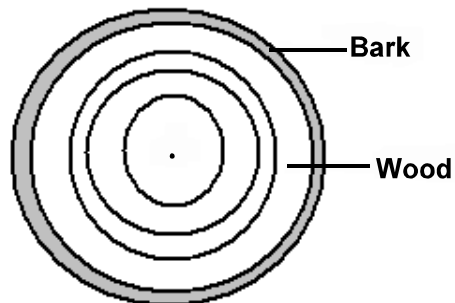


PART I
Total Value: 60%

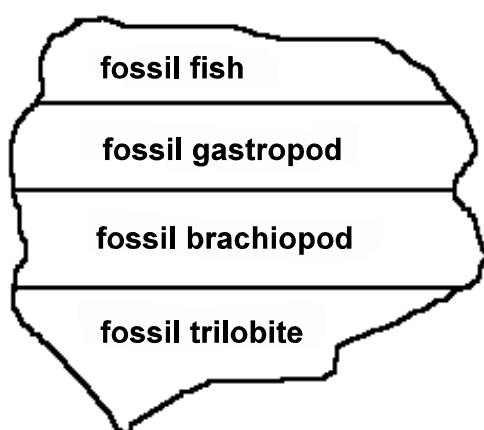
Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. What is an untested explanation of a naturally occurring phenomenon?
(A) hypothesis
(B) law
(C) paradigm
(D) theory
2. Which branch of Earth Science studies the arrangement of atoms in minerals?
(A) crystallography
(B) geomorphology
(C) seismology
(D) volcanology

3. How old is the tree illustrated in the diagram below?

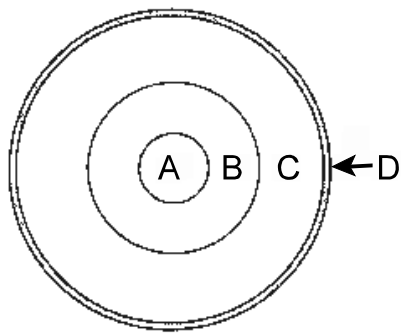


- (A) 4 years
(B) 5 years
(C) 6 years
(D) 7 years
4. What principle tells us that the fossil brachiopod is older than the fossil gastropod in the rock section below?



- (A) catastrophism
(B) correlation
(C) superposition
(D) uniformitarianism

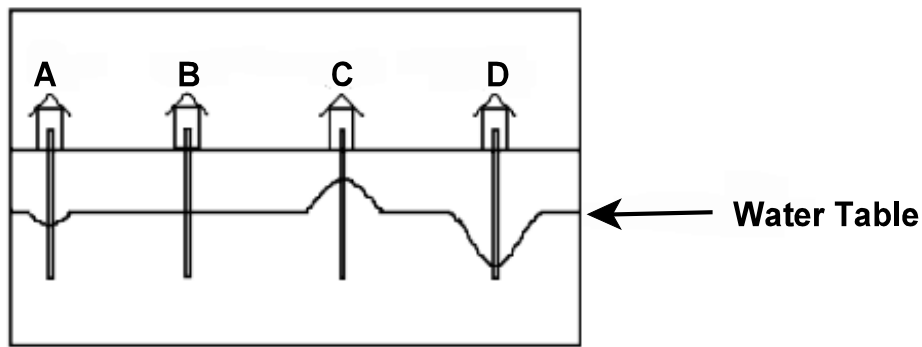
5. Which is the shortest unit of geologic time?
- (A) eon
 - (B) epoch
 - (C) era
 - (D) period
6. What refers to the process by which the solar system forms from dust and gases contracting due to gravitational forces?
- (A) big bang
 - (B) catastrophism
 - (C) creationism
 - (D) nebular hypothesis
7. Which spheres are interacting when a green plant absorbs carbon dioxide for photosynthesis?
- (A) atmosphere and biosphere
 - (B) atmosphere and hydrosphere
 - (C) geosphere and biosphere
 - (D) geosphere and hydrosphere
8. Which letter in the diagram corresponds to the layer of Earth that is solid iron and nickel?



