PART I
Total Value: 60%

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. What do seismologists study?

   (A) crystal structure
   (B) earthquake waves
   (C) magma composition
   (D) sedimentary rocks

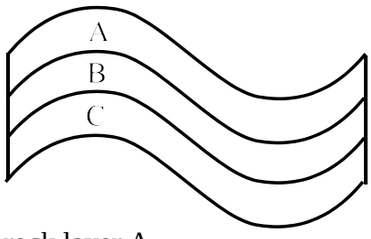
2. Which scientific view describes how our universe was formed?

   (A) Big Bang
   (B) geocentric
   (C) heliocentric
   (D) volcanism

3. Which states that the basic laws of nature have remained unchanged since Earth was created?

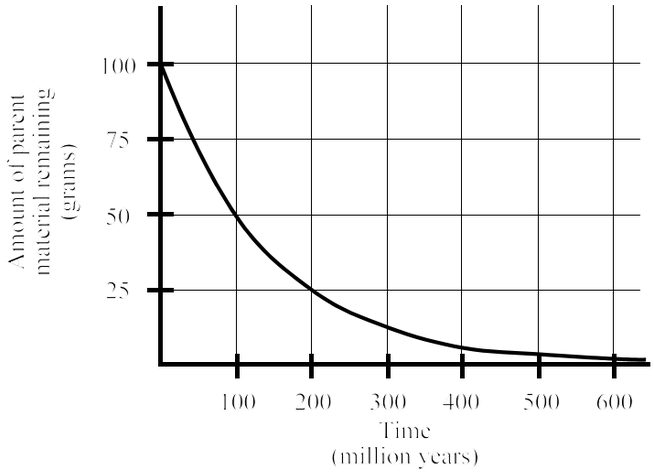
   (A) biological succession
   (B) original horizontality
   (C) superposition
   (D) uniformitarianism

4. Which is true for rock layer B in the diagram below?



   (A) It is younger than rock layer A.
   (B) It is younger than rock layer C.
   (C) It was deposited at the same time as rock layer A.
   (D) It was deposited at the same time as rock layer C.

5. What is the half life in millions of years of the element represented in the graph below?



   (A) 50
   (B) 100
   (C) 150
   (D) 200

6. Which describes the finely layered deposits in glacial lakes resulting from the annual deposition of sediments?

(A) crystals
(B) growth rings
(C) ripple marks
(D) varves

7. Which is the correct order of Earth's layers in order of increasing density?

lowest density → highest density

(A) crust → inner core → outer core → mantle
(B) crust → mantle → outer core → inner core
(C) outer core → crust → inner core → mantle
(D) outer core → mantle → crust → inner core

8. Which rock has the greatest porosity and permeability?

(A) gneiss
(B) granite
(C) sandstone
(D) shale

9. Where is groundwater located?

(A) cone of depression
(B) recharge area
(C) zone of aeration
(D) zone of saturation

10. Which feature of the polar regions causes water reservoirs to form ice?

(A) angle of sunlight
(B) low precipitation
(C) tectonic stress
(D) weather systems

11. Which process is responsible for oxygen in Earth's atmosphere?

(A) chemosynthesis
(B) decomposition
(C) photosynthesis
(D) respiration

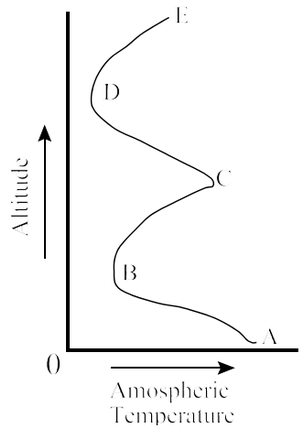
12. Which gas makes up the greatest proportion of Earth's present atmosphere?

