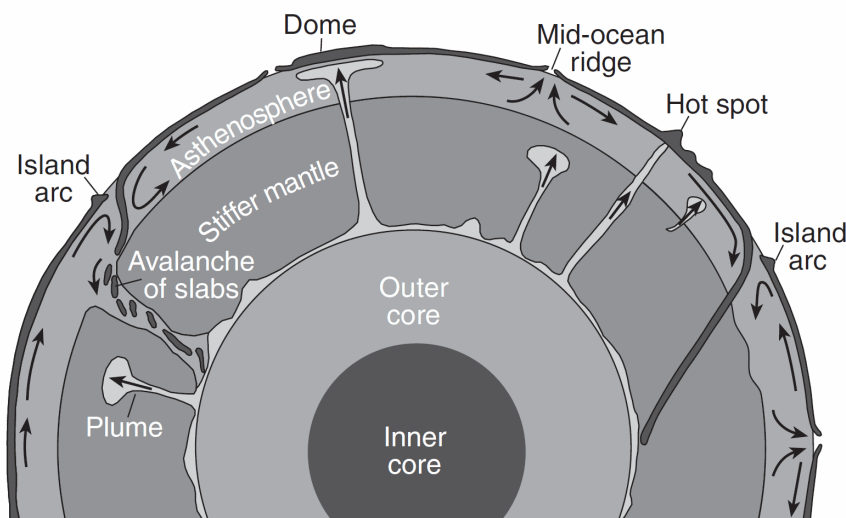


15. Many scientists infer the composition of the Earth's core to be similar to the composition of
- A) **metallic meteorites**
  - B) Moon rocks
  - C) the mantle
  - D) the oceanic crust
16. The density of Earth's crust is
- A) less than the density of the outer core but greater than the density of the mantle
  - B) greater than the density of the outer core but less than the density of the mantle
  - C) **less than the density of both the outer core and the mantle**
  - D) greater than the density of both the outer core and the mantle
17. The inferred temperature and pressure of Earth's interior at a depth of 3,000 kilometers are approximately
- A) 1000°C and 0.5 million atmospheres
  - B) 1000°C and 1.0 million atmospheres
  - C) **5000°C and 1.5 million atmospheres**
  - D) 5000°C and 3.0 million atmospheres
18. Most inferences about the characteristics of Earth's mantle and core are based on
- A) **the behavior of seismic waves in Earth's interior**
  - B) well drillings from Earth's mantle and core
  - C) chemical changes in exposed and weathered metamorphic rocks
  - D) comparisons between Moon rocks and Earth rocks
19. Andrija Mohorovicic discovered the interface between the crust and the mantle that is now named for him. His discovery of the "Moho" was based on analysis of
- A) landscape boundaries
  - B) continental coastlines
  - C) erosional surfaces
  - D) **seismic waves**

Base your answers to questions 20 through 22 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.



(Not drawn to scale)

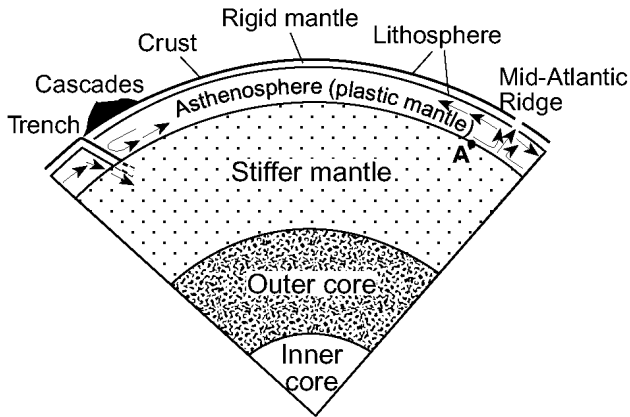
20. Compared to the surrounding material, mantle plumes rise toward Earth's surface from the core-mantle boundary because they are
- A) cooler and less dense                      B) cooler and more dense  
C) **hotter and less dense**                      D) hotter and more dense
21. At which depth below Earth's surface is the boundary between Earth's outer core and stiffer mantle located?
- A) 700 km              B) 2000 km              C) **2900 km**              D) 5100 km
22. The basaltic rock that forms volcanic mountains where mantle plumes reach Earth's surface is usually composed of
- A) fine-grained, dark-colored felsic minerals  
B) **fine-grained, dark-colored mafic minerals**  
C) coarse-grained, light-colored felsic minerals  
D) coarse-grained, light-colored mafic minerals

23. Scientists have inferred the structure of Earth's interior mainly by analyzing

- A) the Moon's interior
- B) the Moon's composition
- C) Earth's surface features

**D) Earth's seismic data**

24. Base your answer to the following question on the diagram below, which shows a portion of Earth's interior. Point *A* is a location on the interface between layers.



