

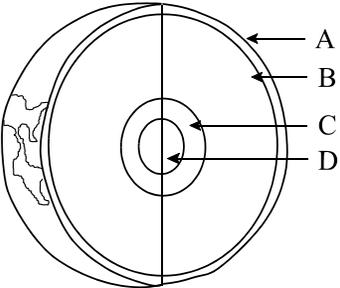
Part I
Total Value: 50%

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

1. Which scientific concept has the highest degree of certainty?
(A) hypothesis ✓ (B) law
(C) observation (D) theory
2. Which branch of Earth Science focuses on the study of Earth's water systems?
✓ (A) hydrology (B) paleontology
(C) petrology (D) seismology
3. Which describes the origins of the universe?
✓ (A) Big Bang Theory
(B) Chemosynthetic Theory
(C) Geocentric Model
(D) Heliocentric Model
4. Which statement supports uniformitarianism?
(A) Events that change Earth can not be undone.
(B) Events that change Earth rarely happen.
(C) Processes that changed Earth are no longer happening.
✓ (D) Processes that changed Earth are still happening.
5. Which time span would least likely contain fossil evidence?
(A) Cenozoic (B) Mesozoic
(C) Paleozoic ✓ (D) Precambrian

6. In the diagram below, where is Earth's asthenosphere located?

✓ (A) A
(B) B
(C) C
(D) D



7. Which factors were responsible for separating Earth's interior into layers with different physical properties?
✓ (A) density and heat (B) outgassing and weathering
(C) uplift and erosion (D) volcanism and earthquakes
8. What is a major source of energy driving Earth's internal processes?
✓ (A) accretion (B) gravity
(C) radioactivity (D) volcanism
9. What is the largest source of fresh water on Earth?
✓ (A) glaciers (B) groundwater
(C) lakes (D) rivers
10. Which rock type is an aquifer?
✓ (A) granite (B) gneiss
(C) sandstone (D) shale

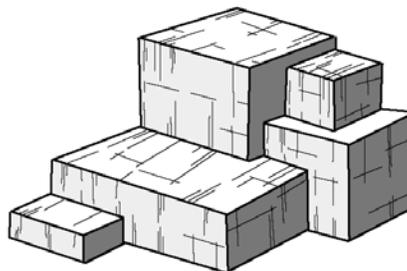
11. Which would have the greatest negative impact on the quality of groundwater?
 ✓ (A) agricultural chemicals (B) burning fossil fuels
 (C) land subsidence (D) stream erosion
12. In which atmospheric layer does weather occur?
 (A) mesosphere (B) stratosphere
 (C) thermosphere ✓ (D) troposphere
13. Which atmospheric component shows a yearly cyclic change in concentration due to natural processes?
 (A) argon ✓ (B) carbon dioxide
 (C) helium (D) volcanic dust

14. Which kingdom is matched with its general characteristics?

Kingdom	Characteristics
(A) Animalia	multicellular, eukaryotic, absorptive
(B) Fungi	unicellular, prokaryotic, autotrophic
✓ (C) Monera	unicellular, prokaryotic, absorptive
(D) Plantae	multicellular, eukaryotic, ingestive

15. Which refers to the appearance and quality of light reflected from the surface of a mineral?
 (A) colour (B) crystal form
 ✓ (C) luster (D) streak
16. What is the specific gravity of a 33.3 g sample of calcite that displaces 12.3 mL of water?
 (A) 0.37 (B) 1.6
 ✓ (C) 2.7 (D) 21
17. Which mineral displays cubic cleavage as shown in the diagram below?

- ✓ (A) diamond
 (B) galena
 (C) mica
 (D) quartz

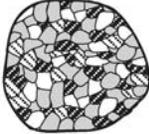


18. What is the most abundant element in Earth's crust?
 (A) aluminum (B) iron
 ✓ (C) oxygen (D) silicon
19. Which is an example of a halide?
 (A) barite (BaSO_4) (B) calcite (CaCO_3)
 ✓ (C) fluorite (CaF_2) (D) hematite (Fe_2O_3)
20. What characteristic allows two igneous rocks with the same mineral composition to have different names?
 (A) colour (B) foliation
 (C) shape ✓ (D) texture

21. Which rock sample displays a coarse-grained texture?

(A)  conglomerate

(B)  gneiss

✓ (C)  granite

(D)  limestone

22. Which rock formed in an extrusive environment?

✓ (A) basalt (B) diorite
(C) gabbro (D) granite

23. What is the sequence in a continental margin extending seaward from the continent?

(A) shelf → rise → slope ✓ (B) shelf → slope → rise
(C) slope → rise → shelf (D) slope → shelf → rise

24. What is the most common agent of erosion and deposition in deserts?

(A) gravity (B) soil creep
(C) streams ✓ (D) wind

25. Which sedimentary rock is paired with its classification?

(A) coal - clastic (B) gypsum - clastic
✓ (C) limestone - chemical (D) sandstone - chemical

26. Sediments are deposited and sorted as a stream enters a large body of water. How does the particle density and size change as they move further from the shoreline?

