

**PART I**  
**Total Value: 50%**

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

1. Which refers to how Plate Tectonics explains the present location of the continents?
- (A) hypothesis  
(B) law  
(C) paradigm  
✓ (D) theory
2. Which branch of Earth Science would be **most** involved with the processing of ore?
- ✓ (A) hydrology  
(B) mineralogy  
(C) paleontology  
(D) volcanology
3. A geologist determines the age of a rock to be 2.1 billion years old according to Uranium 235-Lead 207 (half life 0.7 billion years). What was the original amount of Uranium 235 in the rock if there are now 15g remaining?
- (A) 5g  
(B) 7.5g  
(C) 45g  
✓ (D) 120g
4. Which bar graph of the geological time scale represents the relative amount of time occupied by Precambrian?
- ✓ (A) 

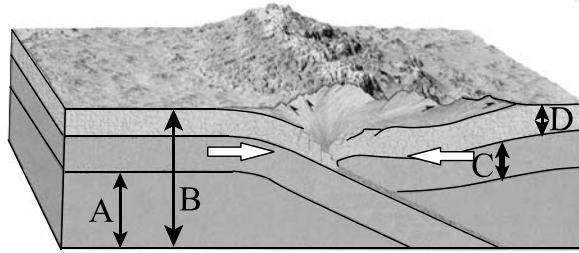
Precambrian	
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- (B) 

Precambrian	
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- (C) 

Precambrian	
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- (D) 

7 Precambrian	
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5. “The same geologic processes now at work were also active in the past. Earth’s physical features were formed by these processes over long periods of time.”
- This is a statement of which fundamental geological principle?
- (A) catastrophism  
(B) fundamentalism  
(C) superposition  
✓ (D) uniformitarianism

6. Which layer indicates the mantle?



- ✓ (A) A  
(B) B  
(C) C  
(D) D
7. The Moho is the boundary between which two layers?
- ✓ (A) crust and mantle  
(B) inner core and outer core  
(C) lower mantle and upper mantle  
(D) outer core and mantle
8. Which **best** describes a difference between oceanic and continental crust?
- (A) Oceanic crust is granitic; continental crust is basaltic.  
(B) Oceanic crust is less dense than continental crust.  
(C) Oceanic crust is older than continental crust.  
✓ (D) Oceanic crust is thinner than continental crust.
9. A porous and permeable sandstone is layered between an unfractured limestone and a shale. If the sandstone contains groundwater, which term would be applied to the sandstone?
- (A) aquiclude  
(B) aquiduct  
✓ (C) aquifer  
(D) aquitard
10. Which reservoir contains 97% of all water on Earth?
- (A) atmosphere  
(B) glaciers  
(C) groundwater  
✓ (D) oceans
11. Which aquifer would be **best** for purifying groundwater that is contaminated with harmful sewage bacteria?
- (A) cavernous limestone  
(B) coarse gravel  
✓ (C) fine sand  
(D) highly fractured granite
12. What are the two **most** important heat absorbing gases in the lower atmosphere?
- (A) argon and oxygen  
(B) oxygen and nitrogen  
(C) ozone and chlorofluorocarbon (CFC)  
✓ (D) water vapor and carbon dioxide

13. Which factor has the greatest effect on the amount of UV radiation reaching Earth's surface?
- ✓ (A) decreasing concentrations of helium
  - (B) decreasing concentrations of ozone
  - (C) increasing concentrations of argon
  - (D) increasing concentrations of greenhouse gases
14. Which processes **best** describe "life"?
- (A) metabolism, photosynthesis, respiration
  - (B) photosynthesis, reproduction, growth
  - (C) respiration, metabolism, growth
  - ✓ (D) reproduction, growth, metabolism
15. Which is **NOT** a characteristic of minerals?
- ✓ (A) definite chemical composition
  - (B) either a liquid or a solid
  - (C) formed by inorganic processes
  - (D) possess a crystalline structure
16. What does the cleavage property of a mineral generally represent?
- ✓ (A) Chemical bonds are weak in specific directions.
  - (B) It always shows the true crystal shape of that mineral.
  - (C) It contains soluble molecules.
  - (D) It shows the degree of metamorphism that occurred during formation.
17. To which major mineral group does calcite ( $\text{CaCO}_3$ ) belong?
- ✓ (A) carbonates
  - (B) oxides
  - (C) silicates
  - (D) sulfates
18. Why might a sample of quartz sandstone fizz when exposed to a drop of acid?
- (A) Quartz readily reacts with acid.
  - (B) The acid has gone bad.
  - (C) The clays are undergoing disintegration.
  - ✓ (D) The sandstone is cemented with carbonate.
19. Which is an example of an extrusive igneous rock?
- ✓ (A) basalt
  - (B) gabbro
  - (C) granite
  - (D) shale
20. What would a porphyritic texture indicate about a rock?
- ✓ (A) It contains large broken fossil fragments.
  - (B) It experienced two different cooling environments.
  - (C) It was deposited in a near shore environment.
  - (D) It will have highly developed foliation.

