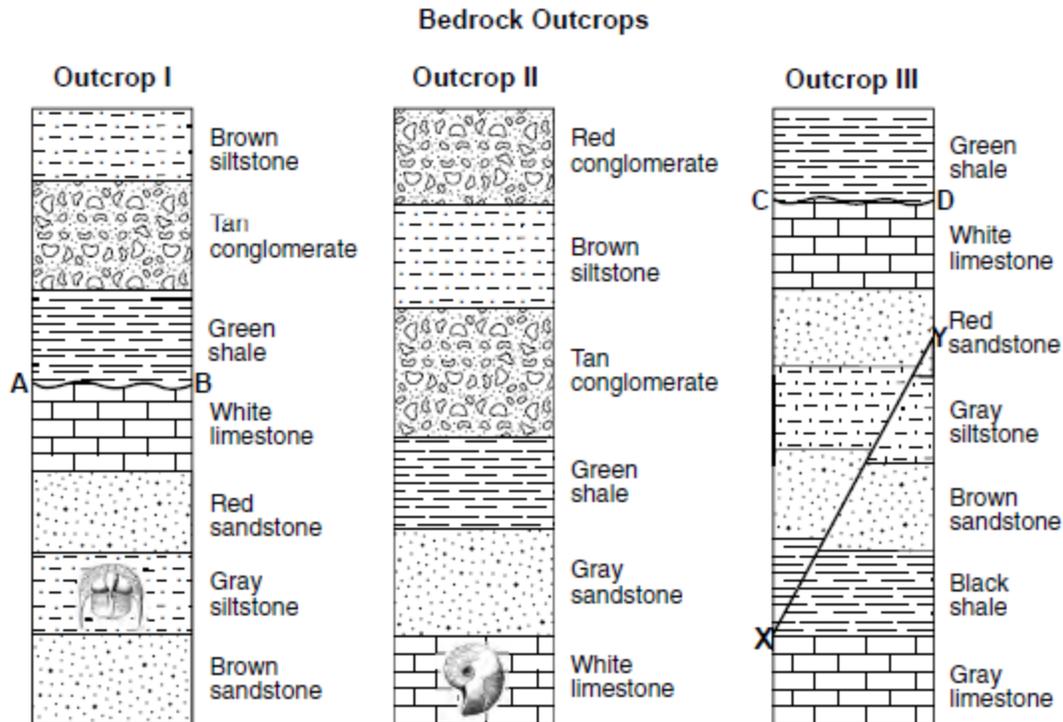


Base your answers to questions 1 through 4 on the three bedrock outcrops below and on your knowledge of Earth science. The outcrops, labeled I, II, and III, are located within 15 kilometers of each other. Lines *AB* and *CD* represent unconformities. Line *XY* represents a fault. No overturning of the layers has occurred.



1. Which processes produced the brown siltstone layer in outcrops I and II?
  - 1) cooling and solidification of mafic lava at Earth's surface
  - 2) cooling and solidification of felsic magma deep within Earth
  - 3) compaction and cementation of rock fragments ranging in size from 0.006 to 0.2 centimeter in diameter
  - 4) compaction and cementation of rock fragments ranging in size from 0.0004 to 0.006 centimeter in diameter
2. Based on evidence shown in the diagram, which rock layer is older than fault *XY*?
  - 1) tan conglomerate
  - 2) black shale
  - 3) brown siltstone
  - 4) white limestone
3. The unconformities at *AB* and *CD* resulted from
  - 1) uplift and erosion, followed by subsidence and deposition
  - 2) movement along a crack between two rock layers
  - 3) contact metamorphism between two sedimentary layers
  - 4) regional metamorphism of deeply buried sedimentary rocks
4. Which layer is the youngest?
  - 1) gray limestone
  - 2) red conglomerate
  - 3) brown siltstone
  - 4) brown sandstone

5. Which sequence of geologic events is in the correct order, from oldest to most recent?

- 1) oceanic oxygen begins to enter the atmosphere → earliest stromatolites → initial opening of the Iapetus Ocean → dome-like uplift of the Adirondack region begins
- 2) dome-like uplift of the Adirondack region begins → initial opening of the Iapetus Ocean → oceanic oxygen begins to enter the atmosphere → earliest stromatolites
- 3) initial opening of the Iapetus Ocean → earliest stromatolites → oceanic oxygen begins to enter the atmosphere → dome-like uplift of the Adirondack region begins
- 4) earliest stromatolites → oceanic oxygen begins to enter the atmosphere → initial opening of the Iapetus Ocean → dome-like uplift of the Adirondack region begins

6. Volcanic ash is a good geologic time marker because the ash

- 1) is deposited rapidly over a large area
- 2) spreads evenly in all compass directions
- 3) is easily weathered and eroded
- 4) remains in the atmosphere for millions of years

7. The map below shows the inferred shape of the North American landmass in the past. The location of Florida is labeled.



Which event was occurring on the Earth when Florida was located at the equator?

- 1) The dome-like uplift of the Adirondack region began.
  - 2) The earliest dinosaurs appeared on Earth.
  - 3) Oceanic oxygen began to enter the atmosphere.
  - 4) Earth's first coral reefs were forming.
8. Which event is inferred to have contributed to the significant global climate change that may have caused the mass extinctions of organisms at the end of the Late Cretaceous Epoch?
- 1) the Big Bang
  - 2) an asteroid impact
  - 3) formation of Pangaea
  - 4) shifting of Earth's magnetic poles

9. Which event is inferred by most scientists to be responsible for a climate change that has recently led to a *decrease* in the size of most glaciers?