(A) argon
(B) carbon dioxide
(C) nitrogen
(D) water vapour

13. Where do most storms occur in our atmosphere?

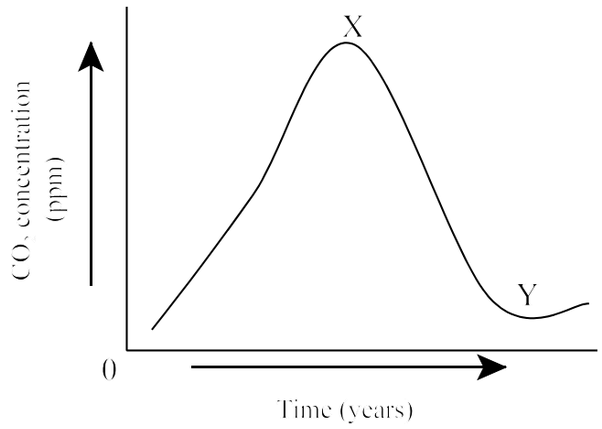
(A) mesosphere
(B) stratosphere
(C) thermosphere
(D) troposphere

14. The graph below shows the changes in atmospheric temperature with increasing altitude. Between which points is radiation absorbed?



(A) A to B and C to D
(B) A to B and D to E
(C) B to C and C to D
(D) B to C and D to E

15. The graph below shows the annual changes in CO_2 levels in North America's atmosphere. Which seasons do points X and Y most likely represent?



	X	Y
(A)	spring	fall
(B)	spring	winter
(C)	summer	fall
(D)	summer	winter

16. Where is all life on Earth found?

(A) atmosphere
(B) biosphere
(C) geosphere
(D) hydrosphere

17. Which kingdoms are most represented in the fossil record?

(A) Animalia and Fungi
(B) Animalia and Plantae
(C) Monera and Fungi
(D) Monera and Plantae

18. Which elements are most common in halite?

(A) magnesium and chlorine
(B) magnesium and iodine
(C) sodium and chlorine
(D) sodium and iodine

19. Which atomic structure is the building block of a silicate mineral?

(A) chromium - aluminum octahedron
(B) chromium - oxygen octahedron
(C) silicon - aluminum tetrahedron
(D) silicon - oxygen tetrahedron

20. Which accounts for the difference in physical properties of diamond and graphite?

(A) amount of impurities
(B) atomic structure
(C) specific gravity
(D) time of formation

21. A mineral has a mass of 75 g. If an equal volume of water has a mass of 15 g, what is the specific gravity of the mineral?

(A) 3.5
(B) 4.0
(C) 4.5
(D) 5.0

22. Which mineral gives a characteristic red-brown streak when rubbed across a streak plate?

(A) calcite
(B) gypsum
(C) hematite
(D) quartz

23. What is used to determine the difference between igneous, sedimentary, and metamorphic rocks?

(A) characteristics of location
(B) conditions of formation
(C) mineral composition
(D) particle composition

24. Why do extrusive igneous rocks have smaller crystals than intrusive igneous rocks?

(A) Extrusive rocks cool faster than intrusive rocks.
(B) Extrusive rocks cool slower than intrusive rocks.
(C) Extrusive rocks melt faster than intrusive rocks.
(D) Extrusive rocks melt slower than intrusive rocks.

25. Which volcanic feature is built mostly of pyroclastic materials?

(A) cinder cone
(B) dike
(C) shield volcano
(D) sill

26. To which group do rocks that consist entirely of shell fragments (coquina) belong?

(A) biochemical igneous
(B) biochemical sedimentary
(C) organic igneous
(D) organic sedimentary