21. According to the data given in the table below, which statement is correct?

Moh's Mineral Hardness Scale		Approximate Hardness of Common Objects	
Talc	1	Fingernail	2.5
Gypsum	2	Copper penny	3.5
Calcite	3	Iron nail	4.5
Fluorite	4	Glass	5.5
Apatite	5	Steel file	6.5
Feldspar	6		
Quartz	7		
Topaz	8		
Corundum	9		
Diamond	10		

- (A) A fingernail will scratch calcite, but not quartz.
- (B) A fingernail will scratch quartz, but not calcite.
- ✓ (C) A piece of glass can be scratched by quartz, but not by calcite.
- (D) A piece of glass can be scratched by calcite, but not by quartz.

22. What can be used to classify igneous rocks?

- (A) bedding
- (B) foliation
- (C) fossils
- ✓ (D) texture

23. Which type of coal was exposed to metamorphic processes?

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

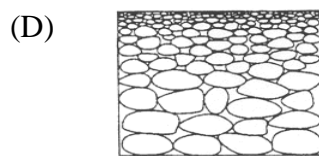
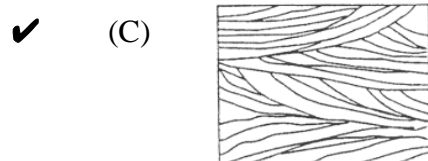
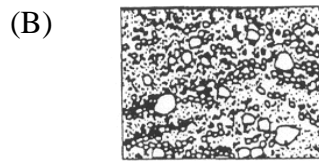
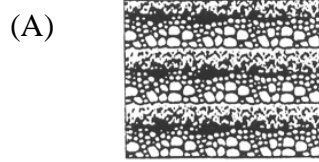
24. Which property is a feature of a sedimentary rock?

- (A) foliation
- (B) glassy texture
- ✓ (C) layering
- (D) vesicles

25. Which sedimentary rock would be composed of particles of varying sizes?

- ✓ (A) conglomerate
- (B) sandstone
- (C) shale
- (D) siltstone

26. Which cross section best represents the sediment that was transported and deposited by wind?



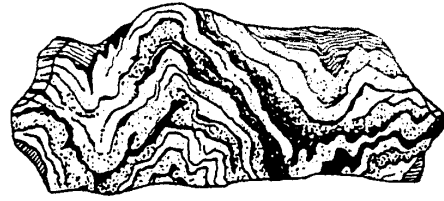
27. What is the metamorphic equivalent of limestone?

- ✓ (A) gneiss  
(B) marble  
(C) quartzite  
(D) schist

28. Which Canadian scientist made major contributions to the development of the Plate Tectonic theory?

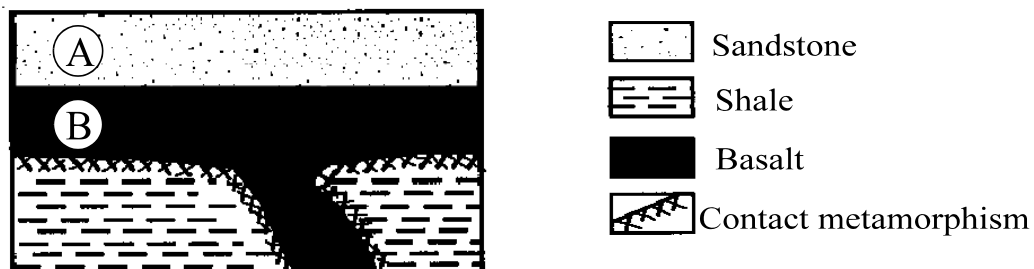
- (A) Alfred Wegener  
(B) Arthur Holmes  
(C) James Hutton  
✓ (D) Tuzo Wilson

29. This diagram shows a large folded mountain structure. What would be the dominant rock type present?



- ✓ (A) igneous extrusive  
(B) igneous intrusive  
✓ (C) metamorphic  
(D) sedimentary

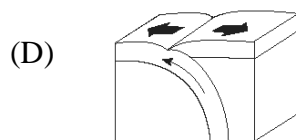
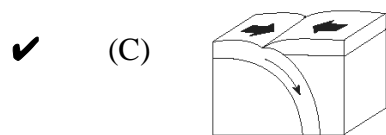
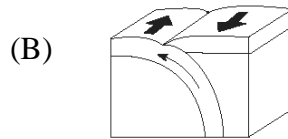
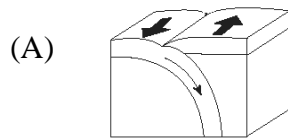
30. The diagram below shows a cross section through a portion of Earth's crust.