- 1) a decrease in the rate of divergence of lithospheric plates along a mid-ocean ridge
- 2) a decrease in the amount of insolation reaching Earth's surface
- 3) an increase in the amount of greenhouse gases in Earth's atmosphere
- 4) an increase in the amount of vegetative cover in the tropics

10. The accumulation of water vapor, carbon dioxide, and nitrogen in Earth's early atmosphere approximately 4 billion years ago resulted mainly from

- 1) outgassing from Earth's interior
- 2) radioactive decay
- 3) photosynthesis by the earliest land plants
- 4) convection currents in Earth's outer core

11. Which plate tectonic events occurred as the Iapetus Ocean closed?

- 1) Taconian orogeny and Grenville orogeny
- 2) Taconian orogeny and Acadian orogeny
- 3) Alleghenian orogeny and Acadian orogeny
- 4) Alleghenian orogeny and Grenville orogeny

12. Which geologic event is inferred to have occurred most recently?

- 1) collision between North America and Africa
- 2) metamorphism of the bedrock of the Hudson Highlands
- 3) formation of the Queenston delta
- 4) initial opening of the Atlantic Ocean

Date:

Base your answers to questions 13 and 14 on the data table below and on your knowledge of Earth science. The data table shows information on six major mass extinction events that occurred many million years ago (mya) in Earth's history.

Some Major Mass Extinctions in Earth's History

Approximate Time (mya)	Certain Life-Forms That Became Extinct
65.5	all dinosaurs and all ammonoids
200	many species of nautiloids, ammonoids, mammal-like reptiles, and early dinosaurs
251	all trilobites and 90% of other marine species and 70% of land species
376	many species of corals, brachiopods, and trilobites
444	more than half of brachiopod species, many trilobite species, and some coral species
520	small shelly fossil species and some early trilobite species

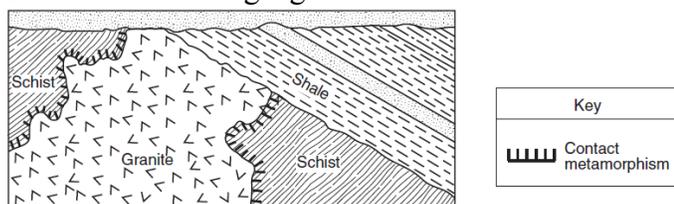
13. Which event is generally accepted as the cause of the mass extinction that occurred 65.5 million years ago?

- 1) volcanic eruption
- 2) continental collision
- 3) asteroid impact
- 4) sea-level change

14. More than half of brachiopod species became extinct at the end of the

- 1) Devonian Period
- 2) Silurian Period
- 3) Ordovician Period
- 4) Cambrian Period

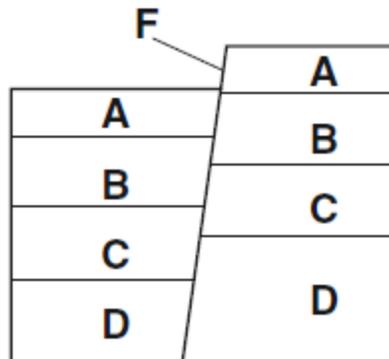
15. The geologic cross section below shows a complex structure containing a granite intrusion.



If the granite intrusion occurred 24 million years ago, what are the most probable ages of the schist and shale, in millions of years?

- 1) schist – 25; shale – 23
- 2) schist – 25; shale – 26
- 3) schist – 23; shale – 25
- 4) schist – 23; shale – 20

16. The cross section below shows rock layers A, B, C, D, and fault F. The rock layers have not been overturned.

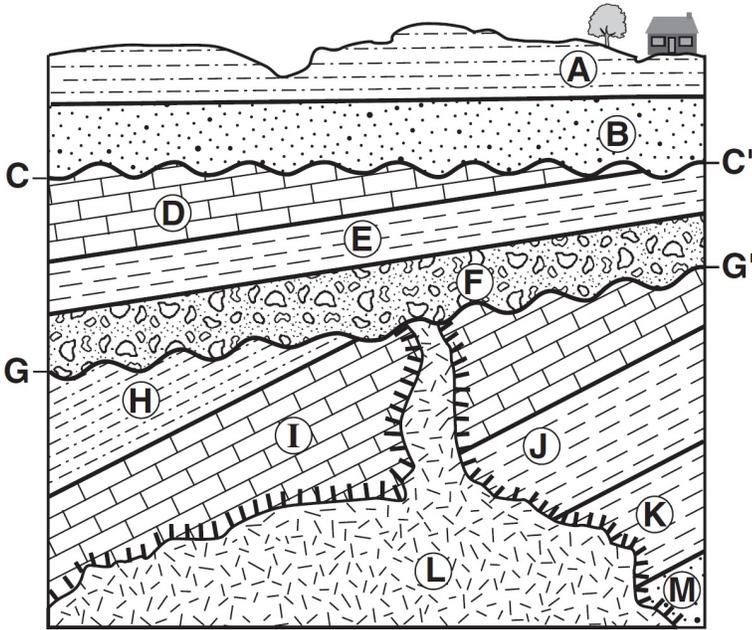


Which sequence places the rock layers and fault in order from oldest to youngest?

- 1)  $D \rightarrow C \rightarrow B \rightarrow A \rightarrow F$
- 2)  $A \rightarrow B \rightarrow C \rightarrow D \rightarrow F$
- 3)  $F \rightarrow D \rightarrow C \rightarrow B \rightarrow A$
- 4)  $F \rightarrow A \rightarrow B \rightarrow C \rightarrow D$

Date:

Base your answers to questions 17 through 20 on the cross section below and on your knowledge of Earth science. The cross section represents rock units that have *not* been overturned. Lines *CC'* and *GG'* represent unconformities. The geologic ages of some of the lettered rock units are shown below the cross section.