	Density	Size
✓ (A)	decrease	decrease
(B)	decrease	increase
(C)	increase	decrease
(D)	increase	increase

27. Which is the sequence for the metamorphism of clay?

(A) gneiss → shale → schist → slate
(B) gneiss → shale → slate → schist
(C) shale → slate → gneiss → schist
✓ (D) shale → slate → schist → gneiss

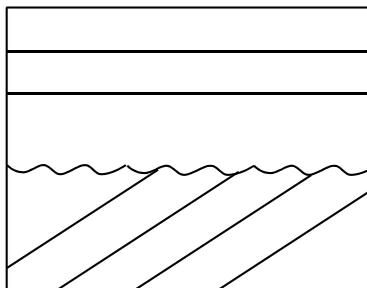
28. Which rock displays a non-foliated texture?

(A) gneiss ✓ (B) marble
(C) schist (D) slate

29. Where would rocks formed as a result of regional metamorphism most likely be found?

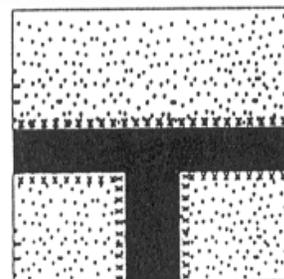
(A) Hawaii (B) Iceland
✓ (C) Rocky Mountains (D) Sahara Desert

30. Which scientist proposed that convection currents beneath the crust are the mechanism for plate movement?
 ✓ (A) Arthur Holmes (B) James Hutton
 (C) Tuzo Wilson (D) Xavier Lepichon
31. Which fault is created by tensional forces?
 ✓ (A) normal (B) reverse
 (C) thrust (D) transform
32. Where does the largest concentration of earthquakes and volcanic events occur?
 (A) areas bordering Atlantic Ocean ✓ (B) areas bordering Pacific Ocean
 (C) areas middle of North America (D) areas middle of South America
33. Which scale measures the structural damage caused by an earthquake?
 ✓ (A) Mercalli (B) Moh's
 (C) Richter (D) Time
34. Which boundary would explain the formation of the Himalayan Mountain Range?
 ✓ (A) continent - continent (B) normal fault
 (C) oceanic - oceanic (D) transform fault
35. Where are the most hazardous volcanoes located?
 ✓ (A) along convergent plate boundaries (B) along mid-ocean ridges
 (C) at oceanic hot spots (D) at transform fault boundaries
36. Which layer of Earth is composed of molten nickel-iron?
 (A) asthenosphere (B) inner core
 (C) lithosphere ✓ (D) outer core
37. An earthquake has a magnitude of 4.6. How many times more energy would be released from a earthquake with a magnitude of 7.6?
 (A) 30 (B) 90
 (C) 1000 ✓ (D) 27 000
38. Which series of events produces the cross-section below?

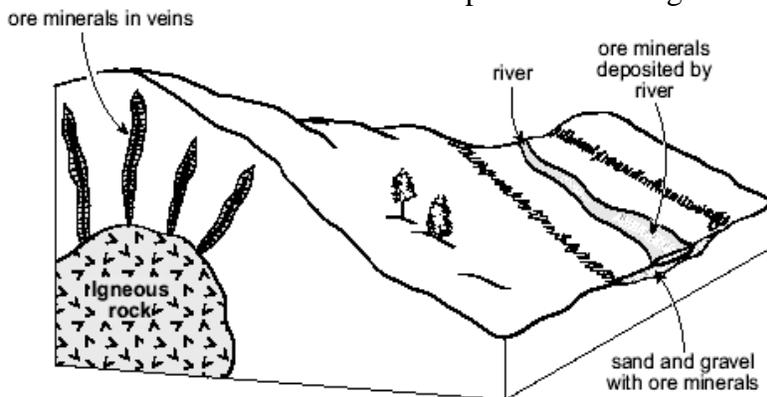


- ✓ (A) deposition → erosion → tilting → erosion
 (B) deposition → tilting → erosion → deposition
 (C) erosion → deposition → tilting → deposition
 (D) erosion → tilting → deposition → erosion
39. What is the arrow pointing towards in the diagram below?