27. Which rock is formed by the lithification of silt and clay?

(A) breccia
(B) conglomerate
(C) sandstone
(D) shale

28. Which sedimentary feature may indicate a beach or stream channel environment?

(A) graded bedding
(B) hanging valley
(C) mud cracks
(D) ripple marks

29. Which texture is characterized by rock crystals that are roughly equal in size and can be seen with the naked eye?

(A) coarse grained
(B) fine grained
(C) glassy
(D) porous

30. Which is a high grade metamorphic rock?

(A) gneiss
(B) granite
(C) shale
(D) slate

31. Which rock exhibits a foliated texture?

(A) limestone
(B) marble
(C) quartzite
(D) schist

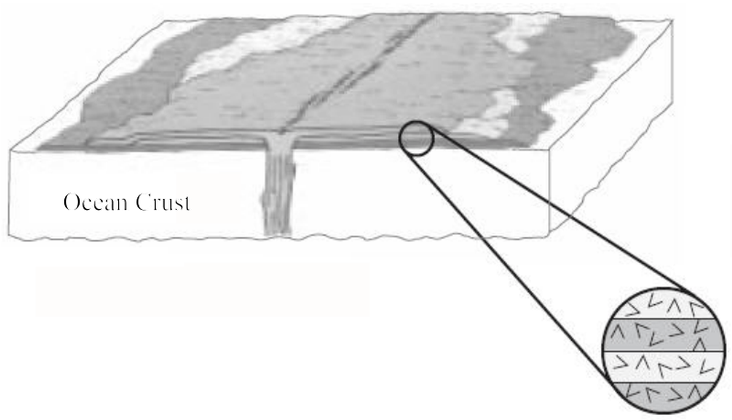
32. How do clastic sedimentary rocks form?

(A) deposition of fragments from molten lava
(B) deposition of fragments from weathered rocks
(C) precipitation of sediments from freshwater
(D) precipitation of sediments from seawater

33. Why does the velocity of an earthquake's P wave generally increase as it travels deeper into the mantle?

(A) confining pressure decreases
(B) confining pressure increases
(C) rock density decreases
(D) rock density increases

34. Which best describes the composition and viscosity of lava produced by the volcanic feature in the diagram below?



	composition	viscosity
(A)	basaltic	high
(B)	basaltic	low
(C)	granitic	high
(D)	granitic	low

35. Which characterizes the asthenosphere?

(A) a decrease in the velocity of S-waves
(B) an increase in the velocity of S-waves
(C) strong gravitational forces
(D) weak gravitational forces

36. In which tectonic setting were the Hawaiian Islands formed?

(A) convergent boundary
(B) hot spot
(C) ocean ridge
(D) transform boundary

37. Who first proposed the idea of continental drift?

(A) Hutton
(B) Lyell
(C) Wegener
(D) Wilson

38. When an earthquake occurs on one side of Earth, what will seismograph stations record on the opposite side of Earth?

(A) P and L waves
(B) P waves only
(C) S and L waves
(D) S waves only

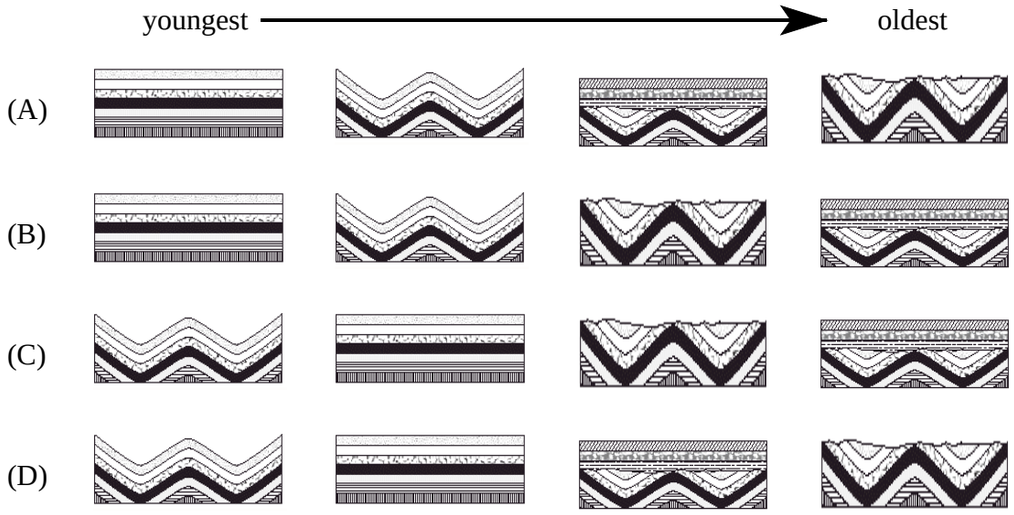
39. What is the point on Earth's surface directly above the source of an earthquake?