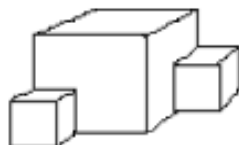
(not to scale)

- (A) A
 - (B) B
 - (C) C
 - (D) D
9. Which is the largest reservoir of fresh water on Earth?
- (A) glaciers
 - (B) groundwater
 - (C) oceans
 - (D) rivers
10. In which zone are pore spaces filled with water?
- (A) aeration
 - (B) permeability
 - (C) porosity
 - (D) saturation

11. Which well would have the highest pumping rate?



- (A) A
(B) B
(C) C
(D) D
12. Which is the most accurate statement about Earth's interior?
- (A) crust is thickest beneath the oceans
(B) inner core is composed of molten Si and Al
(C) pressure within the mantle increases with depth
(D) temperature within the core decreases with depth
13. What are the two most common elements in Earth's crust?
- (A) iron and aluminum
(B) iron and silicon
(C) oxygen and aluminum
(D) oxygen and silicon
14. To which mineral group does CaSO_4 belong?
- (A) carbonates
(B) oxides
(C) sulfates
(D) sulfides
15. What is the approximate hardness of an unknown mineral if it can be scratched by a copper penny but not by a fingernail?
- (A) < 2.5
(B) $2.5 - 3$
(C) $4 - 4.5$
(D) > 4.5
16. How many cleavage planes are visible in the mineral sample?

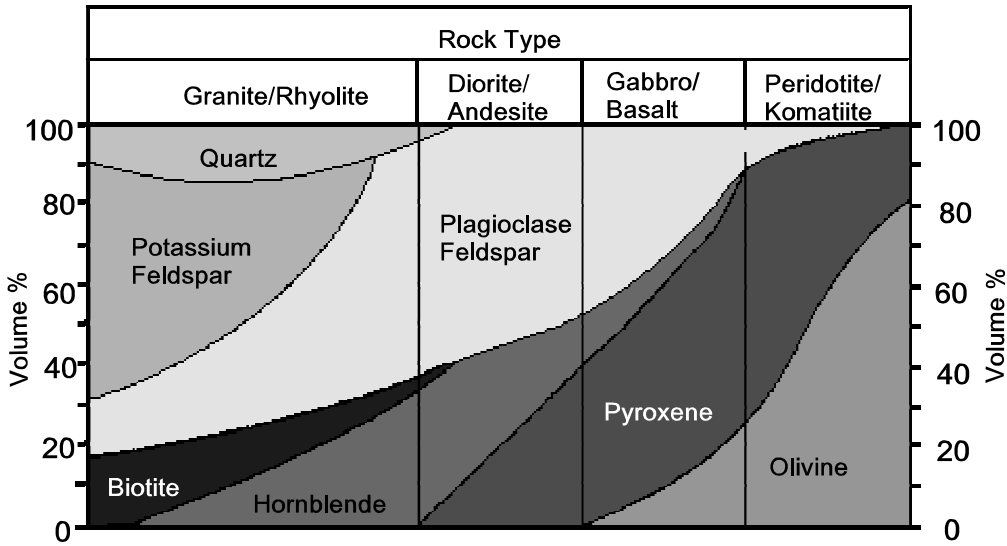


- (A) 3
(B) 6
(C) 9
(D) 12

17. Which statement is true about the rock cycle?
- (A) magma cools and crystallizes to form metamorphic rocks
 - (B) metamorphic rocks lithify to form sediments
 - (C) sedimentary rocks may contain igneous and metamorphic rocks
 - (D) weathering affects only igneous rocks
18. What rock forms when a pre-existing rock is altered as a result of heat and pressure?
- (A) igneous
 - (B) metamorphic
 - (C) sandstone
 - (D) sedimentary
19. Which rock type matches its method of classification?

	Rock Type	Method of Classification
(A)	chemical sedimentary	crystal size and composition
(B)	clastic sedimentary	particle size and shape
(C)	extrusive igneous	biochemical and inorganic
(D)	intrusive igneous	density and recrystalization

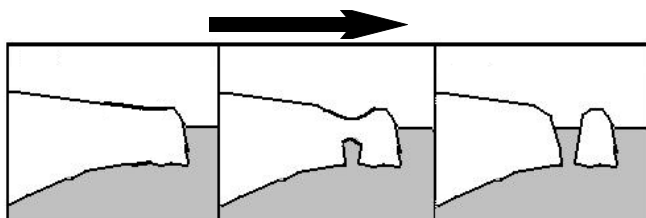
20. Using the diagram below, what is the volcanic equivalent of a rock that has 55% plagioclase feldspar, 25% hornblende and 20% pyroxene?