(Not drawn to scale)

The temperature of rock at location *A* is approximately

- A) 600°C
- B) 1,000°C
- C) **2,600°C**
- D) 3,000°C

25. What caused the interior of Earth to separate into layers?

- A) a decrease in the rate of rotation of Earth
- B) the gravitational pull on materials of varying densities**
- C) variations in heating by the Sun due to Earth's tilt
- D) collisions with meteors and comets

26. What is the range of pressure in Earth's interior where rock with a density range of 9.9 to 12.2 g/cm<sup>3</sup> is found?

- A) 0.2 to 1.4 million atmospheres
- B) 0.8 to 2.3 million atmospheres
- C) 1.4 to 3.1 million atmospheres**
- D) 2.3 to 3.5 million atmospheres

27. Geologists have used information about the composition of meteorites to make inferences about Earth's

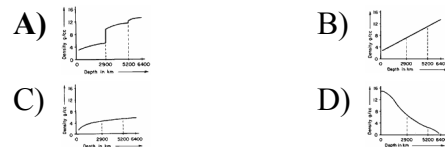
**A) core properties**

- B) atmospheric structure
- C) asthenosphere location
- D) continental-crust thickness

28. Compared to Earth's crust, Earth's core is believed to be

- A) less dense, cooler, and composed of more iron
- B) less dense, hotter, and composed of less iron
- C) more dense, hotter, and composed of more iron**
- D) more dense, cooler, and composed of less iron

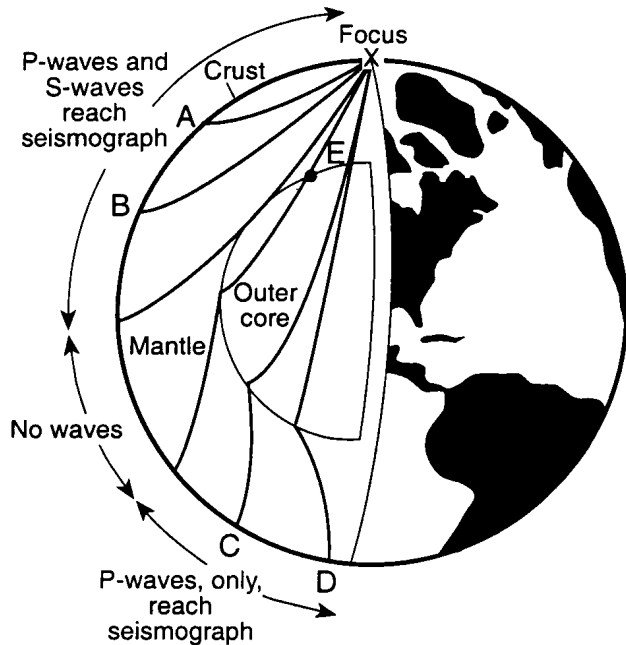
29. Which graph best represents the relationship between depth and density for the Earth's interior?



30. Which combination of temperature and pressure is inferred to occur within Earth's stiffer mantle?

- A) 3500°C and 0.4 million atmospheres**
- B) 3500°C and 2.0 million atmospheres
- C) 5500°C and 0.4 million atmospheres
- D) 5500°C and 2.0 million atmospheres

31. Base your answer to the following question on the diagram below, which shows a cutaway view of Earth in which the interior layers are visible. The paths of earthquake waves generated at point *X* are shown. *A*, *B*, *C*, and *D* are locations of seismic stations on Earth's surface, and point *E* is located in Earth's interior.

