

PART I
Total Value: 60%

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

1. Which is a formal statement in which a natural phenomena is described under given conditions?

☐ (A) evidence
☐ (B) hypothesis
☒ (C) law
☐ (D) paradigm

2. Which branch of earth science is studied when a geologist and biologist work together?

☐ (A) astronomy
☐ (B) meteorology
☐ (C) mineralogy
☒ (D) paleontology

3. Which illustrates a logical progression of scientific thought as a result of new evidence?

☒ (A) Continental Drift → Plate Tectonics
☐ (B) Radiometric Dating → Relative Dating
☐ (C) Solar Nebular → Big Bang
☐ (D) Uniformitarianism → Catastrophism

4. Which type of dating would be used to tell the age of a tree using tree rings?

☒ (A) absolute
☐ (B) isotope
☐ (C) radiometric
☐ (D) relative

5. The half life of an element in a sample is 2000 years. If 50% of the element has decayed, how old is the sample?

☐ (A) 1000 years
☐ (B) 1500 years
☒ (C) 2000 years
☐ (D) 4000 years

6. Which evolutionary sequence is ordered from youngest to oldest?

☐ (A) fishes → reptiles → invertebrates → amphibians
☐ (B) invertebrates → fishes → reptiles → amphibians
☒ (C) reptiles → amphibians → fishes → invertebrates
☐ (D) reptiles → fishes → amphibians → invertebrates

7. Which best describes continental crust?

☐ (A) 7 kilometres thick; higher density than ocean crust
☐ (B) 7 kilometres thick; lower density than ocean crust
☐ (C) 35-40 kilometres thick; higher density than ocean crust
☒ (D) 35-40 kilometres thick; lower density than ocean crust

8. Which is the correct sequence of Earth’s layers from the surface to the center?

Surface —————→ Center

- (A) crust - inner core - outer core - mantle
- ✓ (B) crust - mantle - outer core - inner core
- (C) mantle - crust - inner core - outer core
- (D) mantle - outer core - inner core - crust

9. Which is the largest source of freshwater on Earth?

- ✓ (A) glaciers
- (B) groundwater
- (C) oceans
- (D) rivers

10. Which correctly describes permeability and porosity?

	Permeability	Porosity
(A)	amount of pore space	movement of water
✓ (B)	movement of water	amount of pore space
(C)	quality of water	amount of pore space
(D)	quality of water	movement of water

11. Which will prevent the seepage of agrichemicals into an aquifer?

- (A) cavernous limestone
- ✓ (B) clay
- (C) gravel
- (D) permeable sandstone

12. Which is responsible for the formation of Earth’s hydrosphere?

- (A) meteorite impact
- (B) radioactive decay
- (C) respiration
- ✓ (D) volcanic outgassing

13. Which is a substance that is solid, inorganic, occurs naturally, and exhibits a definite chemical composition and molecular structure?

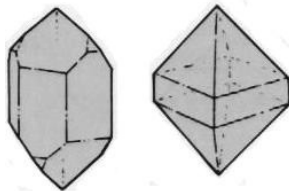
- (A) electron
- (B) isotope
- ✓ (C) mineral
- (D) rock

14. Which is a sulfate mineral?

- (A) $\text{CaMg}(\text{CO}_3)_2$
- ✓ (B) $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$
- (C) KCl
- (D) ZnS

15. A mineral sample with a mass of 75 g is placed in a graduated cylinder with 100 ml of water. The water level rises to 125 ml in the cylinder. What is the specific gravity of the mineral?
- ✓ (A) 0.33
(B) 3.0
(C) 50.0
(D) 75.0

16. What mineral identification property is shown in the diagram below?



- ✓ (A) crystal shape
(B) hardness
(C) luster
(D) specific gravity
17. Which mineral property is found by scraping a mineral across an unglazed porcelain tile?
- (A) double refraction
(B) hardness
(C) lustre
✓ (D) streak
18. Which rock forms from a silica-rich magma?
- (A) andesite
(B) basalt
(C) gabbro
✓ (D) rhyolite