(A) aftershock
(B) epicentre
(C) fault
(D) focus

40. Which is formed by metamorphism?

(A) anthracite
(B) bituminous
(C) lignite
(D) peat

41. Which is the correct sequence, from youngest to oldest, in the development of a section of Earth's crust?



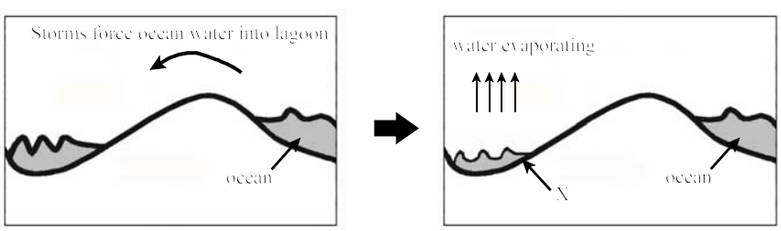
42. Which describes a rock where oil and gas are found?

(A) non-porous and impermeable
(B) non-porous and permeable
(C) porous and impermeable
(D) porous and permeable

43. Which mineral is paired correctly with its resource?

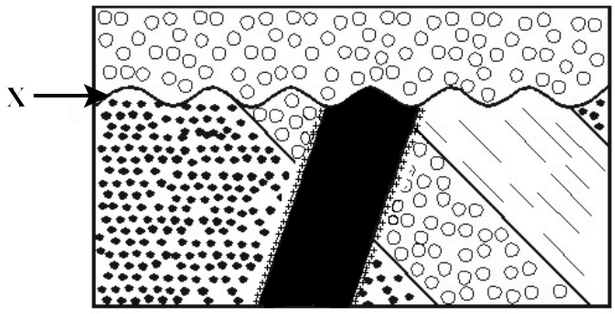
	mineral	resource
(A)	bauxite	aluminum
(B)	galena	copper
(C)	hematite	lead
(D)	sphalerite	iron

44. Which sedimentary deposit was most likely formed at X in the diagram below?



(A) coal
(B) rock salt
(C) shale
(D) siltstone

45. What is indicated by line X in the diagram below?

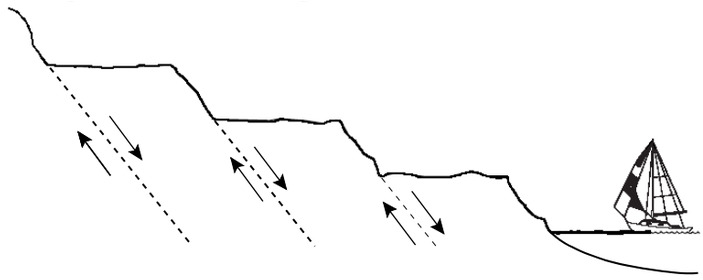


(A) angular unconformity
(B) contact metamorphism
(C) intrusion
(D) nonconformity

46. Which native element is paired correctly with its economic use?

	native element	economic use
(A)	copper	fertilizer
(B)	diamond	jewelry
(C)	gold	lubricants
(D)	silver	plaster

47. Which fault is represented in the diagram below?



(A) compressional
(B) normal
(C) reverse
(D) tensional

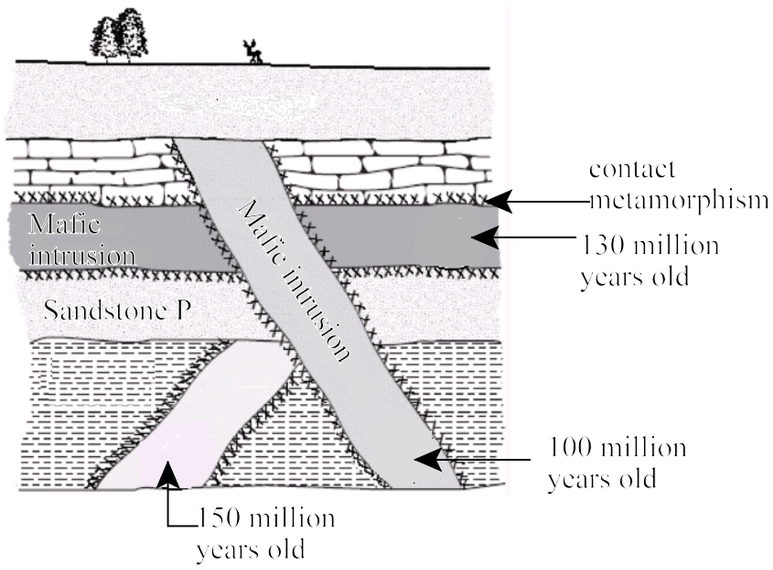
48. In which plate tectonic boundary are shear forces active?