- ✓ (A) contact metamorphism
 (B) faulting
 (C) regional metamorphism
 (D) unconformity



40. Which statement best describes the mineral deposits in the diagram below?



- (A) In the veins, they are placer deposits.
- ✓ (B) In the veins, they are hydrothermal deposits.
- (C) When deposited by the river, they are metamorphic.
- (D) When deposited by the river, they are magmatic.

41. What is the main mineral used in making plaster?

- (A) barite
- (B) graphite
- ✓ (C) gypsum
- (D) pyrite

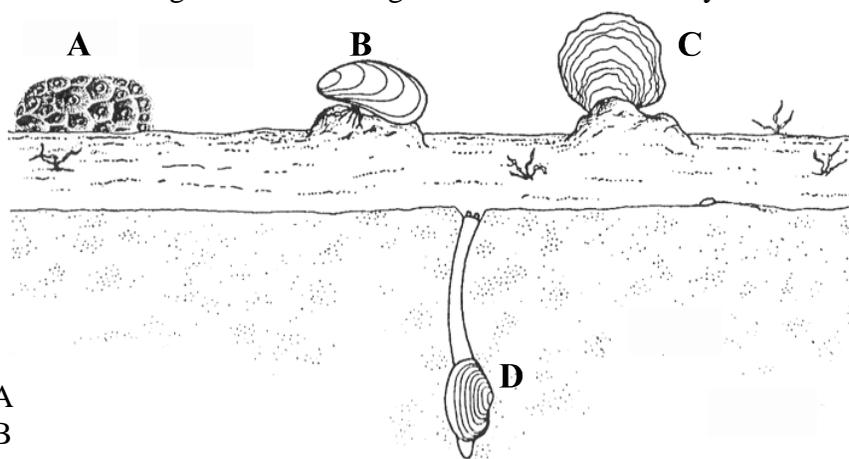
42. Which is hardest and burns cleanest?

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

43. Which best describes the geologic setting where diamonds are most likely formed?

- ✓ (A) high heat; high pressure
- (B) high heat; low pressure
- (C) low heat; high pressure
- (D) low heat; low pressure

44. A trace fossil is a piece of indirect evidence giving clues to the activities of ancient organisms. Which organism in the diagram below is most likely to leave a trace fossil?



- (A) A
- (B) B
- (C) C
- ✓ (D) D

45. Which fossil type preserves internal details of an organism?

- (A) cast
- (B) impressions
- (C) molds
- ✓ (D) petrification

46. In which rock would fossils normally form?

- (A) granite
- (B) obsidian
- ✓ (C) shale
- (D) slate

47. Which best describes the progression of life forms from Precambrian to Cenozoic?

- (A) bacteria → dinosaurs → trilobites → mammoths
- ✓ (B) bacteria → trilobites → dinosaurs → mammoths
- (C) dinosaurs → bacteria → mammoths → trilobites
- (D) dinosaurs → mammoths → bacteria → trilobites

48. What continental arrangement, proposed by Wegener, is believed to have existed 200 million years ago?
- ✓ (A) Gondwanaland (B) Laurasia
(C) Pangea (D) Rodinia
49. Which supports the idea that plate tectonic activity is continuing in present time?
- ✓ (A) activity along the San Andreas fault
(B) formation of fossils in shallow seas
(C) increased global temperatures
(D) weathering due to glacial activity
50. Which is a direct result of global warming?
- ✓ (A) decreased sea levels; decreased polar ice
(B) decreased sea levels; increased polar ice
(C) increased sea levels; decreased polar ice
(D) increased sea levels; increased polar ice

Part II
Total Value: 50%

Instructions: Complete ALL questions in the space provided. Some answers require diagrams. You may use diagrams in any question to aid in your answer.

Value

2% **51.(a)** 1200 g of a radioactive element has decayed to produce 75 g of the element. If the half-life of the mineral is 0.40 billion years, what is the age of the sample? Show calculations.