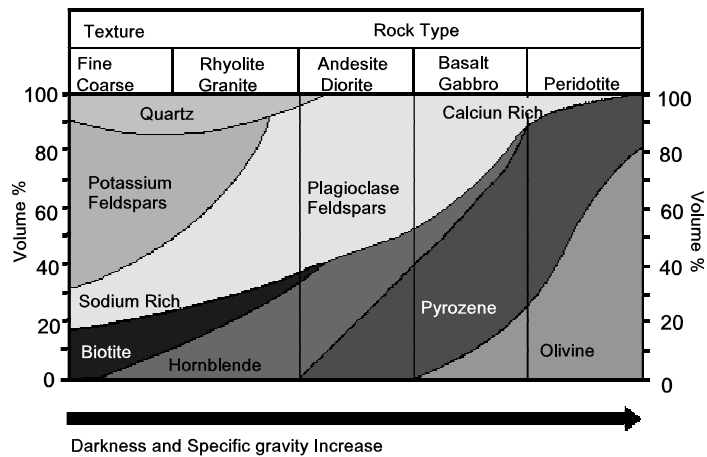
19. What is the correct match for magma composition and environment?

	Magma Composition	Environment
(A)	felsic	divergent boundary
(B)	felsic	hot spots
✓ (C)	mafic	ridge
(D)	mafic	transform boundary

20. Which describes the cooling rate and crystal size of lava that cools at Earth’s surface?

	Cooling Rate	Crystal Size
(A)	fast	large
✓ (B)	fast	small
(C)	slow	large
(D)	slow	small

21. Based on the diagram below, which mineral is found in most igneous rocks?



- (A) biotite
- (B) olivine
- ✓ (C) plagioclase feldspar
- (D) potassium feldspar

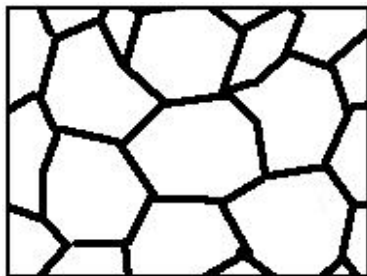
22. Which mineral forms in a hot, shallow marine environment?

- (A) feldspar
- ✓ (B) gypsum
- (C) olivine
- (D) quartz

23. Which is an organic sedimentary rock?

- (A) andesite
- (B) gneiss
- ✓ (C) lignite
- (D) shale

24. Which sedimentary feature is evident in the diagram below?



- (A) cross-bedding
- ✓ (B) mud cracks
- (C) striations
- (D) varves

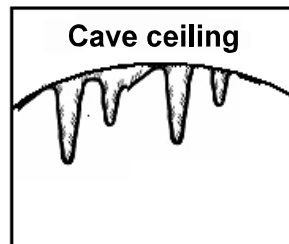
25. Which are used to determine the direction of glacier movement?

- (A) erratics, cirques, and eskers
- (B) horns, arêtes and ground moraine
- ✓ (C) striations, drumlins and terminal moraines
- (D) u-shaped valleys, horns, and erratics

26. Which is the most abundant type of deposit associated with deep-sea fans?

- (A) basalt
- (B) granite
- (C) tillite
- ✓ (D) turbidite

27. Which sedimentary feature is illustrated in the diagram below?



- (A) arêtes
- (B) horns
- ✓ (C) stalactites
- (D) stalagmites

28. Which is an erosional feature associated with shoreline environments?

- (A) delta
- (B) sand dune
- ✓ (C) sea stack
- (D) striations

29. What can be used to determine current direction?

- ✓ (A) cross bedding
- (B) fossils
- (C) mud cracks
- (D) varves

30. Which rock is formed when a layer of shale becomes metamorphosed?

- (A) granite
- (B) marble
- (C) quartzite
- ✓ (D) slate

31. In which of Earth's layers does convection occur?

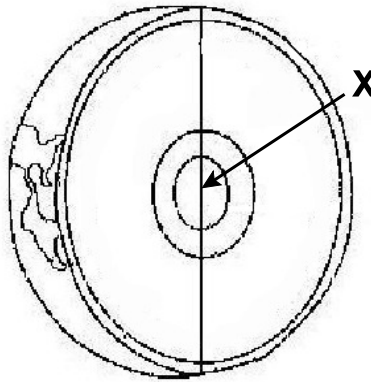
- (A) crust
- (B) inner core
- (C) lithosphere
- ✓ (D) mantle

32. What texture is evident in the rock sample below?



- ✓ (A) foliated
- (B) glassy
- (C) porphyritic
- (D) pyroclastic

33. Which layer of Earth's structure is represented by X?



- ✓ (A) asthenosphere
- (B) inner core
- (C) lithosphere
- (D) outer core

34. Which describes a transform plate boundary?

- (A) Composite volcanoes accompany the plate boundary.
- ✓ (B) Lithosphere is neither created nor destroyed.
- (C) One plate subducts below the other plate.
- (D) Up-welling of basalt fills the area between two plates.