**Rock Unit Geologic Age**

B = Cretaceous Period  
E = Permian Period  
J = Silurian Period  
M = Cambrian Period

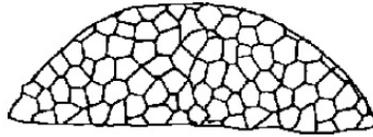
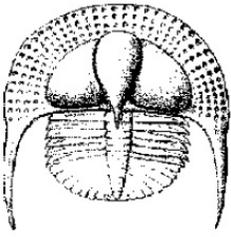
**Key**

 Igneous intrusion  
 Contact metamorphism

17. Which inference about rock units *D*, *E*, and *H* can best be supported by evidence in the cross section?

- 1) They contain mostly sand-sized sediment.
- 2) They contain both land and marine fossils.
- 3) They were altered by contact metamorphism.
- 4) They were deposited as horizontal layers and were later tilted.

18. The diagrams below represent three index fossils found in one of the rock units.



These fossils are most likely found in

- 1) rock unit *I*      2) rock unit *J*      3) rock unit *K*      4) rock unit *M*

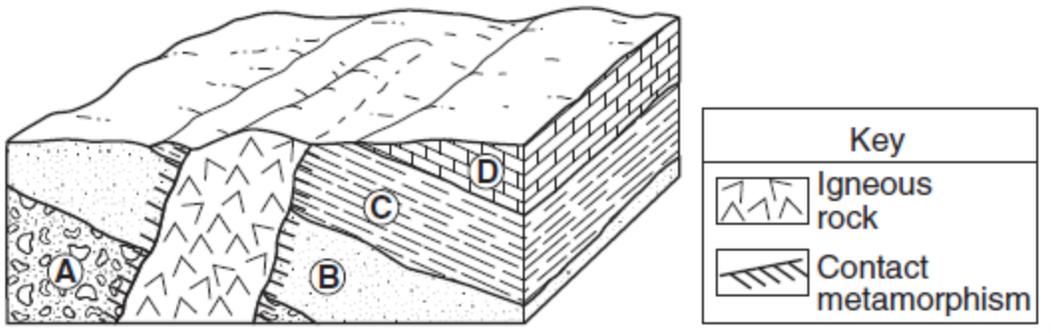
19. Why is there *no* contact metamorphism indicated between rock unit *L* and rock unit *F*?

- 1) Conglomerate does not metamorphose.
- 2) The intrusion was not hot enough to metamorphose rock unit *F*.
- 3) The contact metamorphism within rock unit *F* eroded away.
- 4) Rock unit *F* was deposited after the intrusion of rock unit *L*.

20. Which rock unit was formed most recently?

- 1) *A*                      2) *F*                      3) *L*                      4) *M*

21. Base your answer to the following question on "the block diagram below, which shows a portion of Earth's crust. Letters *A*, *B*, *C*, and *D* indicate sedimentary layers.



Which event occurred most recently?

- 1) formation of layer *A*
- 2) formation of layer *D*
- 3) tilting of all four sedimentary rock layers
- 4) erosion of the igneous rock exposed at the surface

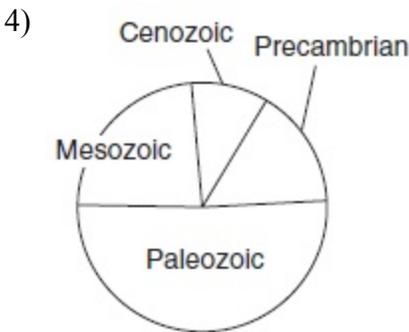
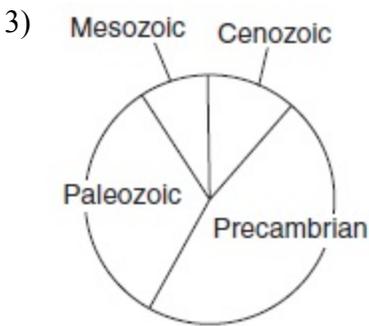
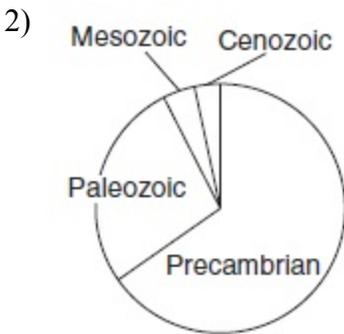
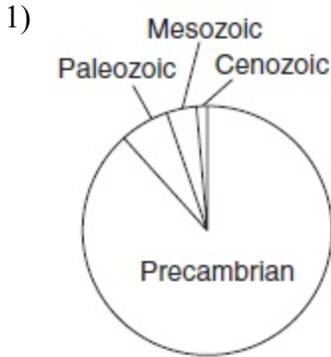
22. The New York State index fossil *Valcouroceras* is classified as a

- 1) coral                      2) crinoid  
3) eurypterid              4) nautiloid

23. According to the fossil record, which group of organisms has existed for the greatest length of time?

- 1) gastropods              2) corals  
3) mammals                4) vascular plants

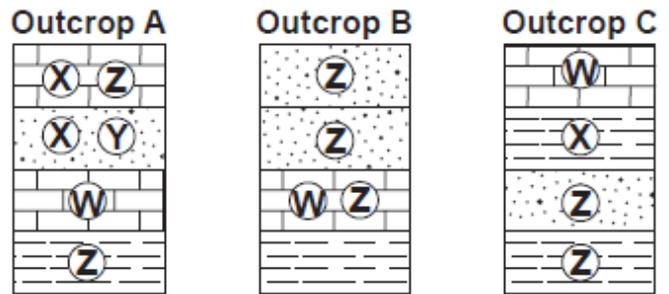
24. Which pie graph best shows the relative length of time of the major intervals of Earth's geologic history?