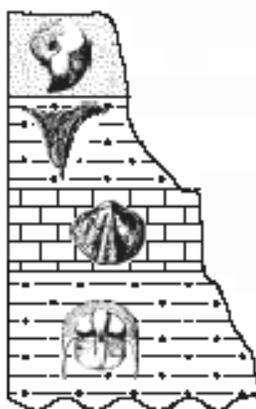
Answer:

First; 1200g → 600g → 300g → 150g → 75g Thus, 4 half lives.

Second; 0.40 Billion Years x 4 = 1.6 Billion Years

The radioactive sample is 1.6 billion years old.

2% **(b)** Refer to the diagram below to describe the relationship between superposition and relative time.



Answer:

Relative time is found by comparing one event with another and chronologically arranging them according to age. Relative ages of the layers in the diagram can be seen when referring to the Law of Superposition which states that the lowest layer is the oldest and the age progressively gets younger as you move toward the top of the rock sequence, assuming that the sequence of rock layers were not disturbed.

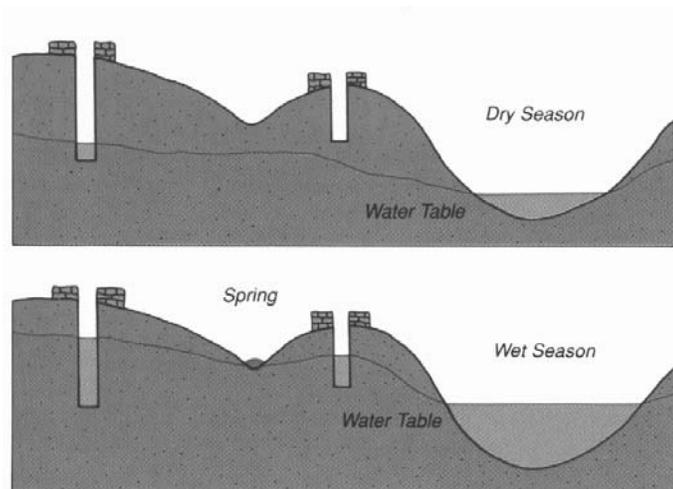
Value

2% **51.(c)** In what two ways does the solar nebular hypothesis explain the formation of our solar system?

Answer:

Approximately 5 billion years ago, gravitational forces caused a cloud of dust and gases to contract and flatten into a spiraling disk shape. Within the rotating flattened disk most of the material concentrated within the center and increasing heat caused it to ignite into a hot proto sun. The remaining material throughout the flattened disk concentrated into several major areas and coalesced to form the proto planets. This marked the birth of our solar system.

3% **(d)** With the aid of diagrams, explain the effect of a drought on the water table.



Answer:

If an area experienced a period of very little precipitation (rain), the water table in that area would begin to lower. This is because the rate of water withdrawal (taken from the ground) would be greater than the rate of water recharge (put back into the ground).

Value

3% 51.(e) Refer to the layers of the atmosphere to describe three ways the biosphere is protected from harmful solar radiation.

Answer:

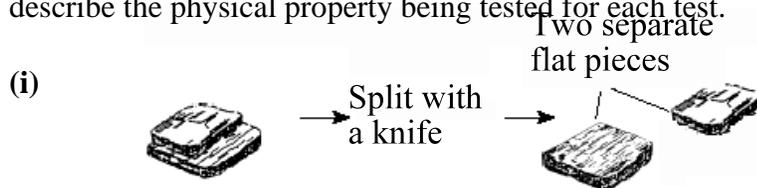
Solar radiation when it enters the atmosphere is obstructed from reaching earth in three ways;

1) *Absorption* - gases such as oxygen, ozone, and water vapor tend to absorb solar radiation which cause certain atmospheric layers to increase in temperature.

2) *Reflection* - gases and cloud cover reflects a percentage of incoming solar radiation before it reaches Earth's surface.

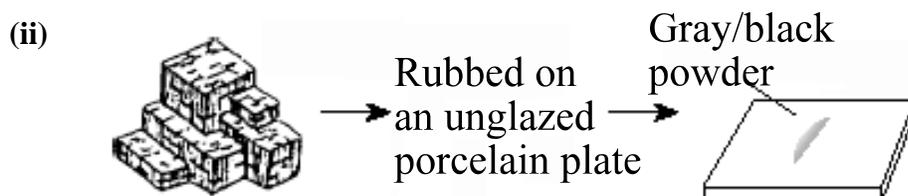
3) *Scattering* - gases and dust particles within the atmosphere tend to scatter solar radiation as it passes through the atmosphere.