35. Which feature would most likely form from compressional forces?

- (A) divergent boundary
- (B) normal fault
- ✓ (C) reverse fault
- (D) transform boundary

36. Which supports the concept of sea floor spreading based on evidence collected in the 1960's?

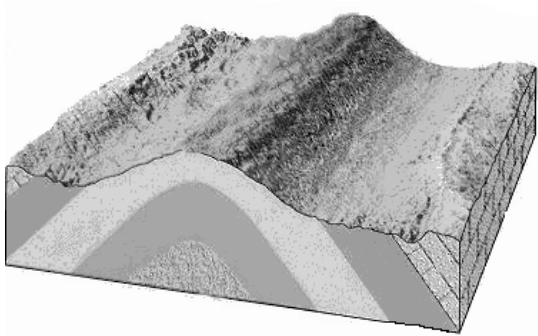
- (A) Evidence of glaciation is found in both South America and Africa.
- (B) Similar fossils are found on both sides of the Atlantic Ocean.
- ✓ (C) The age of oceanic crust increases as you move away from a mid-oceanic ridge.
- (D) The continents fit together like a jigsaw puzzle.

37. Earthquake X is 3.5 on the Richter scale. Earthquake Y releases approximately 27 000 times more energy than earthquake X. What is the Richter scale reading of earthquake Y?
- (A) 4.5
 - (B) 5.5
 - ✓ (C) 6.5
 - (D) 8.5

38. What is the correct pairing of rock type and plate boundary?

	Rock Type	Plate Boundary
✓ (A)	basalt	ocean-ocean divergent
(B)	gabbro	convergent
(C)	granite	divergent
(D)	gypsum	ocean-continent convergent

39. What produced the structure in the diagram below?



- ✓ (A) compressional forces
- (B) faulting
- (C) shear forces
- (D) tensional forces

40. Where do the majority of earthquakes occur?

- (A) centre of continents
- (B) continental shelves
- (C) deep ocean basins
- ✓ (D) plate boundaries

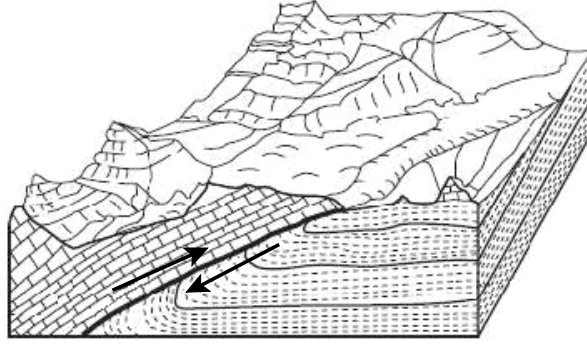
41. What happens to the speed of seismic waves when they pass from the crust to the mantle?

- (A) remains the same
- (B) slows down
- ✓ (C) speeds up
- (D) stops

42. Which geological setting would be the site of violent volcanic eruptions?

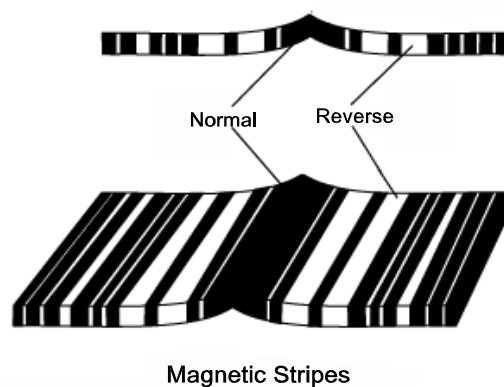
- ✓ (A) convergent plate boundary
- (B) divergent plate boundary
- (C) mid-oceanic hot spot
- (D) transform plate boundary