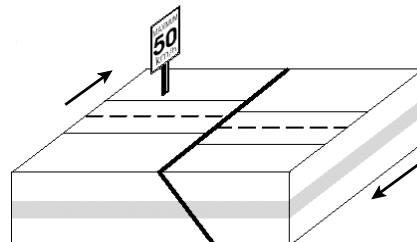
What does Unit B represent?

- ✓ (A) buried lava flow  
(B) intrusion  
(C) oil trap  
✓ (D) volcanic rock
31. What evidence indicates Earth's asthenosphere is not molten?
- (A) Holes drilled into the asthenosphere have never found any magma.  
✓ (B) If the asthenosphere were molten, then the crust would sink in it.  
(C) S waves pass through the asthenosphere without any difficulty.  
(D) The frequency of deep earthquakes suggests that the asthenosphere is brittle.

32. In which diagram do the arrows best represent the motions of Earth's crust at an oceanic trench?



33. What type of fault is illustrated in the diagram below?



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

34. What type of stress causes strata to be folded?

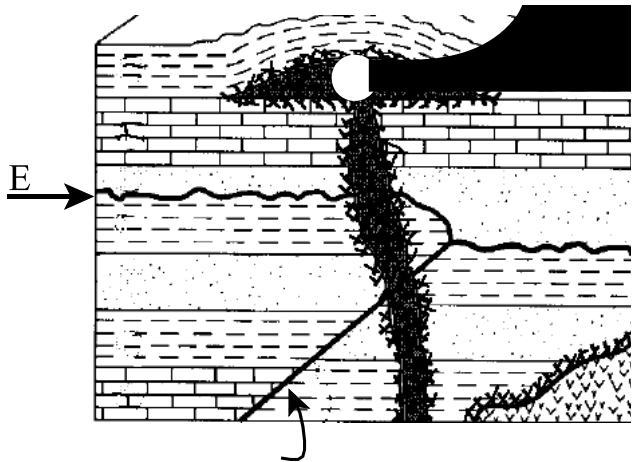
- ✓ (A) compression  
(B) expression  
(C) shearing  
(D) tension

35. The Himalayan Mountains are located along a portion of the southern boundary of the Eurasian Plate. At the top of Mt. Everest (8 800 meters) in the Himalayan Mountains, climbers have found fossilized marine shells in the surface bedrock. From this observation, which conclusion can be made about the origin of the Himalayan Mountains?

- ✓ (A) Sea level has been lowered more than 8 788 meters since the fossilization.  
(B) The bedrock containing the fossil shells is part of an uplifted sea floor.  
(C) The Himalayan Mountains formed at a divergent plate boundary.  
(D) The Himalayan Mountains were formed by volcanic activity.

36. What does going up one whole unit on the Richter scale represent?
- (A) A 10 fold increase in damage done by the quake.
  - (B) A 10 fold increase in energy release.
  - (C) A 30 fold increase in damage done by the quake.
  - ✓ (D) A 30 fold increase in energy release.

Use the diagram below to answer the next two questions.



37. What geologic feature is indicated by the letter “E” in the diagram?
- (A) angular unconformity
  - (B) buried lava flow
  - ✓ (C) disconformity
  - (D) intrusion
38. Which geologic principle indicates that rock unit “H” formed after fault “Y”?
- ✓ (A) cross-cutting relationships
  - (B) original horizontality
  - (C) superposition
  - (D) uniformitarianism
39. What is the correct matching for a plate boundary and its corresponding volcano type?
- |       | Plate Boundary | Volcano Type  |
|-------|----------------|---------------|
| ✓ (A) | convergent     | composite     |
| (B)   | convergent     | shield        |
| (C)   | divergent      | cinder        |
| (D)   | divergent      | stratovolcano |
40. In which environment would the mineral gypsum form?
- (A) deep marine
  - (B) plutonic igneous
  - ✓ (C) shallow marine
  - (D) volcanic igneous