- (A) andesite
- (B) basalt
- (C) komatiite
- (D) rhyolite

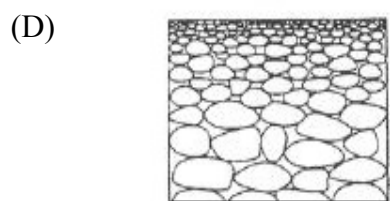
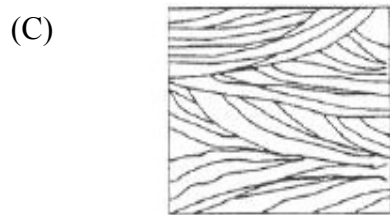
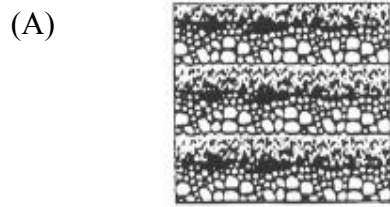
21. Which rock will form when lava cools instantly?
- (A) andesite
 - (B) basalt
 - (C) obsidian
 - (D) tuff
22. What is the origin of fine-grained igneous rock?
- (A) lava that cooled quickly on Earth's surface
 - (B) lava that cooled slowly on Earth's surface
 - (C) silt that settled quickly in ocean water
 - (D) silt that settled slowly in ocean water
23. Which is a clastic sedimentary rock?
- (A) breccia
 - (B) gypsum
 - (C) rock salt
 - (D) travertine
24. Which processes most likely form shale?
- (A) compaction and cementation
 - (B) heat and pressure
 - (C) melting and re-crystallization
 - (D) uplift and solidification
25. Which property best distinguishes sediment deposited by a river from sediment deposited by a glacier?
- (A) age of fossils found in the sediment
 - (B) amount of sediment sorting
 - (C) mineral composition of the sediment
 - (D) thickness of sediment layers
26. How does a river transport salt?
- (A) as bed load
 - (B) as dissolved load
 - (C) by saltation
 - (D) by suspension

27. Which process created the coastal features below?



- (A) wave deposition
- (B) wave erosion
- (C) stream deposition
- (D) stream erosion

28. Which diagram represents the type of sediments found in a moraine?



29. Which feature can be used to determine the direction of glacial movement?

- (A) cirque
- (B) drumlin
- (C) erratic
- (D) horn

30. Which is an icicle-like, depositional feature common to cave ceilings?

- (A) breccia
- (B) stalactite
- (C) stalagmite
- (D) travertine

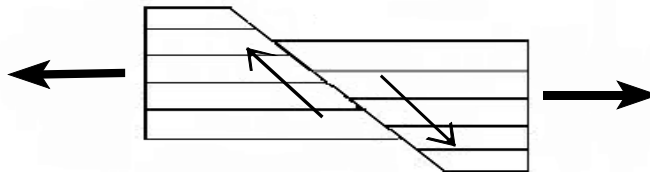
31. Which is a depositional feature formed by wind?