(A) divergent
(B) convergent
(C) subduction
(D) transform

49. How many million years ago did dinosaurs become extinct?

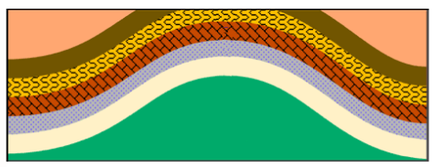
(A) 66
(B) 245
(C) 570
(D) 2500

50. In the diagram below, how many million years old is sandstone P?



(A) 105
(B) 120
(C) 140
(D) 160

51. Which feature is represented in the diagram below?



(A) anticline
(B) normal fault
(C) reverse fault
(D) syncline

52. Which method would produce the best fossil for the organism below?

(A) carbonization
(B) mineral replacement
(C) mold and cast
(D) petrification

53. Which age dating method would be used to date the dried remains of a camel found in the Sahara desert?

(A) carbon-14
(B) potassium-40
(C) rubidium-87
(D) uranium-235

54. Which is the shortest span of geologic time?

(A) Cenozoic
(B) Mesozoic
(C) Paleozoic
(D) Phanerozoic

55. Which is direct evidence of ancient life?

(A) footprints found in volcanic ash
(B) shark teeth found in sediments
(C) trilobite trails found in siltstone
(D) worm burrows found in shale

56. From oldest to youngest, which is the correct evolutionary sequence?

oldest ⟶ youngest

(A) fish → invertebrates → birds → mammals
(B) fish → invertebrates → mammals → birds
(C) invertebrates → fish → birds → mammals
(D) invertebrates → fish → mammals → birds

57. Which geologic time provides evidence of mass extinctions believed to have been caused by meteorite impact?

(A) end of Mesozoic Era
(B) end of Paleozoic Era
(C) Silurian-Devonian boundary
(D) Tertiary-Quarternary boundary

58. Which supercontinent formed most recently?

(A) Gondwanaland
(B) Laurentia
(C) Pangaea
(D) Rodinia

59. Which is the best example of a renewable resource?

(A) coal
(B) gas
(C) oil
(D) trees

60. What does a paleontologist study?

(A) faults
(B) fossils
(C) minerals
(D) rocks

PART II
Total Value: 40%

Instructions: Complete all items in this section. Your responses must be clearly presented in a well-organized manner.

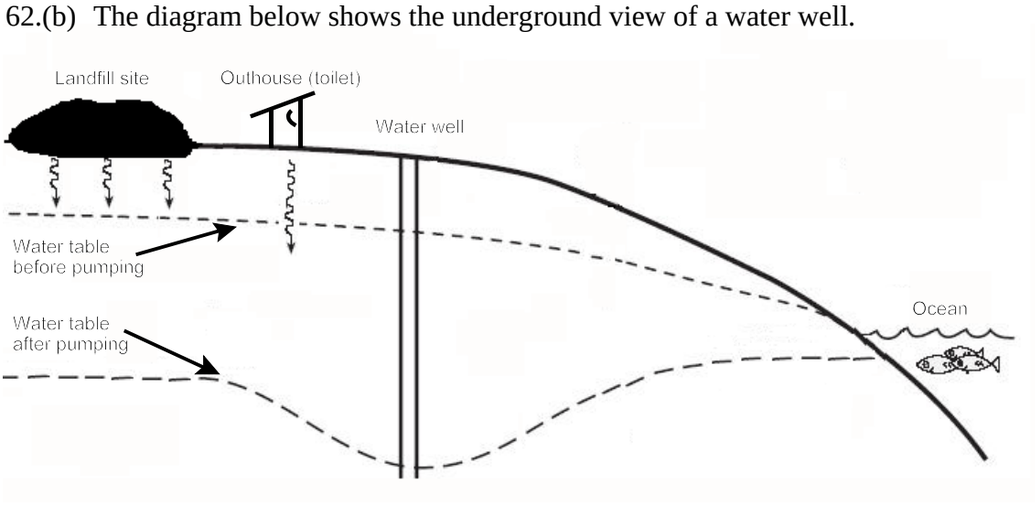
Value

3% 61. The half life of uranium-235 is 713 million years. If a sample had 256 g of uranium-235 originally, how many grams of the parent material would remain after 2139 million years have passed? Show all workings.