25. A volcanic ash layer between sedimentary rock layers is used by geologists to

- 1) determine Earth's absolute age
- 2) predict global warming
- 3) locate an earthquake epicenter
- 4) correlate widely separated rock formations

26. The cross sections below represent three widely separated bedrock outcrops labeled A, B, and C. Letters W, X, Y, and Z represent fossils found in the rock layers.

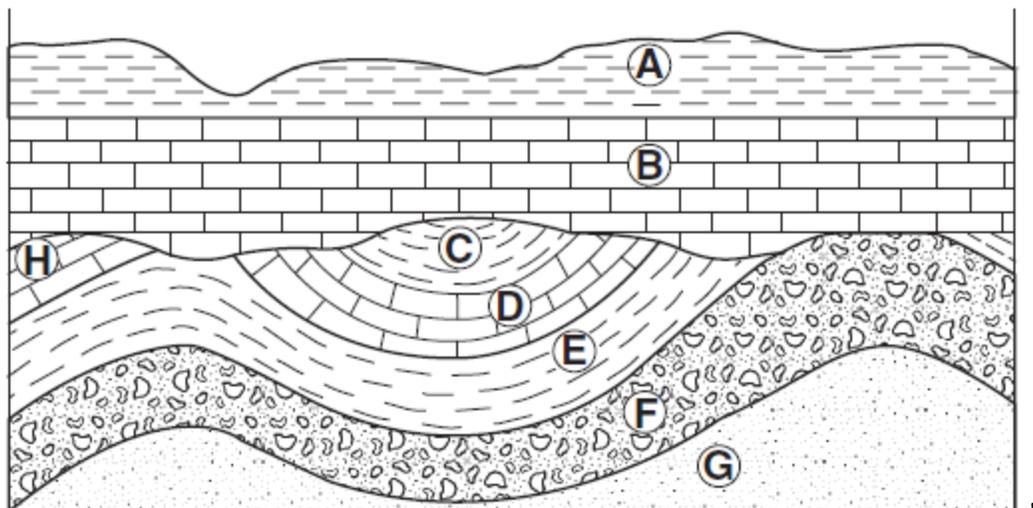


Which fossil could best be used as an index fossil?

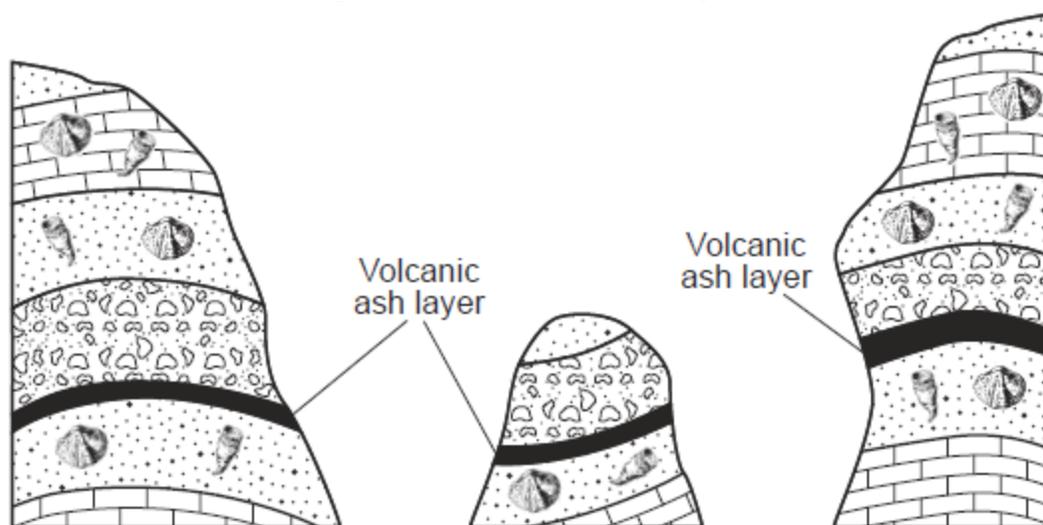
- 1) W    2) X    3) Y    4) Z
27. Organisms that later became good index fossils lived over a
- 1) wide geographic area and existed for a long geologic time
  - 2) wide geographic area and existed for a short geologic time
  - 3) limited geographic area and existed for a long geologic time
  - 4) limited geographic area and existed for a short geologic time
28. One reason *Tetragraptus* is considered a good index fossil is that *Tetragraptus*
- 1) existed during a large part of the Paleozoic Era
  - 2) has no living relatives found on Earth today
  - 3) existed over a wide geographic area
  - 4) has been found in New York State
29. During which geologic epoch does the New York State rock record consist of weakly consolidated to unconsolidated sediments?
- 1) Early Permian    2) Early Jurassic
  - 3) Late Cretaceous    4) Pliocene
30. Fossils of which type of animal would most likely be found in the surface bedrock of the Catskills?
- 1) reptiles    2) brachiopods
  - 3) mammals    4) birds

Date:

Base your answers to questions 31 and 32 on "the geologic cross section below in which overturning has not occurred. Letters *A* through *H* represent rock layers.