43. Which type of plate boundary and force is illustrated in the diagram below?



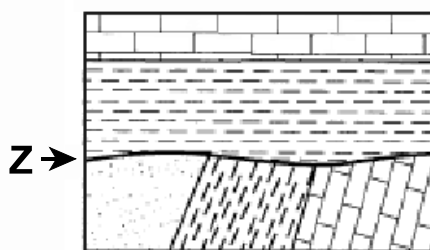
- ✓ (A) convergent - compressional
(B) convergent - tensional
(C) divergent - compressional
(D) divergent - tensional

44. Which is confirmed by the discovery of parallel magnetic stripes on the ocean floor?



- (A) contact metamorphism
(B) Earth's rotation
(C) polar wandering
✓ (D) sea floor spreading

45. What type of boundary exists at **Z** in the diagram below?

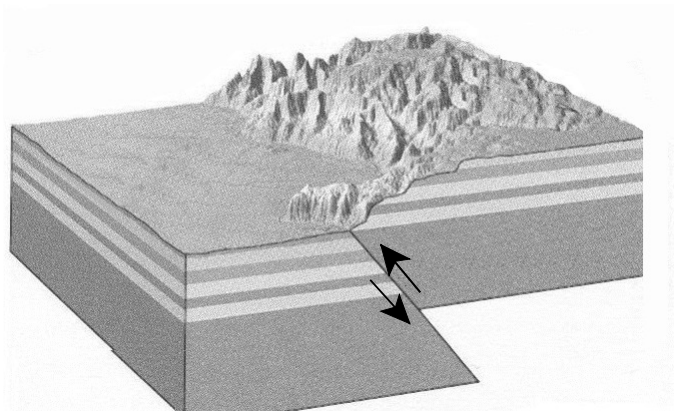


- ✓ (A) angular unconformity
(B) bedding plane
(C) intrusion
(D) nonconformity

46. Which scientific device provided data to support the outer core being a liquid?

- (A) magnetometer
(B) microscope
✓ (C) seismograph
(D) telescope

47. What type of faulting is illustrated in the diagram below?



- (A) normal
- ✓ (B) reverse
- (C) strike-slip
- (D) transform

48. Which elements are currently being mined at Voisey’s Bay, Labrador?

- ✓ (A) copper and nickel
- (B) lead and gold
- (C) magnesium and silver
- (D) zinc and aluminum

49. What mineral is the main source of iron?

- (A) bauxite
- (B) galena
- ✓ (C) hematite
- (D) sphalerite

50. What is the correct match between the resource and its economic use?

	Resource	Economic Use
(A)	gold	steel manufacturing
(B)	gypsum	jewelry
✓ (C)	natural gas	fossil fuel
(D)	sulphur	building material

51. In which rock type do the oil and gas deposits of Hibernia occur?

- (A) granite
- (B) igneous
- (C) metamorphic
- ✓ (D) sedimentary

52. Which rock type would most likely contain well-preserved fossils?

- (A) conglomerate
- (B) granite
- (C) schist
- ✓ (D) shale

53. In what geological era would one find a rock layer containing numerous dinosaur fossils?

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

54. What method of fossilization preserve plants by depositing minerals in pore spaces?

- (A) carbonization
- (B) mold and cast
- ✓ (C) petrification
- (D) preservation

55. In which environment did these organisms live?



- (A) desert
- (B) glacial
- ✓ (C) marine
- (D) mountain

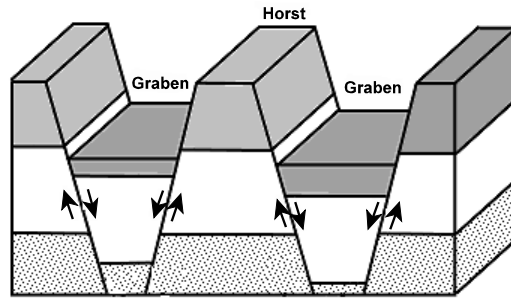
56. What life form was last to evolve?