2% 62.(a) Explain how the composition of Earth's original atmosphere is different from its present composition.

Value

3% 62.(b) The diagram below shows the underground view of a water well.



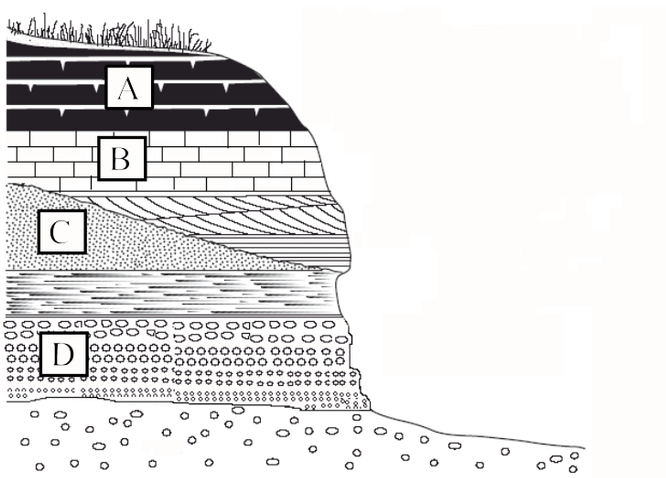
(i) Describe two factors that would decrease the quality of this well water.

(ii) What could be done to prevent contamination of the water supply in the diagram above?

Value

3% 63.(a) Describe three pieces of geologic evidence that could be used to prove that two continents were once joined together.

2% (b) The cross-section below shows a cliff face with sedimentary layers A, B, C, and D. Which layer has most likely been overturned? Explain.