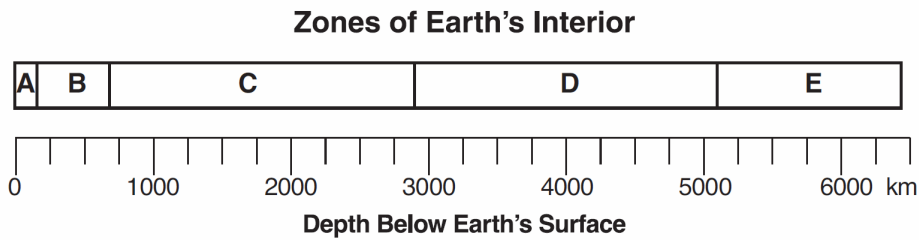


The actual rock temperature at point *E* is inferred to be approximately

- A) 1,500°C                      B) 2,900°C  
 C) 5,000°C                      D) 6,200°C
32. What are the inferred pressure and temperature at the boundary of Earth's stiffer mantle and outer core?
- A) 1.5 million atmospheres pressure and an interior temperature of 4950°C  
 B) 1.5 million atmospheres pressure and an interior temperature of 6200°C  
 C) 3.1 million atmospheres pressure and an interior temperature of 4950°C  
 D) 3.1 million atmospheres pressure and an interior temperature of 6200°C

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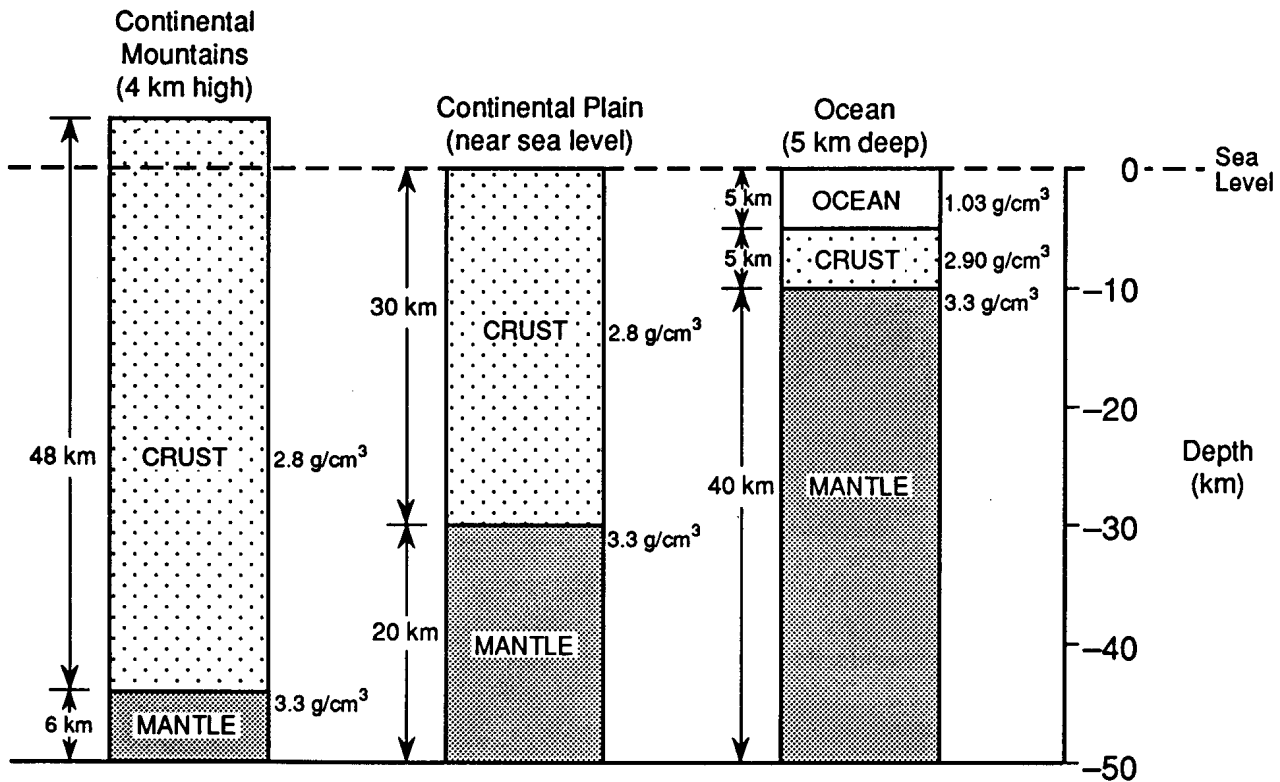
Base your answers to questions 33 and 34 on the diagram below, which represents zones of Earth's interior, identified by letters *A* through *E*. The scale shows depths below Earth's surface, measured in kilometers.