3% 52.(a) The diagrams below show three minerals undergoing a physical test. Identify and describe the physical property being tested for each test.



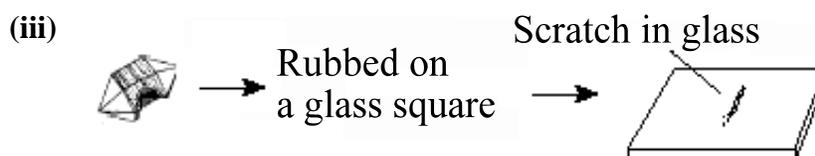
Answer:

Cleavage - ability for a mineral to break along smooth, flat, parallel surfaces.



Answer:

Streak - the true color of the mineral in powdered form when it is rubbed along an unglazed tile.



Answer:

Hardness - resistance of a mineral to scratching.

Value

2% 52.(b) (i) Describe the difference in the chemical composition of silicate minerals and carbonate minerals.

Answer:

Silicate minerals consist of silicon and oxygen (SiO₄) bonded with metals, whereas, carbonate minerals consist of carbon and oxygen (CO₃) bonded with metals.

(ii) Give an example of each mineral.

Answer:

silicate: Answer Varies (quartz, micas, pyroxenes, amphiboles, etc...)

carbonate: Answer Varies (calcite, dolomite, etc...)

2% (c) Why is coal considered to be a rock, and not a mineral?

Answer:

By definition, a mineral is any substance that forms from an inorganic source. Coal is the product of decayed vegetative plant life which is considered to be organic in origin. For this reason coal is not a mineral, but is classified as an organic sedimentary rock.

2% (d) Describe the texture of both granite and basalt. How did the texture of each rock form?

(i) granite:

Answer:

granite has a coarse texture (phaneritic), the crystals are visible to the unaided eye, and this texture formed as a result of felsic magmas cooling slowly over a long time in a plutonic environment.

(ii) basalt:

Answer:

basalt has a fine texture (aphanitic), the crystals are too small to be seen with the unaided eye, and this texture formed when mafic lava cools quickly in a volcanic environment.

Value

2% 52.(e) How can contact metamorphism distinguish an igneous intrusion from a buried lava flow?

Answer:

Contact metamorphism forms when a heat source (magma or lava) comes in contact and changes (metamorphoses) rock units. An igneous intrusion formed from magma, would have contact metamorphism surrounding the entire intrusion, above and below, whereas, a lava flow forms on the surface of Earth and would have contact metamorphism only below the solidified lava.

2% 53.(a) Describe two glacial features that indicate the direction of glacial movement.

Answer:

The direction of glacial movement can be identified by many glacial features including the following;
moraines - accumulation of glacial debris beneath or at the margin.
drumlins - an asymmetrical hill composed of glacial till.
striations and grooves - scratches left on the rock by advancing glaciers.

2% (b) Describe the environment required to produce ripple marks.

Answer:

Ripple marks form where streams, waves, water currents, and wind interact with sediment such as sand and clay. These features are most often seen in shallow water environments, beaches and deserts (on a larger scale).

Value

4% 53.(c) The table below provides information collected at seismic stations A, B, and C for the same earthquake.

Seismic Station	P - Wave Arrival Time	S - Wave Arrival Time	Difference in Arrival Times	Distance to Epicenter (km)
A	08:48:30	No S - waves		
B	08:42:00		00:04:30	
C	08:46:00			3500

(i) Why are no S - waves recorded at station A?

Answer:

No S-waves are recorded at station "A" because station "A" is located in a shadow zone, an area 103° - 143° from the earthquake epicenter.

(ii) What is the distance from station B to the epicentre? Show workings.

Answer:

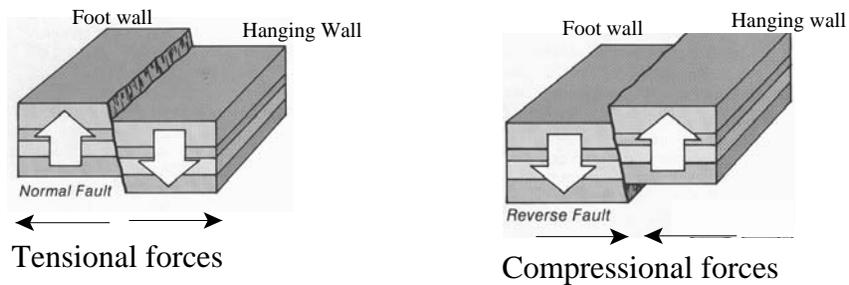
**OMIT
Can not complete because travel-time graph is missing.**

(iii) What is the arrival time of the S - wave for station C? Show workings.