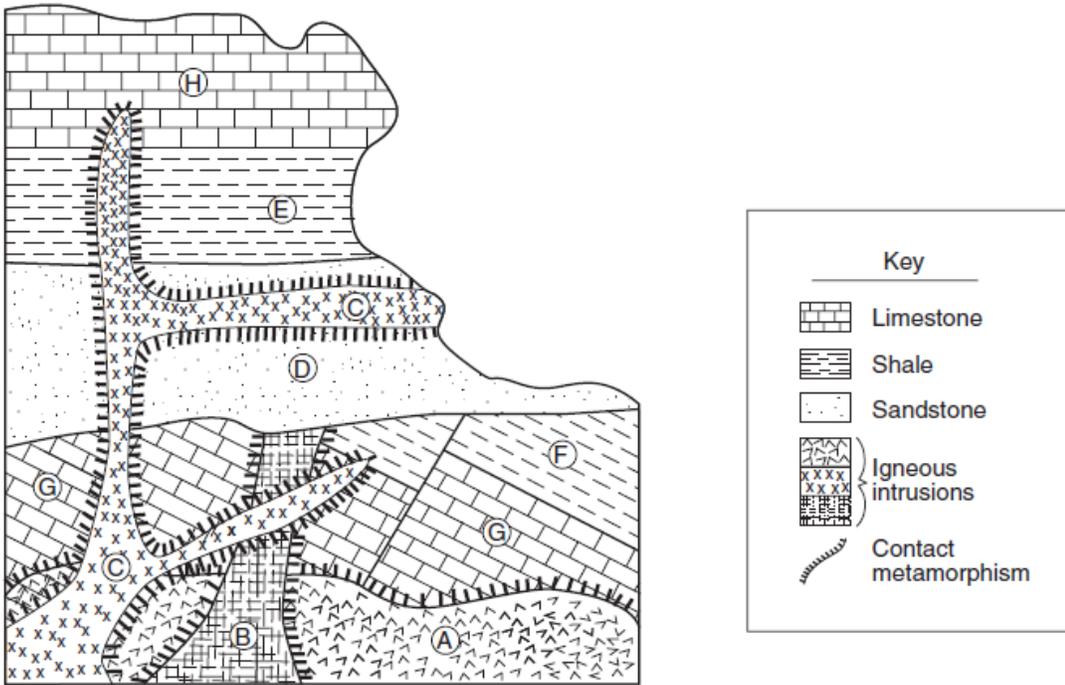
31. Which two letters represent bedrock of the same age?
- 1) *A* and *E*      2) *B* and *D*      3) *F* and *G*      4) *D* and *H*
32. The folding of rock layers *G* through *C* was most likely caused by
- 1) erosion of overlying sediments      2) contact metamorphism  
3) the collision of lithospheric plates      4) the extrusion of igneous rock
33. The cross sections below represent three bedrock outcrops found several kilometers apart.



Which statement best explains why the volcanic ash layers are useful for correlating the relative ages of the bedrock in the three outcrops?

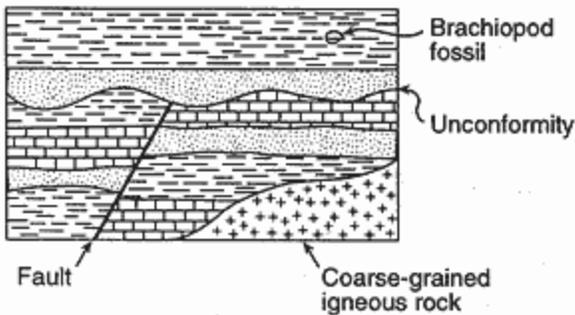
- 1) The ash was deposited over a large area when a volcano erupted.  
2) There are no fossils found within the volcanic ash.  
3) The volcanic eruptions that produced the ash layer occurred over a long period of geologic time.  
4) The volcanic ash is found between many different layers of bedrock.

Base your answers to questions 34 and 35 on "the diagram below, which shows a cross section of Earth's crust.



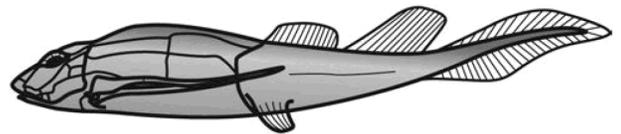
34. The most apparent buried erosional surface is found between rock units  
 1) *A* and *B*      2) *C* and *D*      3) *D* and *F*      4) *E* and *H*
35. Which statement gives an accurate age relationship for the bedrock in the cross section?  
 1) Intrusion *A* is younger than intrusion *C*.    2) Intrusion *C* is younger than intrusion *B*.  
 3) Intrusion *B* is older than intrusion *A*.      4) Intrusion *C* is older than layer *E*.

36. Which feature in the geologic cross section below was formed by erosion?



- 1) unconformity  
 2) fault  
 3) brachiopod fossil  
 4) coarse-grained igneous rock

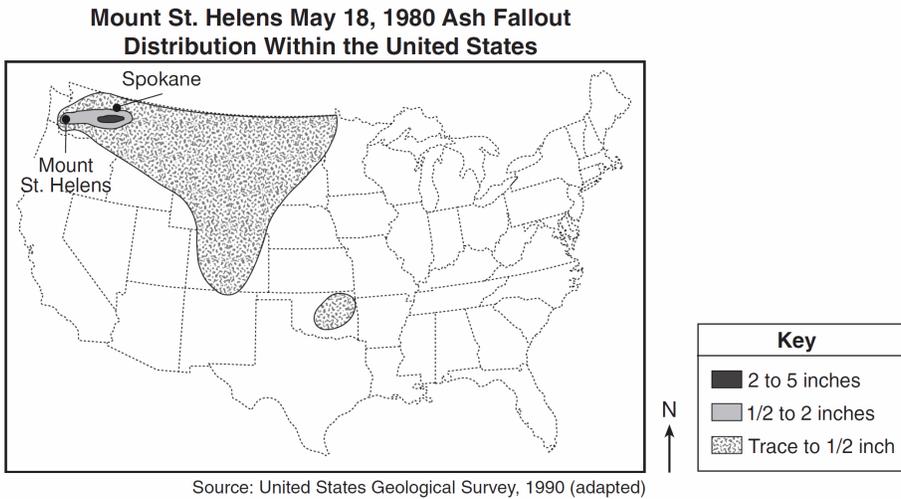
37. The diagram below represents the placoderm fish *Bothriolepis*, an index fossil found in New York State.