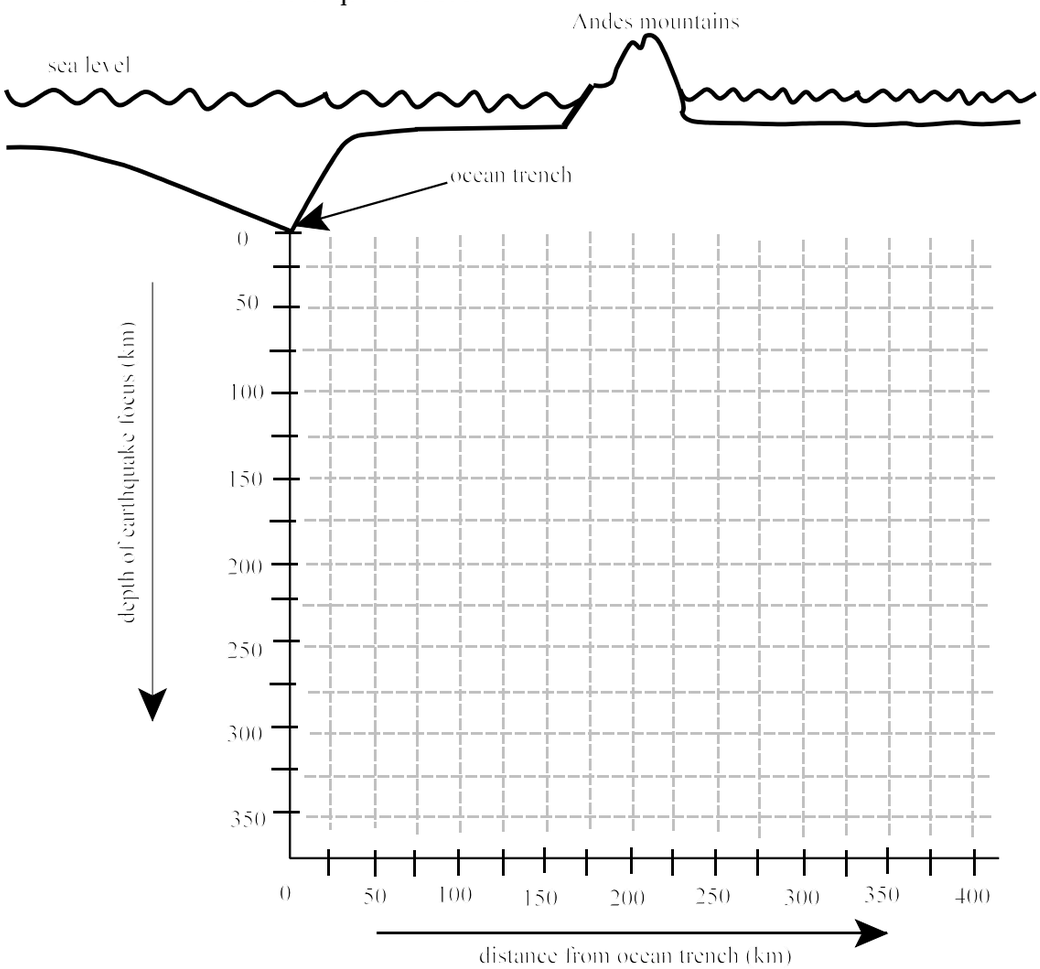


Value

4% 63.(c) Earthquakes occurred in a deep ocean trench that runs parallel to the west coast of South America. The table below shows the earthquakes' distance from the ocean trench and the depth.

Distance from Ocean Trench (km)	Depth of Earthquake Focus (km)
0	0
75	50
150	100
225	175
300	250
375	325

(i) On the grid below, plot the values from the table and draw a line to show the relationship between the distance from the ocean trench and the depth of earthquake focus.

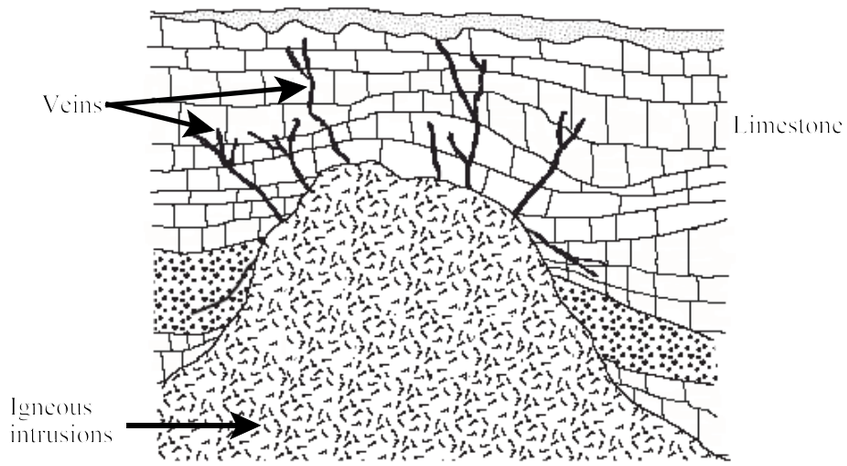


(ii) Draw a labelled diagram of this boundary. Indicate the type of boundary, corresponding crustal plates and direction of motion arrows.

Value

2% 63.(d) For earthquake A, the arrival time between the P and S waves is 4 minutes. For earthquake B, the arrival time between the P and S waves is 7 minutes. Which earthquake is furthest from the seismic station? Justify your answer.

3% (e) The diagram below shows a section through an igneous intrusion containing veins with copper mineralization.