33. Which zone is characterized by partially melted rock and large-scale convection currents?
- A) zone *A*      **B) zone *B***      C) zone *C*      D) zone *E*
34. Which zone of Earth's interior has a density closest to the densities of the other terrestrial planets?
- A) zone *A*      B) zone *E*      **C) zone *C***      D) zone *D*
- 
35. 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
36. The *rate* of temperature increase below the Earth's surface is greatest between depths of
- A) **250 and 500 km**    B) 1500 and 2500 km  
C) 2500 and 3500 km    D) 3500 and 4000 km
37. What is the relationship between density, temperature, and pressure inside the Earth?
- A) As depth increases, density, temperature, and pressure decrease.  
B) As depth increases, density and temperature increase, but pressure decreases.  
C) As depth increases, density increases, but temperature and pressure decrease.  
**D) As depth increases, density, temperature, and pressure increase.**
-



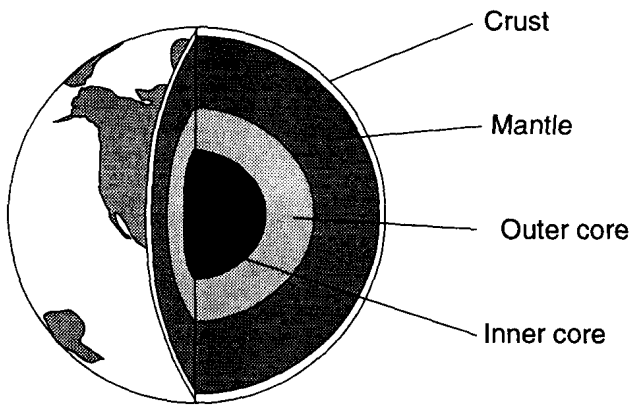
38. Base your answer to the following question on the diagram below which represents three cross sections of the Earth at different locations to a depth of 50 kilometers below sea level. The measurements given with each cross section indicate the thickness and the density of the layers.



In which group are the layers of the Earth arranged in order of increasing average density?

- A) mantle, crust, ocean water                      B) crust, mantle, ocean water  
 C) ocean water, mantle, crust                      D) **ocean water, crust, mantle**
- 
39. At 4,500 kilometers below the surface of the Earth, the pressure is estimated to be
- A) 1.4 million atmospheres  
 B) 2.0 million atmospheres  
 C) **2.8 million atmospheres**  
 D) 3.1 million atmospheres
40. At a depth of 2,000 kilometers, the temperature of the stiffer mantle is inferred to be
- A) 6,500°C                      B) **4,200°C**  
 C) 3,500°C                      D) 1,800°C
41. What is the approximate temperature at the mantle-outer core boundary?
- A) 1,500°C                      B) 4,500°C  
 C) **5,000°C**                      D) 7,000°C

Base your answers to questions 42 through 44 on the diagram below which represents Earth's interior zones.

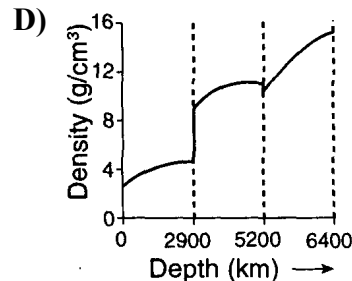
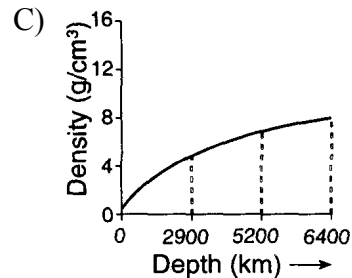
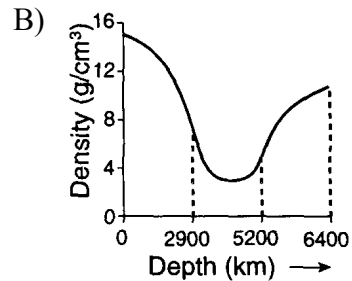
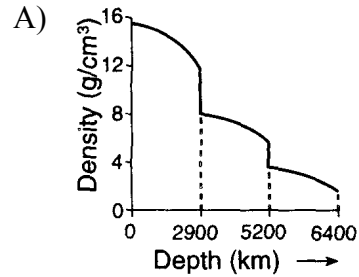