The surface bedrock at which location is most likely to contain this fossil?

- 1) Ithaca                      2) Old Forge  
 3) Albany                    4) New York City
38. During which geologic epoch do scientists infer that the earliest grasses first appeared on Earth?  
 1) Holocene                  2) Pleistocene  
 3) Oligocene                4) Eocene

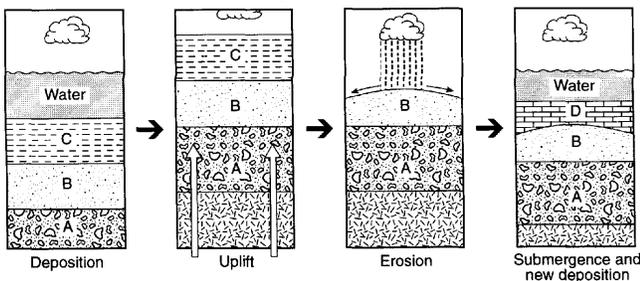
39. The map below shows the distribution of ash across the United States as a result of the May 18, 1980 volcanic eruption of Mount St. Helens.



Volcanic ash deposits such as these are usually excellent geologic time markers because they

- 1) occur at regular time intervals
- 2) spread over a large area in a short amount of time
- 3) represent a time gap in the rock record
- 4) contain index fossils from different time periods

40. The diagrams below show the sequence of events that formed sedimentary rock layers *A*, *B*, *C*, and *D*.



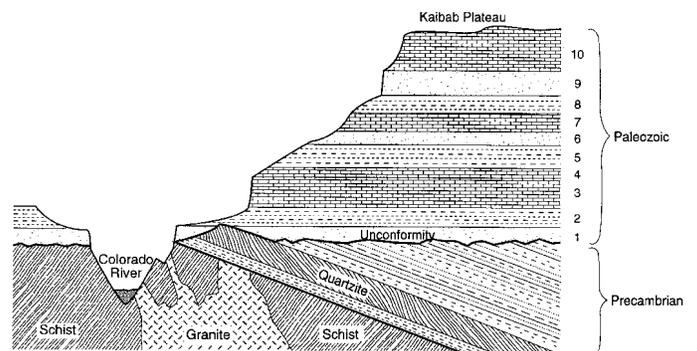
This sequence of events best illustrates the

- 1) formation of a buried erosional surface (unconformity)
- 2) movement of rock layers along a fault between layers *B* and *D*
- 3) overturning of rock layers
- 4) metamorphism of sandstone (layer *B*) into quartzite

41. What percentage of Earth's history represents human existence?

- |                   |                    |
|-------------------|--------------------|
| 1) less than 1.0% | 2) 1.8%            |
| 3) 23.5%          | 4) more than 98.6% |

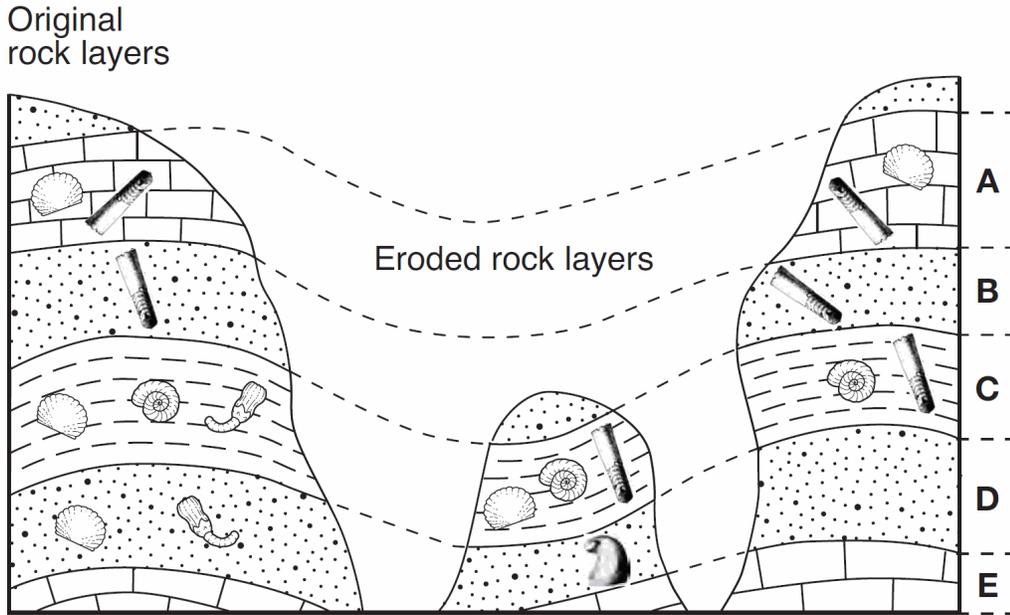
42. Base your answer to the following question on the geologic cross section below of the Grand Canyon. The numbers 1 through 10 represent Paleozoic sedimentary rock layers.