- (A) amphibians
- (B) fish
- ✓ (C) mammals
- (D) reptiles

57. Which process shows a direct link between the atmosphere and the geosphere?

- (A) ground water pollution
- (B) ozone depletion
- (C) photosynthesis
- ✓ (D) volcanic outgassing

58. At which plate boundary would the structure illustrated below occur?



- ✓ (A) convergent
- (B) divergent
- (C) shear
- (D) transform

59. What effect do large volcanic eruptions have on Earth's atmosphere?

- ✓ (A) decrease in dust levels
- (B) decrease in temperatures
- (C) increase in pressure
- (D) increase in solar radiation

60. Which is a non-renewable resource?

- ✓ (A) coal
- (B) forests
- (C) solar energy
- (D) wind energy

Total Value: 40%

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

2%

61.(a) The parent isotope of a radioactive element has a half-life of 250 million years. If a sample contains 12.5% of the parent isotope, how old is the rock? Show all workings.

Answer:

HL = 250 Million yrs

Parent Isotope remaining = 12.5%

Age = ????

<p># of Half Lives = 3HL</p> <p>100% → 50% → 25% → 12.5%</p>	<p>Age = # HL x Time of HL</p> <p>Age = 3 HL x 250 Million years</p> <p>Age = 750 Million Years</p>
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2%

(b) Two hikers sit together on a hilltop overlooking a steep-sided river valley. One hiker explains its formation using uniformitarianism while the other uses catastrophism. Summarize each hiker's explanation of how the valley formed.

Answer:

The hiker that follows an uniformitarianism view would suggest that the valley formed over an extremely long period of time (perhaps millions of years) and was formed by physical forces, such as erosion and weathering, that have affected and shaped Earth for millions of years. In comparison, a hiker that follows a catastrophic view would suggest that the valley formed over a relatively shorter period of time and was formed by some unexplainable, sudden event commonly called a catastrophe, for example an earthquake, etc....

2%

62.(a) Explain how the interaction between the hydrosphere and lithosphere influences landscapes.

Answer:

The hydrosphere is the water portion of Earth which consist of both solid (ice) and liquid (water) states. Landscape features for the most part are the result of ice (glaciers) and moving water (rivers, ground water, waves, etc...) eroding and weathering the lithosphere, which is the upper portion (100 km) of the solid Earth. As ice and water moves over and through the lithosphere, Earth's surface is shaped by the erosive forces and result in uneven, scenic landscape features, such as, glacial valleys, cirques, eskers, river valleys, sea stacks, etc....

Value

2% 62.(b) Describe the process that could lead to the segregation of layers within a newly-formed planet.

Answer:

A newly-formed planet would have a homogeneous solid interior that is the same throughout. Over time the planet would experience numerous impacts from meteoroids and asteroids. This would cause the particles within the planet to collide and heat up as a result of friction. In addition, heat may result when radioactive elements, common in space rocks, decay to become stable elements. The resulting heat would build up within the planet and eventually cause the interior to melt. Heavier, more dense elements would move toward the center of the planet and the lighter, less dense elements would move toward the surface of the planet. This process would continue for extended periods of time and result in the planet becoming segregated into layers according to the density of the material that makes up the planet.

3% 63.(a) Briefly describe how a geologist would use texture and mineral composition to determine the type of igneous rock.

Answer:

Igneous rocks can be classified according to its texture and mineral composition. The texture refers to the size, shape, and arrangement of minerals within an igneous rock and is determined by the environment and the rate at which the molten rock cools. The faster the cooling, the smaller the crystals. This can form a glassy or fine (aphanitic) texture. The slower the cooling rate, the larger the crystals. This can form a coarse (phaneritic) texture. Mineral composition refers to the mineral make up of the igneous rock. Minerals in igneous rocks are generally dark in color or light in color. Igneous rocks are classified as mafic, intermediate and felsic. Each of these three classifications are based on the mineral composition and are reflected by the relative color of the igneous rock.

2% (b) Describe two features that would suggest to a geologist that a valley was subjected to alpine glaciation.

Answer:

The presence of the following erosional features indicate that alpine glaciation had occurred; U-shaped valleys, cirques, aretes, and horn. Also the following deposition features could indicate glaciation had occurred; Moraines (medial, lateral, and terminal), and glacial till.

Value

2%

63.(c) Describe one erosional feature and one depositional feature related to rivers.

Answer:

Erosional features may include:

- i) v-shaped valley - An elongated lowland between ranges of mountains, hills, or other uplands, often having a river or stream running along the bottom.
- ii) canyon - A narrow chasm with steep cliff walls, cut into the earth by running water; a gorge.