( Not drawn to scale )

42. In which layer of Earth's interior is the inferred temperature 6,000°C?

- A) crust                      B) mantle  
 C) **outer core**              D) inner core

43. Which graph best represents the relationship between depth below Earth's surface and density?



44. The composition of Earth's core is thought to be the same as the composition of many

- A) **meteorites**              B) volcanic ashes  
 C) granites                  D) basalts

45. Which statement about the Earth's mantle is correct?

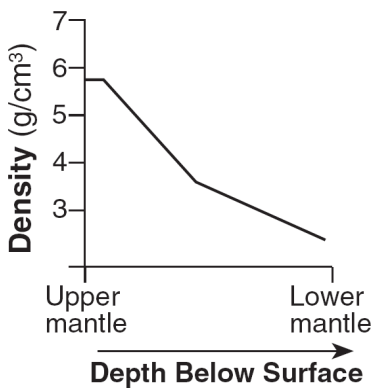
- A) The density of the mantle is greatest 300 km below the Earth's surface.  
 B) The highest temperatures within the Earth occur in the mantle.  
 C) The greatest pressures within the Earth exist in the mantle.  
 D) **The temperature of the mantle 300 km below the Earth's surface is very near its melting point.**

46. Theories about the composition of the Earth's core are supported by meteorites that are composed primarily of

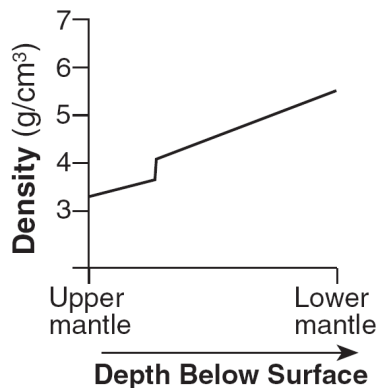
- A) oxygen and silicon
- B) aluminum and iron
- C) aluminum and oxygen
- D) iron and nickel**

47. Which graph best shows the inferred density of Earth's interior as depth increases from the upper mantle to the lower mantle?

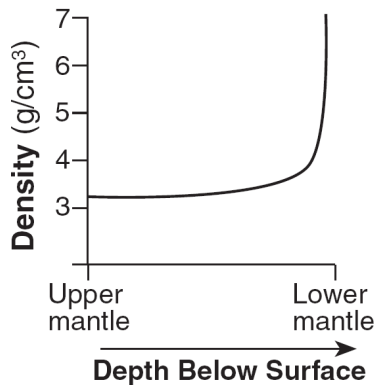
A)



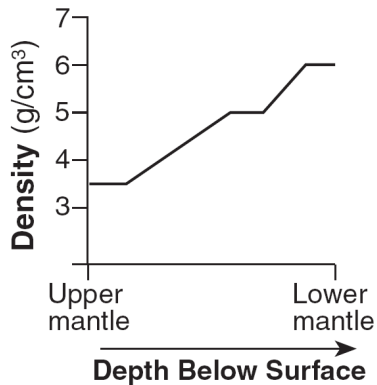
B)



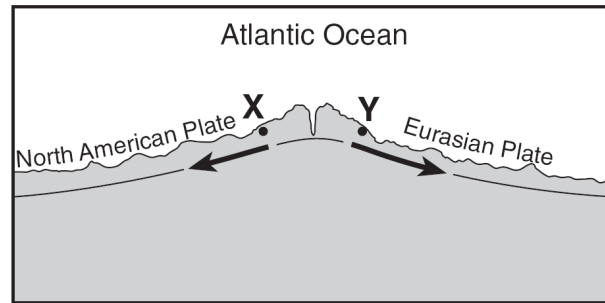
C)



D)