The unconformity between the Paleozoic sedimentary rocks and the Precambrian sedimentary rocks represents

- 1) a gap in the geologic time record
- 2) an intrusion of igneous rock
- 3) an abundance of fossils
- 4) a region of metamorphic rock

43. The diagram below represents three bedrock outcrops. The layers have *not* been overturned. Letters *A* through *E* identify different rock layers. Fossils found in the rock layers are shown.

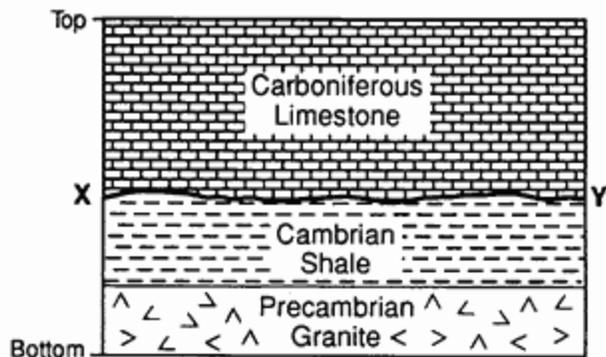


Which fossil could be classified as an index fossil?

- 1)  2)  3)  4) 

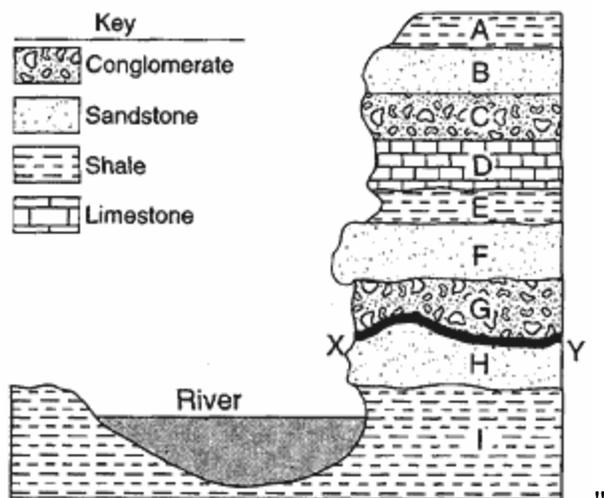
44. Which geologic event occurred in New York State at approximately the same time as the extinction of dinosaurs and ammonoids?
- 1) formation of the Queenston Delta
  - 2) deposition of the sands and clays underlying Long Island
  - 3) initial opening of the Atlantic Ocean
  - 4) advance and retreat of the last continental ice sheet
45. Approximately 2.2 billion years ago, which gas was first added in large amounts to Earth's atmosphere from life-forms that evolved in the oceans?
- 1) carbon dioxide
  - 2) water vapor
  - 3) oxygen
  - 4) nitrogen
46. Antarctica's location and climate changed over the last 200 million years because Antarctica moved
- 1) southward, resulting in a warmer climate
  - 2) southward, resulting in a colder climate
  - 3) northward, resulting in a warmer climate
  - 4) northward, resulting in a colder climate
47. The division of Earth's geologic history into units of time called eons, eras, periods, and epochs is based on
- 1) absolute dating techniques
  - 2) fossil evidence
  - 3) climatic changes
  - 4) seismic data
48. How old is a bone that has 12.5% of the original amount of radioactive carbon-14 remaining?
- 1) 5,700 years
  - 2) 11,400 years
  - 3) 17,100 years
  - 4) 22,800 years

49. The diagram below shows a cross-sectional view of part of the Earth's crust.



What does the unconformity (buried erosional surface) at line *XY* represent?

- 1) an area of contact metamorphism
  - 2) a time gap in the rock record of the area
  - 3) proof that no deposition occurred between the Cambrian and Carboniferous periods
  - 4) overturning of the Cambrian and Carboniferous rock layers
50. Base your answer to the following question on " the diagram below, which is a geologic cross section of an area where a river has exposed a 300-meter cliff of sedimentary rock layers. The rock layers are labeled *A* through *I*. Line *XY* represents a gap in the geologic record (an unconformity).



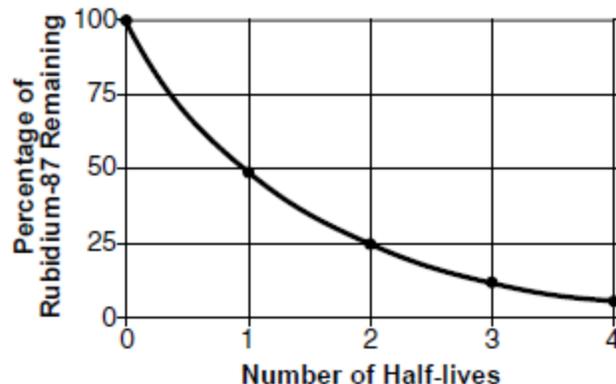
A long period of erosion most likely occurred between the deposition of which layers?

- 1) *C* and *D*
- 2) *D* and *E*
- 3) *F* and *G*
- 4) *G* and *H*

51. Which sequence shows the correct order of Earth's geologic time intervals from oldest to youngest?

- 1) Archean → Mesozoic → Cenozoic → Paleozoic → Proterozoic
- 2) Archean → Proterozoic → Paleozoic → Mesozoic → Cenozoic
- 3) Cenozoic → Mesozoic → Paleozoic → Proterozoic → Archean
- 4) Cenozoic → Paleozoic → Archean → Mesozoic → Proterozoic

52. The graph below shows the radioactive decay of rubidium-87.



What percentage of rubidium-87 atoms will be left after four half lives?

- 1) 25.0%
- 2) 12.5%
- 3) 6.25%
- 4) 3.125%

53. Radioactive decay of  $^{40}\text{K}$  atoms in an igneous rock has resulted in a ratio of 25 percent  $^{40}\text{K}$  atoms to 75 percent  $^{40}\text{Ar}$  and  $^{40}\text{Ca}$  atoms. How many years old is this rock?