41. In which location of Newfoundland and Labrador would you find a world class ore deposit containing nickel, copper, and cobalt?
- (A) Baie Verte
  - (B) Labrador City
  - (C) St. Lawrence
  - ✓ (D) Voisey's Bay
42. Which natural resource is currently being extracted from the Hibernia and Terra Nova sites?
- ✓ (A) asbestos
  - (B) crude oil
  - (C) dimension stone
  - (D) hematite
43. In what type of rocks are fossil fuels found?
- (A) metamorphic
  - (B) plutonic igneous
  - ✓ (C) sedimentary
  - (D) volcanic igneous
44. Which bedrock type would most likely contain fossils?
- ✓ (A) cambrian shale
  - (B) middle-proterozoic quartzite
  - (C) pleistocene basalt
  - (D) precambrian granite
45. Which organism would have the **best** chance of becoming part of the fossil record?
- (A) ant
  - (B) butterfly
  - ✓ (C) fish
  - (D) horse
46. Major changes throughout the past mark the beginning and ending of divisions in geologic time. What marked the end of Paleozoic time?
- ✓ (A) extinction of numerous species of invertebrates
  - (B) extinction of numerous species of reptiles
  - (C) increasing numbers of land plants
  - (D) increasing numbers of mammals
47. Rodinia was the supercontinent that existed before Pangea. It is believed that present continents will once again form a supercontinent. Which geologic principle is the basis for this assumption?
- (A) cross-cutting relationships
  - (B) original horizontality
  - (C) superposition
  - ✓ (D) uniformitarianism

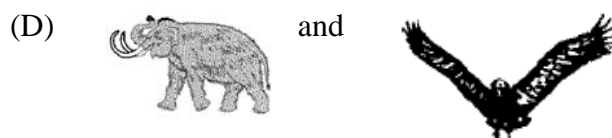
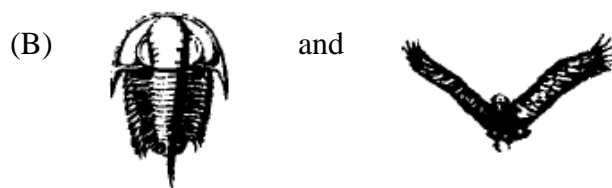
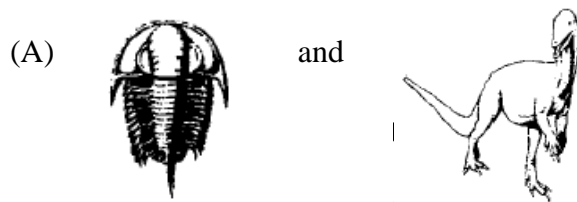
48. Iceland is a volcanic island situated on the northern section of the Mid Atlantic Ridge. Which rock would be most likely found at this location?

- ✓ (A) andesite  
(B) basalt  
(C) diorite  
(D) granite

49. Which is **NOT** a possible explanation for global climate change?

- (A) natural (astronomical) changes in Earth's orbital characteristics  
✓ (B) the blocking of solar radiation by volcanic dust in the atmosphere  
(C) the depletion of mineral resources  
(D) the production of excess greenhouse gases

50. Which pair of fossils can be found in Ordovician (505 - 438 million years ago) bedrock?



**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) Using an example for each, explain the difference between absolute time and relative time.  
Answer:  

Absolute time - time since the occurrence of a certain geologic event, it represents an exact time frame. Example, radioactive dating, varves, tree rings, etc...

Relative time - time organized in a chronological sequence and is often determined by comparison. Example, Law of superposition, crosscutting, etc....
- 2%

b) A stone arrowhead was found embedded in a thigh bone of a wooly mammoth. Would you select the arrowhead or the thigh bone for testing if only carbon-14 dating technology was available? Explain.  
Answer:  

The thigh bone would be the best choice if dating using C-14 technology due to the fact that stone usually do not contain significant amounts of carbon. Bone is considered to be organic and will contain significant amounts of carbon-12 and carbon -14, thus allowing the wooly mammoth thigh bone to be dated using c-14 dating.
- 2%

c) 4.6 billion years ago, Earth’s interior was a uniform mixture while today it is segregated into distinct layers. Explain what caused this segregation to happen.  
Answer:  

Billions of years ago, the decay of radioactive elements and heat generated by the colliding of particles, caused Earth’s interior to melt. This allowed Earth’s interior to segregate based on density. The denser elements, nickel and iron, would sink to the interior (center) while the lighter rocky components (silicates) floated toward the surface. This segregation by density is thought to still occur today on a smaller scale and was responsible for the apparent layering of Earth’s interior into layers with different properties.
- 3%

d) When fluid is being pumped out of a well, the rate of flow must be specific so that the well does not dry up. Explain.  
Answer:  

When water is pumped from a well at an increasing rate, the groundwater within the aquifer can not move fast enough to refill the well. The result is the water table lowers forming a cone of depression and the water level in the well lowers. Thus, water pumped from a well can not exceed the rate at which water can pass through the aquifer, if it does then the well will dry up.