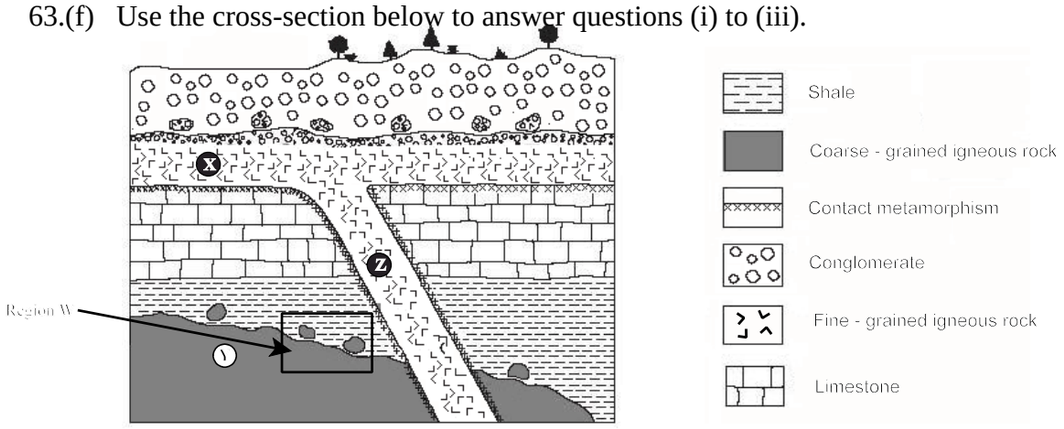


(i) Describe the method by which copper became concentrated in the veins?

(ii) Name one other metal that could be concentrated in a similar way.

Value

6% 63.(f) Use the cross-section below to answer questions (i) to (iii).



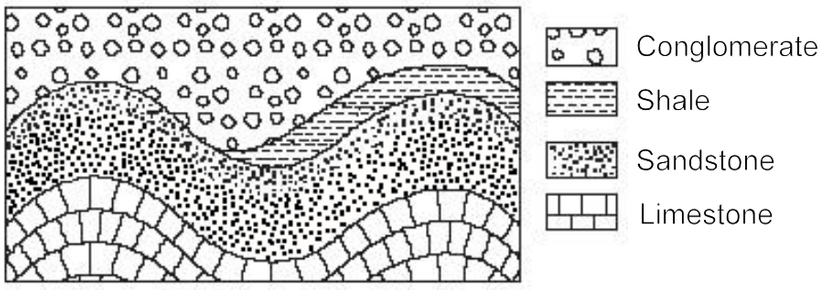
(i) What relative dating principle is indicated in region W? Explain how this indicates that the contact between rock unit Y and the shale is an erosion surface.

(ii) Rock unit Z shows a difference in crystal sizes across its width. Describe a specific location where the smallest crystals would be found and explain why they would be found there.

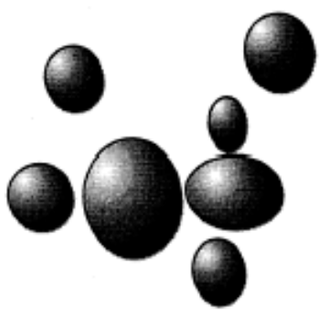
(iii) Which metamorphic rock would form at the contact between the limestone and rock unit X? Describe the change in texture that occurs to form this rock.

Value

3% 63.(g) Draw a line in the cross section below to represent a drill hole that would most likely strike oil or gas and give two reasons why you chose this drill site location..

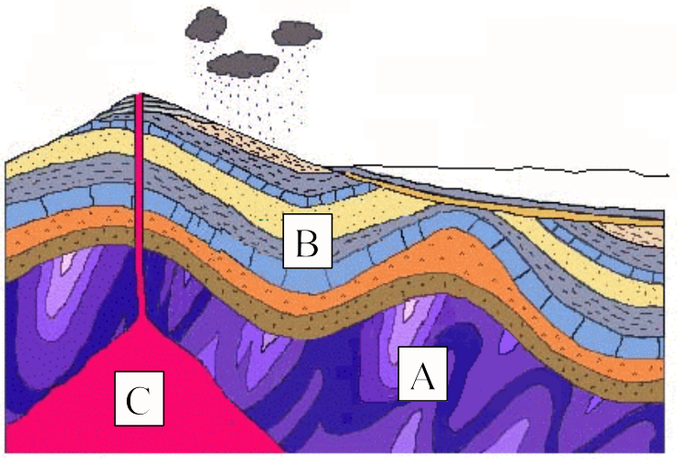


2% (h) The diagram below shows a collection of sedimentary samples. Describe the environment in which these samples were formed and explain why they are smooth and have rounded shapes.



Value

3% 63.(i) What types of rock (igneous, sedimentary, or metamorphic) could form in areas A, B, and C in the diagram below? Justify your answer by describing a feature from each area in the diagram.



A: _____

_____

_____

B: _____

_____

_____

C: _____

_____

_____

Value

4% 64. Climate patterns have changed significantly throughout Earth's history. Describe one way in which the global climate has been influenced by each of the following:

(i) natural phenomenon

(ii) human activity