Depositional features may include:

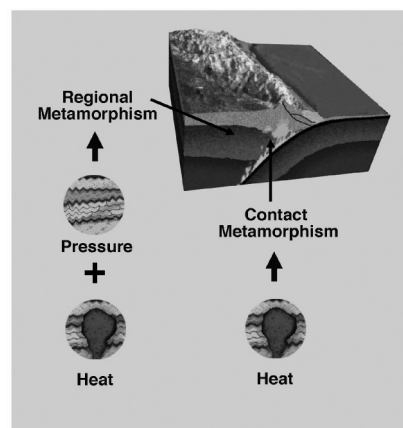
- i) delta - a usually triangular alluvial deposit at the mouth of a river.
- ii) ripple marks - ripple marks are sedimentary structures that indicate agitation by river currents.
- iii) flood plain - the relatively flat land stretching from either side of a river to the bottom of the valley walls.

3%

(d) Explain the difference between regional metamorphism and contact metamorphism within a mountain environment. Include a labeled diagram with your answer.

Answer:

Two of the main factors that affect metamorphism is temperature and pressure. During regional metamorphism, both heat and pressure are present which cause rocks to change (metamorphosis) over a large area. For example, the interior of mountainous environments experience regional metamorphism, (see diagram). Whereas, during contact metamorphism, only heat is needed to cause rocks to change (metamorphosis) over a relatively smaller area. For example, the area immediately surrounding (in contact with) hot molten rock (see diagram).



Value

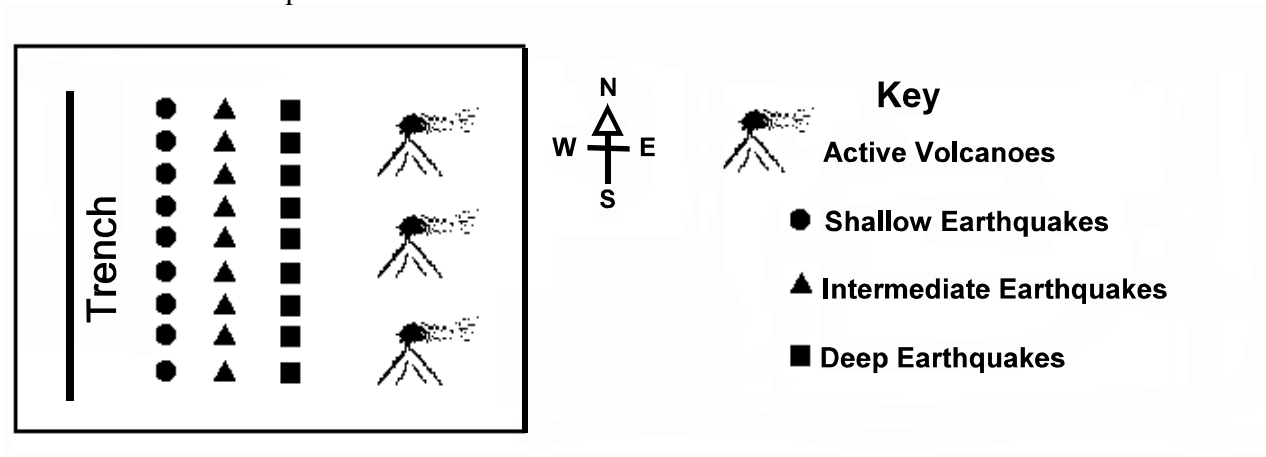
2%

63.(e) In relation to the rock cycle, explain two processes responsible for the formation of sedimentary rocks.

Answer:

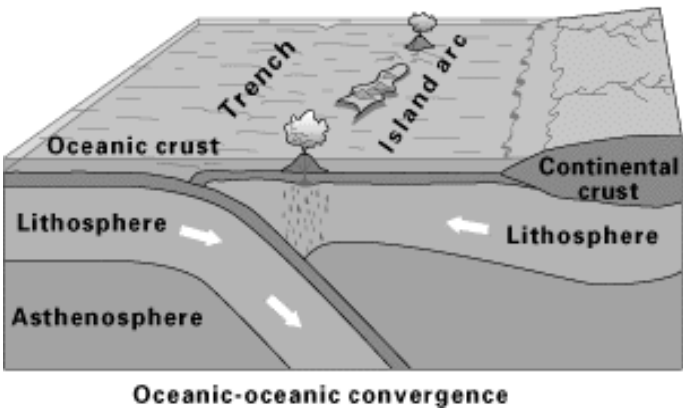
Diagenesis (Lithification) is the process that turns sediment into rock. The first stage of the process is compaction. Compaction occurs as the weight of the overlying material increases. Compaction forces the grains closer together, reducing pore space and eliminating some of the contained water. The second stage of the process is called cementation. Some of this water may carry mineral components (silica/calcite) in solution, and these chemicals may later precipitate as new minerals in the pore spaces. This causes cementation, which will then start to bind the individual particles together.