- (A) delta
- (B) glacial varves
- (C) sand dune
- (D) striations

32. Metamorphism of which rock will form quartzite?

- (A) basalt
- (B) conglomerate
- (C) granite
- (D) sandstone

33. Which is the correct sequence in the metamorphism of shale?
- (A) phyllite → gneiss → slate → schist
 (B) phyllite → slate → gneiss → schist
 (C) slate → phyllite → schist → gneiss
 (D) slate → schist → phyllite → gneiss
34. Why was the Theory of Continental Drift initially rejected?
- (A) glacial evidence suggested the continents did not move
 (B) magnetic reversals did not support the theory
 (C) no proposed mechanism to explain continental movement
 (D) reconstructed coastlines of Asia and North America did not fit together
35. Why does the oceanic crust sink beneath the continental crust at a subduction boundary?
- (A) continental crust has a more mafic composition than oceanic crust
 (B) continental crust is pulled upward by Moon's gravity
 (C) oceanic crust is more dense than continental crust
 (D) oceanic crust is pulled downward by Earth's magnetic field
36. What is the name of the boundary between the mantle and crust?
- (A) asthenosphere
 (B) lithosphere
 (C) Mohorovicic Discontinuity
 (D) S-wave shadow zone
37. Which is a transform plate boundary?
- (A) Aleutian Trench
 (B) Hawaiian Islands
 (C) Mid-Atlantic Ridge
 (D) San Andreas Fault
38. At which location is andesite most likely found?
- (A) convergent plate boundary
 (B) divergent plate boundary
 (C) hot spot
 (D) transform plate boundary
39. Which force and fault is shown in the diagram below?



	Force	Fault
(A)	compression	normal
(B)	compression	reverse
(C)	tension	normal
(D)	tension	reverse

40. How much greater amplitude is an earthquake of magnitude 8.6 on the Richter scale compared to an earthquake of magnitude 5.6?
- (A) 3
(B) 90
(C) 1000
(D) 27 000
41. Which is the origin of rock displacement during an earthquake?
- (A) elastic rebound
(B) epicenter
(C) focus
(D) shadow zone
42. Seismic evidence supporting the idea that a portion of Earth’s core is liquid, is the observation that which type of waves will not pass through the core?
- (A) long
(B) primary
(C) secondary
(D) tsunami
43. What feature would be common to an ocean - ocean convergent plate boundary?
- (A) hot spot
(B) mid-ocean ridge
(C) transform fault
(D) volcanic island arc
44. At which location is a composite volcano formed?
- (A) convergent plate boundary
(B) divergent plate boundary
(C) hot spot
(D) mid-ocean ridge
45. Two earthquakes, **A** and **B**, occur in two different locations. Which best explains the results of both earthquakes?

Earthquake A	Richter Scale = 7.1	Modified Mercalli Intensity Scale = VII
Earthquake B	Richter Scale = 7.2	Modified Mercalli Intensity Scale = XI

- (A) buildings in location A absorb energy better
(B) buildings in location B absorb energy better
(C) reinforced concrete was commonly used in location B
(D) reinforced concrete was not commonly used in location A

46. Which is a characteristic of a shield volcano?

	Width of Base	Slope
(A)	narrow	gentle
(B)	narrow	steep
(C)	wide	gentle
(D)	wide	steep

47. Which mineral is a source of zinc?

- (A) chalcopyrite
- (B) galena
- (C) pyrite
- (D) sphalerite

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

	Native Element	Economic Use
(A)	copper	fertilizers
(B)	diamond	lubricants
(C)	graphite	pencils
(D)	silver	cements

49. Which scientist contributed to plate tectonic theory by suggesting that hot spots in the mantle create volcanic islands within plates?

- (A) Alfred Wegener
- (B) Arthur Holmes
- (C) James Hutton
- (D) Tuzo Wilson

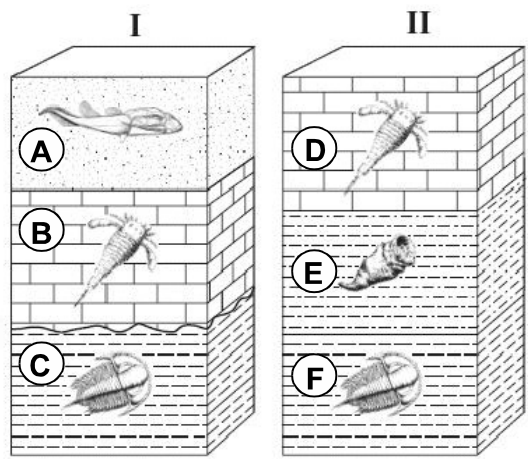
50. What is the correct sequence in the formation of coal?