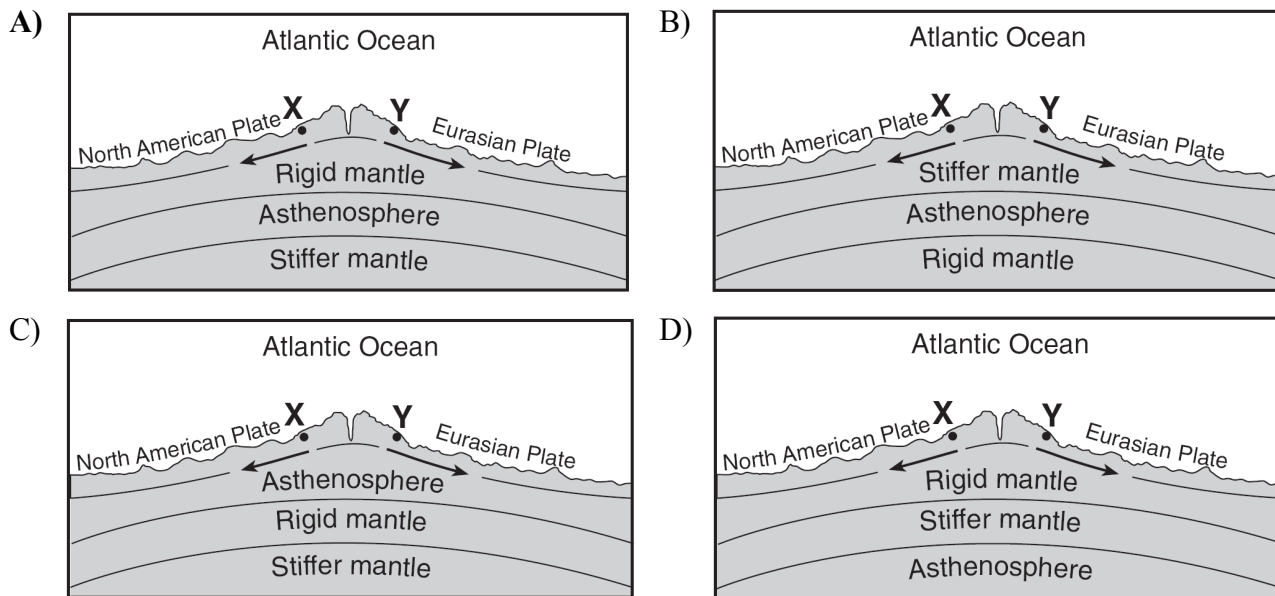


48. Base your answer to the following question on cross section below, which shows an underwater mountain range in the Atlantic Ocean. The oceanic bedrock is composed mainly of basalt. Points *X* and *Y* are locations in the bedrock that have been diverging at the same rate. The movement of the North American Plate and Eurasian Plate is shown by the two arrows.



( Not drawn to scale)

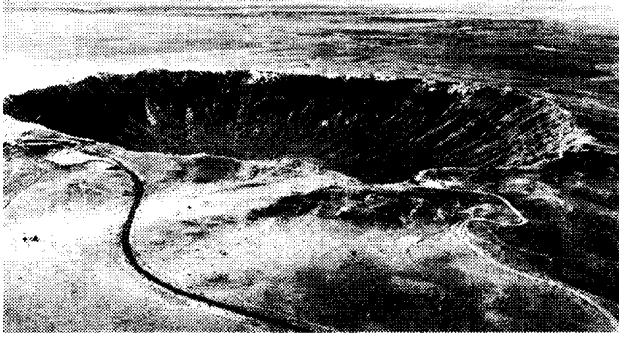
Which cross section best represents the relative locations of Earth's asthenosphere, rigid mantle, and stiffer mantle? (The cross sections are not drawn to scale.)



49. Why does the oceanic crust sink beneath the continental crust at a subduction boundary?
- A) **The oceanic crust has a greater density.**
  - B) The oceanic crust is pulled downward by Earth's magnetic field.
  - C) The continental crust has a more mafic composition.
  - D) The continental crust is pulled upward by the Moon's gravity.

50. Which conditions normally can be found in Earth's asthenosphere, producing a partial melting of ultramafic rock?
- A) temperature = 1,000°C; pressure = 10 million atmospheres
  - B) temperature = 2,000°C; pressure = 0.1 million atmospheres**
  - C) temperature = 3,500°C; pressure = 0.5 million atmospheres
  - D) temperature = 6,000°C; pressure = 4 million atmospheres

- 
51. The photograph below shows a large crater located in the southwestern United States.