(f) The diagram below shows a vertical view of earthquake epicentres and volcanic activity in an area underlain by oceanic crust. Active volcanoes lie to the east of the earthquake zone.



2%

(i) Sketch a cross-sectional diagram from west to east through the region.



1%

(ii) What type of plate collision has occurred in the diagram above?

Answer:

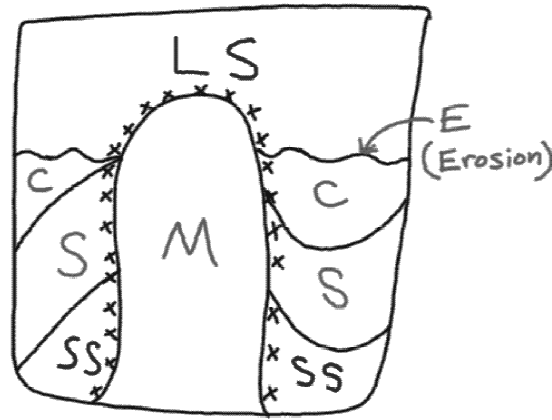
Ocean - continent plate collision is seen in the diagram in part (i). These collision boundaries are located where oceanic plates subduct beneath continental plates.

Value

2%

63.(g) Construct a labeled geological cross-section that represents the following sequence of events.

Sandstone (SS), shale (S) and then conglomerate (C) are deposited horizontally. Compressional forces cause folding of these layers to create a syncline and an anticline. Following folding, there is a period of erosion (**Event E**). Later, deposition places a thick layer of limestone (L) on top. Finally, magma (M) intrudes the entire sequence, and does not reach the surface.



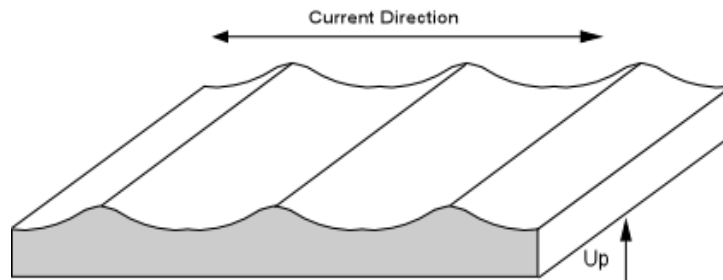
Legend:

SS - Sandstone
S - Shale
C - Conglomerate
LS - Limestone
E - Erosion
M - Magma
"X" - Contact Metamorphism

3%

(h) Explain how symmetrical ripple marks would form in a beach environment. Use a diagram to assist in your answer.

Answer:



Symmetrical ripples form when the water moves back and forth. Symmetrical ripple marks occur in environments where there is a steady back and forth movement of the water, such as tidal action in a beach environment.

2%

63.(i) Describe one type of mineral deposit that may be associated with a large igneous intrusion.

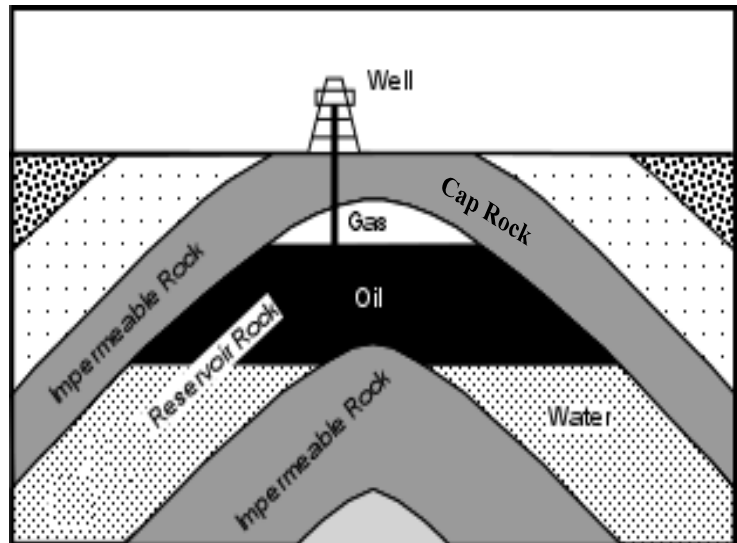
Answer:

Mineral deposits that are associated with large igneous intrusions include, magmatic deposits and hydrothermal deposits. Magmatic mineral deposits are those which are formed during crystallization of a magma, deep underground. The deposit can consist of massive ores in some cases, and disseminations of rare minerals in others. Hydrothermal mineral deposits are any concentration of metallic minerals formed by the precipitation of solids from hot mineral-laden water (hydrothermal solution). The solutions are thought to arise in most cases from the action of deeply circulating water heated by magma.

Value

2% 63.(j) Sketch an anticline oil trap. Include the following in your labeling:

- cap rock
- reservoir rock
- oil
- natural gas
- water



2% (k) Explain one way paleomagnetism supports Plate Tectonic theory.

Answer:

Paleomagnetism is the study of the record of the Earth's magnetic field preserved in various magnetic minerals through time. The study of paleomagnetism has demonstrated that the Earth's magnetic field varies substantially in both orientation and intensity through time. This idea supports the plate tectonic theory in two ways; (1) polar wandering and (2) magnetic reversals on the ocean floor. Paleomagnetic evidence, both reversals and polar wandering data, was instrumental in verifying the theories of continental drift and plate tectonics in the 1960s and 70s.

1) Polar wandering - Scientists measured the orientation and direction of the acquired magnetic fields and, from these orientations, calculated the direction of the rock's magnetism and the distance from the place the rock was found to the magnetic poles. As calculations from rocks of varying ages began to accumulate, scientists calculated the position of the earth's magnetic poles over time. The position of the poles varied depending on where the rocks were collected, and the idea of a polar wander path began to form. When sample paths of polar wander from two continents, such as North America and Europe, were compared, they coincided as if the continents were once joined.

2) Magnetic Reversals - British scientists Fred J. Vine and Drummond H. Matthews combined their observations of the marine magnetic anomalies with the concept of reversals of the earth's magnetic field. They proposed that the marine magnetic anomalies were a "tape recording" of the spreading of the ocean floor as the earth's magnetic field reversed its direction. The concept of magnetic field reversals was a breakthrough that explained the magnetic polarity switches seen in sea floor spreading as well as the concept of similar magnetic patterns in the rocks used to demonstrate plate tectonics.

Value

2% 64.(a) Explain how a plant leaf may become fossilized as a result of carbonization.

Answer:

When a plant leaf becomes trapped between sediments compression results. The compression removes volatile compounds (water and gases) and transforms the organic structure, leaving a thin film of carbon. The thin, dark, film is made of stable carbon molecules that remain after more volatile and unstable compounds get dissolved away. This carbon creates an impression of the leaf in the rock outlining the fossil, sometimes with great detail.

2% (b) Why does the island of Newfoundland have distinct geologic zones?

Answer:

The island of Newfoundland has three distinct geologic zones, represented within the Western, Central, and Eastern regions of the island portion of Newfoundland and Labrador. These regions resulted when tectonic plates collides some 450 million years ago. During this time the North American plate (Western Newfoundland) collided with the African Plate (Eastern Newfoundland) and sandwiched remnants of the ocean floor (Central Newfoundland) in between the two landmasses. This process formed the three distinct geologic zones of the island of Newfoundland.

2% (c) What effects could prolonged volcanic activity have on the biosphere?

Answer:

There are many negative effects that a volcanic eruption can have on the biosphere. The hydrosphere is somewhat related to the biosphere. Without water, life cannot exist. Therefore, pollution in major water sources for all living things affect their survival. Volcanic eruptions also destroy crops and plants. Without these plants, the ecosystem will be affected. Food webs will be affected. Volcanic ash can stay in the atmosphere for years blocking sunlight that is necessary for life on Earth, which may also cause food webs to be affected.