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

51. Which rock is paired with the correct economic use?

	Rock	Economic Use
(A)	basalt	wall board
(B)	granite	counter tops
(C)	gypsum	roof shingles
(D)	marble	paint

52. Which is used to conclude that Layer **B** is the same age as layer **D**?



- (A) fossil correlation
 - (B) plate tectonics
 - (C) superposition
 - (D) uniformitarianism
53. Which describes the progression of life forms from Precambrian to Cenozoic?
- (A) amphibians → fish → mammals → reptiles
 - (B) amphibians → mammals → fish → reptiles
 - (C) fish → amphibians → reptiles → mammals
 - (D) fish → reptiles → amphibians → mammals
54. If fossilized shells were found to have a radiometric age of 800 million years, how would this change the geological time scale?
- (A) Paleozoic boundary would begin at 800 million years
 - (B) Paleozoic/Precambrian boundary would be unchanged
 - (C) Precambrian boundary would begin at 800 million years
 - (D) Precambrian time will now be longer
55. Which is the correct pairing of the geological boundary and the extinction of major life forms?

	Geological Boundary	Extinction of Life Forms
(A)	Mesozoic/Cenozoic	Mammals
(B)	Paleozoic/Mesozoic	Marine Invertebrates
(C)	Precambrian/Paleozoic	Reptiles
(D)	Precambrian/Paleozoic	Land Plants

56. Which supercontinent existed 200 million years ago?
- (A) Gondwanaland
 - (B) Laurasia
 - (C) Pangaea
 - (D) Rodinia

57. Which gas in our atmosphere increased as a result of the evolution of plant life on Earth?
- (A) argon
 - (B) carbon dioxide
 - (C) oxygen
 - (D) sulfur dioxide
58. What is the most common form of fossilization for woolly mammoths in northern Russia?
- (A) frozen remains
 - (B) petrification
 - (C) preserved in amber
 - (D) preserved in tar pits
59. Which is a non-renewable resource?
- (A) fish
 - (B) minerals
 - (C) sunlight
 - (D) trees
60. Who studies the remains of ancient organisms?
- (A) geomorphologist
 - (B) paleontologist
 - (C) seismologist
 - (D) volcanologist

PART II
Total Value: 40%

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

Value
2% 61.(a) Recently a mummified human was found in Greenland. Radiometric analysis found that 6.25 % of the original carbon-14 remains. How old is the mummy? (half-life of carbon-14 = 5730 years). Show calculations.

2% 61.(b) A rock sample collected in the early 1950s was radiometrically age-dated at 3.5 billion years old using uranium/lead isotopes. The sample containers at that time were sealed with lead. Recently, rocks from the same outcrop were radiometrically age-dated at 2.8 billion years. Explain why the 1950s sample was dated incorrectly.

Value

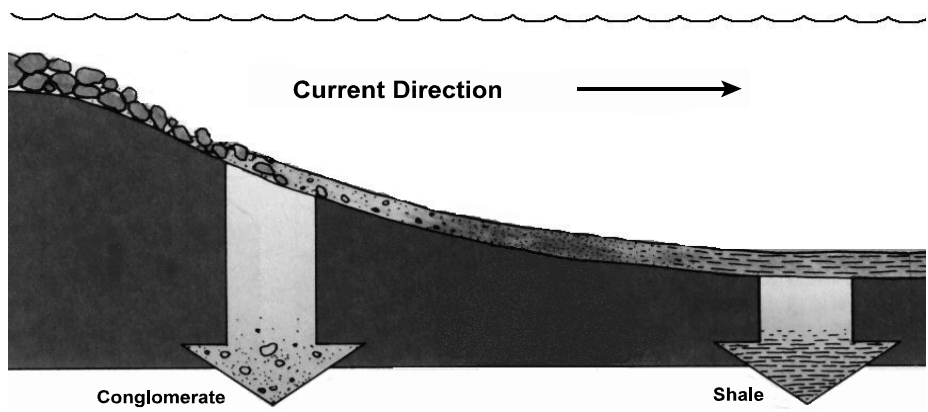
2% 62.(a) There is no evidence to suggest that Pluto ever melted. How would its interior structure differ from that of Earth?

2% 62.(b) With reference to porosity and permeability, sketch and describe a natural artesian system.

2% 63.(a) Explain why there would be a difference in crystal size between a plutonic intrusion with a 1 kilometre diameter and a plutonic intrusion with a 10 metre diameter.

Value

2% 63.(b) With reference to the diagram, explain why the two different sedimentary rocks developed in the areas indicated.