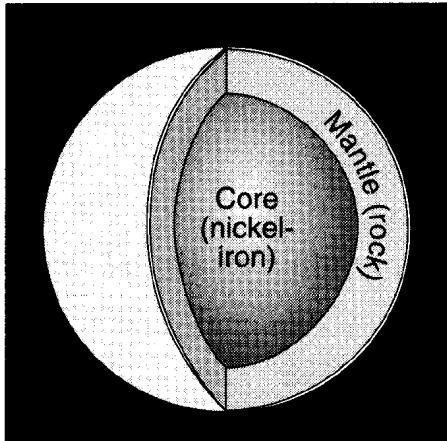


Some fragments taken from the site have a nickel-iron composition. This evidence indicates that the crater probably was formed by

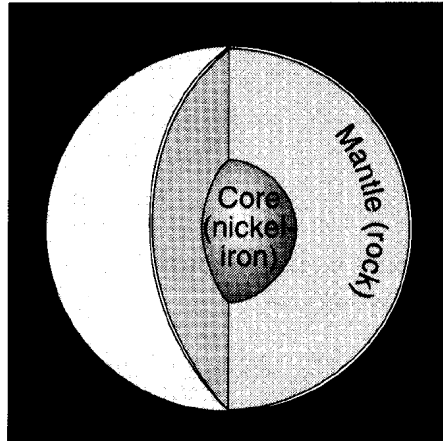
- A) **the impact of a meteorite from space**
  - B) the collapse of a cavern roof
  - C) an eruption of a volcano
  - D) an underwater explosion of steam
52. When a continental crustal plate collides with an oceanic crustal plate, the continental crust is forced to move over the oceanic crust. What is the primary reason that the continental crust stays on top of the oceanic crust?
- A) **Continental crust is less dense.**
  - B) Continental crust deforms less easily.
  - C) Continental crust melts at higher temperatures.
  - D) Continental crust contains more mafic minerals.
53. 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
54. The temperature of rock located 1,000 kilometers below the Earth's surface is about
- A) 200 K
  - B) 2,100 K
  - C) 2,800 K
  - D) **3,200 K**
-

55. The diagram below shows the cutaway views of the inferred interior layers of the planets Mercury and Venus.

**Mercury**



**Venus**



(Not drawn to scale)

What is the reason for the development of the interior layers of these two planets?

- A) Impact events added the mantle rock above the cores.
- B) Heat from the Sun melted the surface rocks to form the mantles above the cores.
- C) Gravity separated the cores and mantles due to their density differences.**
- D) Rapid heat loss caused the cores to solidify before the mantles.

56. In which part of the Earth is a rock temperature of 2,000°C most likely to occur?

- A) continental crust
- B) asthenosphere (plastic mantle)**
- C) stiffer mantle
- D) outer core

57. An earthquake shear wave generally travels faster as the wave moves deeper into Earth's interior because greater depths have

- A) less confining pressure
- B) lower melting points
- C) greater rock density**
- D) greater rock temperatures

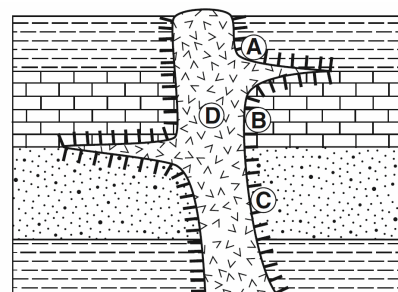
58. The temperature at the center of the Earth is estimated to be

- A) 1,000 K
- B) 2,800 K
- C) 5,000 K
- D) 6,800 K**

59. What happens to the density and temperature of rock within Earth's interior as depth increases?

- A) density decreases and temperature decreases
- B) density decreases and temperature increases
- C) density increases and temperature increases**
- D) density increases and temperature decreases

60. The cross section below represents a portion of Earth's crust. Letters A through D are locations within the rock units.