Answer:

**OMIT
Can not complete because travel-time graph is missing.**

2% (d) With the aid of a clearly labelled diagram, describe the difference between a normal fault and a reverse fault.



Answer:

A normal fault is formed when tensional forces cause movement within Earth's crust. The hanging wall moves down with respect to the foot wall.
A reverse fault is formed when compressional forces cause movement within Earth's crust and the hanging wall moves up in relation to the foot wall.

Value

2% **54.(a)** Explain why it is impossible for oceanic crust to be older than 200 million years.

Answer:

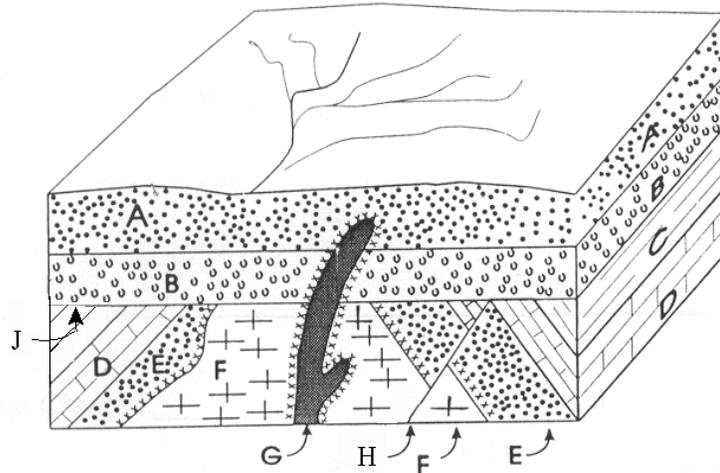
A geologic process called sea floor spreading causes the ocean floor to move.

Ocean floor is created at oceanic ridges and is destroyed or consumed within

Earth at subduction zones. This process of recycling the ocean floor occurs

within a span of 180 - 200 million years.

3% **(b)** Use the diagram below to answer the following questions.



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

Answer:

Oldest —————> Youngest

E - D - C - F - H - J - B - A - G

(ii) What is the feature at J? Explain how it formed.

Answer:

Feature “J” indicates an angular unconformity. This feature formed when sedimentary layers “E”, “D”, and “C” were uplifted and tilted by the igneous intrusion “F” and eroded at a later time.

(iii) What evidence indicates that the fault occurred after the intrusion of unit F?

Answer:

The fault cuts across intrusion “F”, thus, intrusion “F” must have formed before the fault.

Value

2% **54.(c)** Describe how each of these deposits is formed.
(i) evaporites:

Answer:

Chemicals dissolved in water is left behind as the water evaporates and over extended time the mineral deposits accumulate.

2% **(ii)** oil:

Answer:

Organic matter trapped in sediment(clays) transforms to oil as the sediment forms into a solid sedimentary rock (oil shales). This oil can later move and accumulate in areas to form oil traps.

2% **55.(a)** Why are earthworms unlikely to be fossilized?

Answer:

Earthworms lack hard body parts that would resist the processes that cause the soft tissue to break down and decay easily.

2% **(b)** What are two ways delicate organisms, such as insects, can be preserved in the fossil record?

Answer:

Delicate organisms can be preserved in the fossil record by;

- 1. Carbonization**
- 2. Preservation in amber or ice**

Value

2% 55.(c) How did biosphere conditions change as the composition of the atmosphere changed?

Answer:

With the influx of plant life in the oceans and later on land the atmosphere changed in composition, from CO₂ rich to O₂ rich, and as a result the diversity of the biosphere responded as the amount of animals on Earth increased.

2% (d) Using Plate Tectonics, explain why the Hawaiian Islands vary in age and amount of volcanic activity.

Answer:

The Hawaiian Island chain formed as a result of the Pacific plate moving over a hot spot located beneath the Pacific ocean. The oldest volcanic islands are located the farthest from the hot spot and has little to no volcanic activity. Whereas, the closer you get to the hot spot, the younger the volcanic islands are and the greater the amount of volcanic activity. For example, the island of Hawaii is presently positioned directly above the hot spot and experiences volcanic activity on a regular basis, whereas, the island of Oahu is farther from the hot spot and experiences less volcanic activity.