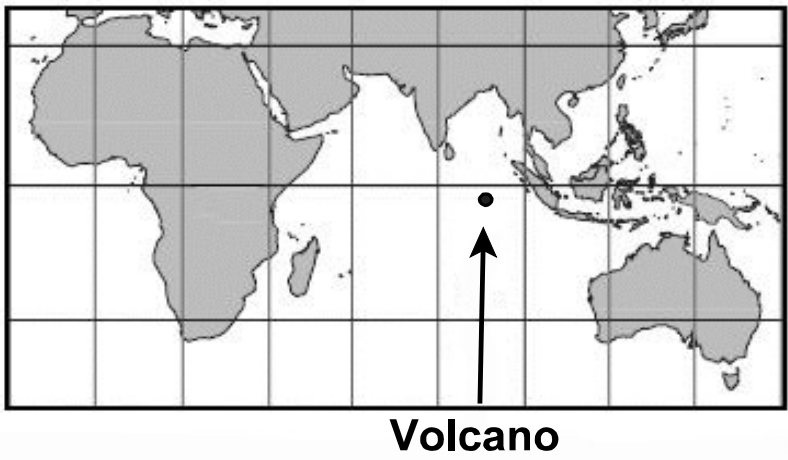
3% 63.(c) (i) Sketch and label a cross-section of the oceanic crust between North America and Europe.

(ii) Explain why the continents are moving.

Value

3%

63.(d) Satellite imaging reveals a new volcano growing in the middle of the Australian-Indian Plate.



(i) What type of volcano is forming in the middle of this crustal plate?

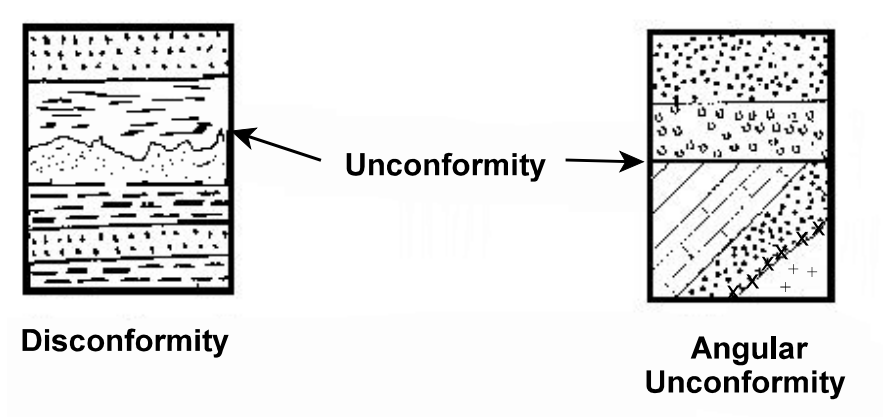
(ii) Explain how a volcano may have formed in this region.

2%

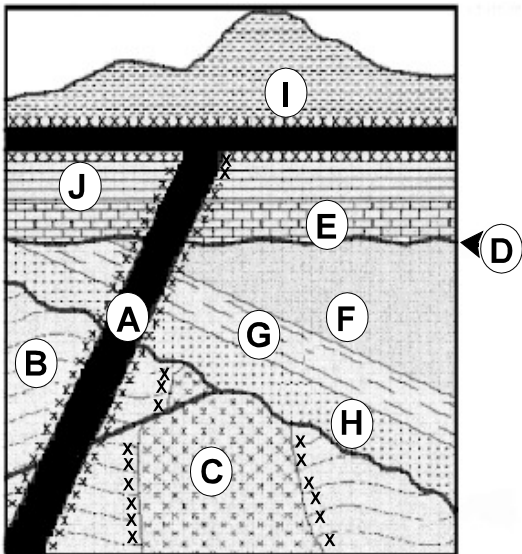
63.(e) Describe two possible effects of increased volcanic activity on Earth’s climate.

Value

2% 63.(f) Which of the unconformities would you expect to form in a mountain-building area? Support your choice.



4% 63.(g) Use the diagram to answer questions (i) and (ii).



(i) Arrange all letters in the diagram above in the order in which they occurred beginning with the oldest.