Key	
	Igneous intrusion
	Contact metamorphism

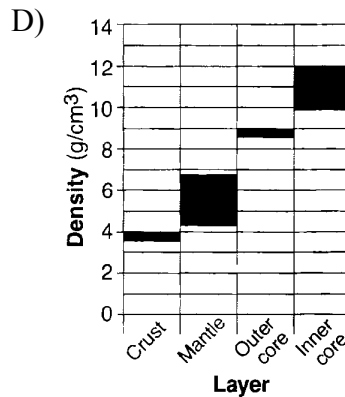
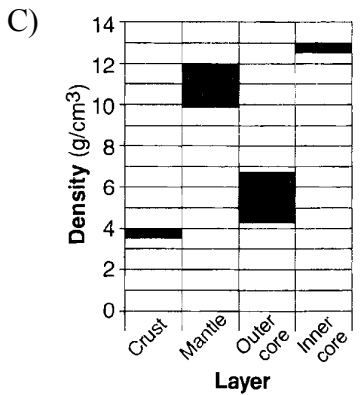
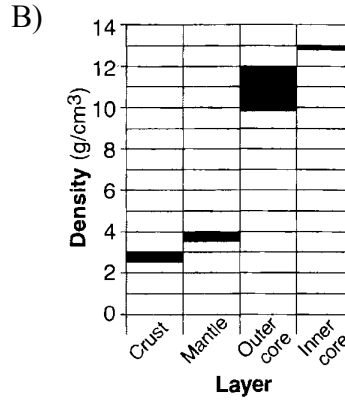
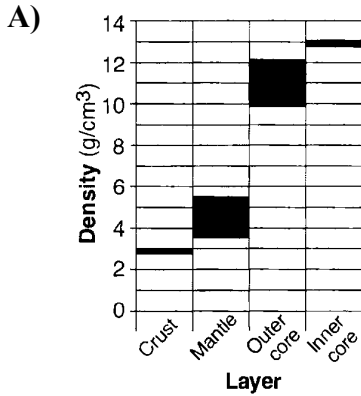
At which location is quartzite most likely found?

- A) A
- B) B
- C) C
- D) D

61. In which zone of the Earth's interior is the melting point of the rock inferred to be lower than the actual temperature of the rock?

- A) **outer core**                      B) inner core  
 C) crust                                D) mantle

62. Which graph best shows the range of density in each of Earth's layers?



63. The Earth's core is believed to be composed primarily of

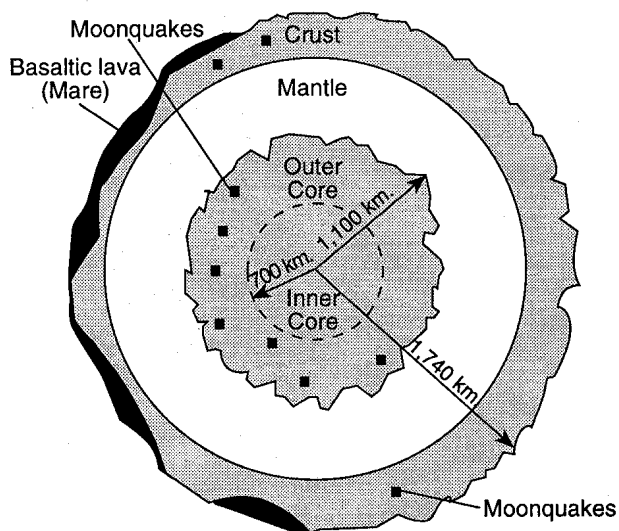
- A) oxygen and silicon  
 B) aluminum and silicon  
 C) **iron and nickel**  
 D) carbon and iron

64. Which statement correctly describes the density of Earth's mantle compared to the density of Earth's core and crust?

- A) **The mantle is less dense than the core but more dense than the crust.**  
 B) The mantle is less dense than both the core and the crust.  
 C) The mantle is more dense than the core but less dense than the crust.  
 D) The mantle is more dense than both the core and the crust.

65. Base your answer to the following question on the information and the cross section below. The cross section represents a possible model of the Moon's interior.

Seismographs left on the Moon by astronauts have provided enough data to develop a model of the Moon's interior. Scientists believe that the Moon has a layered interior and that its crustal thickness varies greatly from one side of the Moon to the other.



If the pressure, temperature, and density patterns of the Moon's interior are similar to those of the Earth's interior, which statement best describes the Moon's characteristics?

- A) **Pressure, temperature, and density all increase with depth.**
- B) Pressure increases with depth, but temperature and density remain the same.
- C) Pressure and temperature increase with depth, but density remains the same.
- D) Pressure, temperature, and density remain the same at all depths.
66. Approximately how far below the Earth's surface is the interface between the mantle and the outer core?
- A) 5 to 30 km            B) 700 to 900 km
- C) **2,900 to 3,000 km**    D) 5,000 to 5,200 km
67. Earth's outer core and inner core are both inferred to be
- A) liquid
- B) solid
- C) **composed of a high percentage of iron**
- D) under the same pressure