- 1)  $0.3 \times 10^9$  y
- 2)  $1.3 \times 10^9$  y
- 3)  $2.6 \times 10^9$  y
- 4)  $3.9 \times 10^9$  y

54. A fossil formed 11,400 years ago. Which percentage of the original amount of carbon-14 remains in the fossil?

- 1) 100%
- 2) 50%
- 3) 25%
- 4) 12.5%

55. Which radioactive isotope is most often used when determining the age of fossil bones found in sediments deposited during the Holocene Epoch?

- 1) carbon-14
- 2) potassium-40
- 3) uranium-238
- 4) rubidium-87

56. The timeline below represents time on Earth from the beginning of the Paleozoic Era (A) to the present (B)

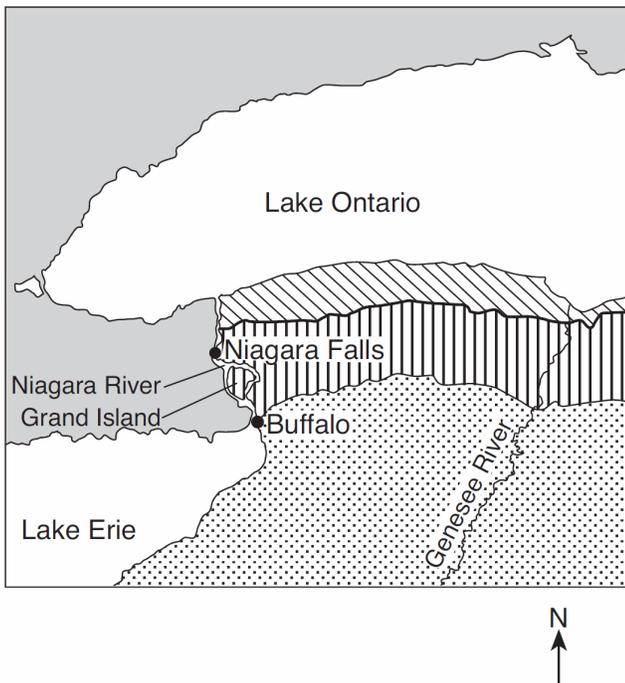


Which numbered position best represents the time when humans first appeared in the fossil record?

- 1) 1
- 2) 2
- 3) 3
- 4) 4

57. Base your answer to the following question on the map below, which shows the generalized bedrock of a part of western New York State.

**Generalized Bedrock Map**



During which geologic time period was the surface bedrock of Grand Island formed?

- 1) Cambrian
- 2) Ordovician
- 3) Silurian
- 4) Devonian

58. Which radioactive element is used to determine the absolute age of late Pleistocene animal remains?

- 1) rubidium-87
- 2) uranium-238
- 3) potassium-40
- 4) carbon-14

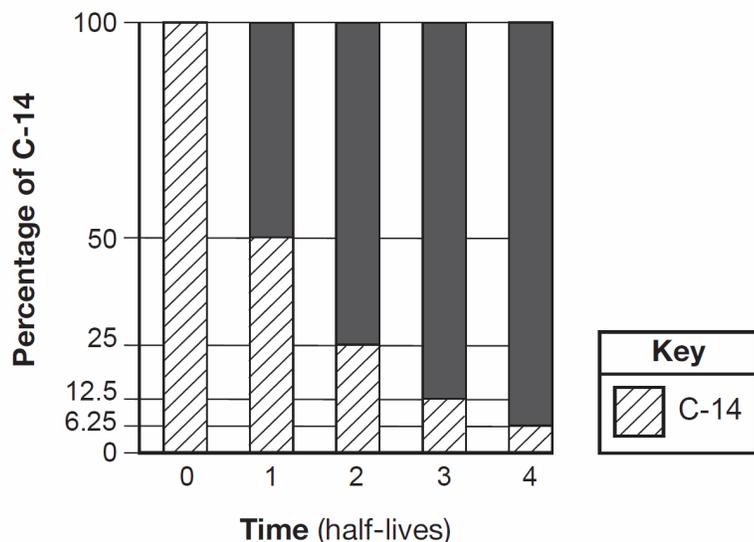
59. How much of an 800-gram sample of potassium-40 will remain after  $3.9 \times 10^9$  years of radioactive decay?

- 1) 50 grams
- 2) 100 grams
- 3) 200 grams
- 4) 400 grams

60. Which group of organisms survived mass extinctions that marked the ends of both the Paleozoic Era and the Mesozoic Era?

- 1) ammonoids
- 2) graptolites
- 3) eurypterids
- 4) gastropods

61. A bar graph of the radioactive decay of carbon-14 is shown below.



The solid black sections of the bars on the graph represent the percentages of

- 1) carbon-14 from the original sample that has not decayed
- 2) uranium-238 from the original sample that has not decayed
- 3) nitrogen-14 decay product resulting from the radioactive decay
- 4) lead-206 decay product resulting from the radioactive decay

62. The table below shows the radioactive decay of carbon-14. Part of the table has been left blank.

Half-Life	Original Carbon-14 Remaining (%)	Number of Years
0	100	0
1	50	5,700
2	25	11,400
3		17,100
4		
5		

After 22,800 years, approximately what percentage of the original carbon-14 remains?

- 1) 15%
- 2) 12.5%
- 3) 6.25%
- 4) 3.125%

63. The change in life-forms in the fossil record from less complex organisms to more complex organisms over time is best explained by

- 1) extinction
- 2) evolution
- 3) dynamic equilibrium
- 4) original horizontally