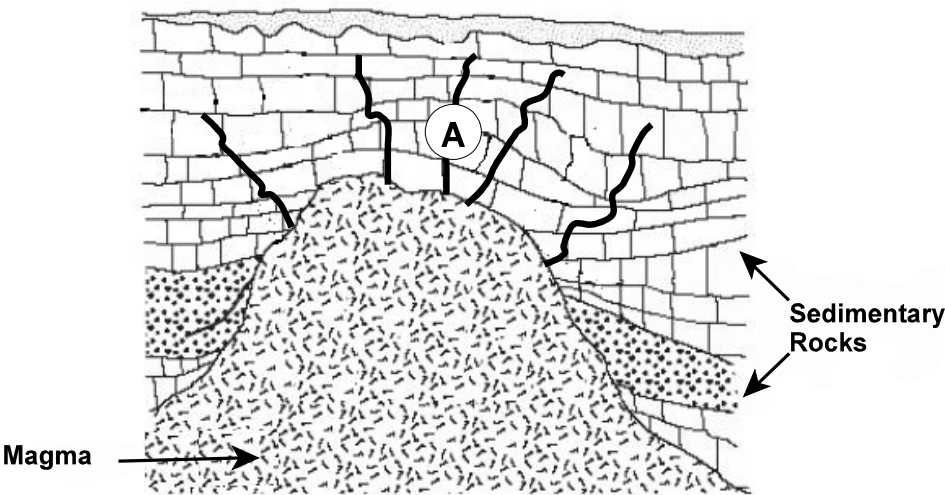
Oldest _____ → Youngest

____, ____, ____, ____, ____, ____, ____, ____, ____, ____

(ii) Does A represent an intrusive feature or extrusive feature? Explain.

Value

3% 63.(h) Indicate the type of mineral deposit which could form at location A and explain the process.



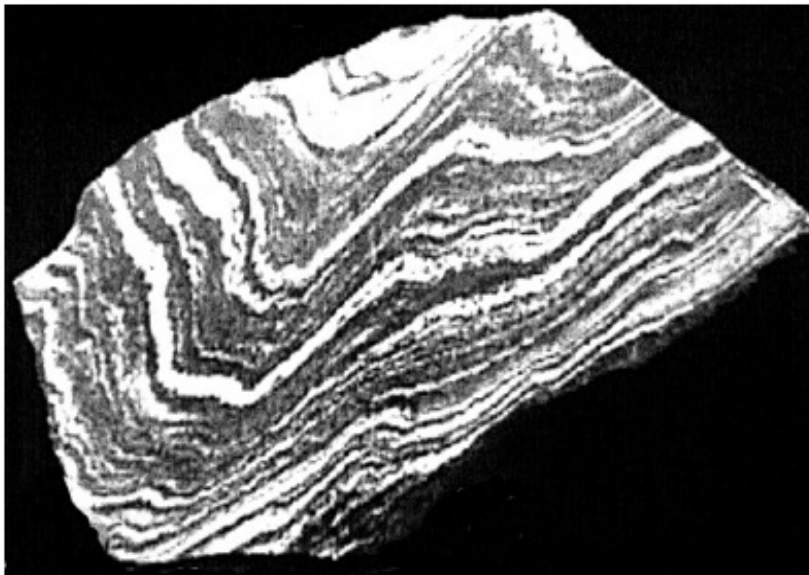
2% 63.(i) Draw and label a diagram to show an oil trap that resulted from the compression of sedimentary layers.

Value

3%

63.(j) (i) Explain why both contact metamorphism and regional metamorphism are common around convergent plate boundaries.

(ii) What metamorphic texture is shown in the diagram?



Value

3%

64.(a) All organisms require specific conditions in order to be fossilized in some way.

- (i) In the Badlands of Alberta, one layer of Jurassic sediments has evidence that dinosaurs lived in the area. Besides bones, what other evidence could have been collected to support this finding?

- (ii) Occasionally, jellyfish have been found in the fossil record. Identify one condition necessary for its fossilization.

3%

64.(b) On the diagram, draw lines to indicate the three main geologic zones on the island of Newfoundland. Briefly describe the origin of each of the geologic zones.