Value

- 2%      51.e) Each year major forest fires sweep through parts of North America. State and explain two reasons why these fires will affect the short-term concentration of atmospheric CO<sub>2</sub>.

Answer:

**Forest fires generally increase CO<sub>2</sub> concentrations in the atmosphere for two main reasons;**

**1) CO<sub>2</sub> is produced by the burning of trees, hence, an increase in CO<sub>2</sub>.**

**2) Deforestation caused by burning of trees will also cause CO<sub>2</sub> concentration to increase because less trees exist to take CO<sub>2</sub> out of the atmosphere.**

- 2%      52.a) A rock sample was weighed and then placed in a graduated cylinder which contained 45 mL of water. Using the information given below, determine the density of the sample shown. **Show ALL calculations.**



mass of sample	150 g
reading on graduated cylinder without sample	45 mL
reading on graduated cylinder with sample	75 mL

Answer:

Since the density of water is 1 g/cm<sup>3</sup>, Specific Gravity of a material is equal to the material density.

$$\text{Density} = \frac{\text{Mass of sample}}{\text{Volume of water}} = \frac{150\text{g}}{75 \text{ mL} - 45 \text{ mL}} = 5 \text{ g/mL}$$

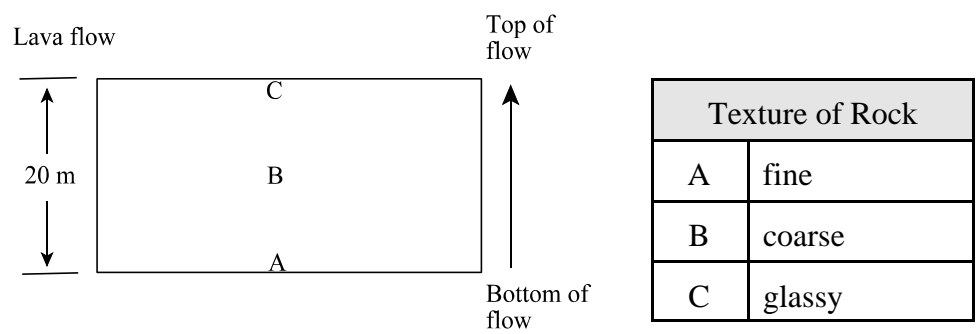
- 2%      b) Using specific mineral examples, explain the difference between fracture and cleavage.

Answer:

**Fracture is the breaking of a material along irregular planes which usually result in smooth curved surfaces (conchoidal fracture) as seen in the mineral quartz. Fracture can also display splintering or irregular jagged breaks in the Mineral, whereas, cleavage is the breaking of minerals along smooth, flat, parallel planes as predetermined by atomic structure and strength of bonding. Mica cleaves in one direction.**

Value

3% 52.c) The diagram below represents a cooled lava flow.



Explain why there are three differences in texture within the same lava flow.

Answer:

Texture in igneous rocks is determined by cooling rate. The cooling rate at points A, B, and C in the diagram differ slightly which can give different textures within the same lava flow.

Lava at position A loses heat fast as it is in contact with a cool surface (ground) and this will result in a fine texture.

Lava at position C will lose heat the fastest and will possibly cool instantly depending on what it comes in contact with (air or Water) causing it to have a glassy texture.

Lava at position B will lose heat the slowest and this will cause the interior of the lava to cool slower than the lava at positions A and C. Minerals here will have a little longer time to form and will result in a texture with coarser crystals than rocks produced at position A and C.

2% d) A river empties into a larger body of water. How will the sedimentary deposits change as distance from the river mouth increases? Explain why.

Answer:

Sedimentary deposits will decrease in sediment size with increasing distance from the shore line because the energy associated with the river is lost when it enters the still water of the ocean. This decrease in energy will cause the larger and more dense sediment to settle first, with the fine and less dense sediment to be carried farther seaward.

2% e) With regards to sorting, how does glacial till differ from stratified drift (outwash)?

Answer:

Glacial till is an unsorted mixture of angular rock fragments and boulders deposited as glacial ice melts, whereas, stratified drift (outwash) is a sorted accumulation of uniform sized sediment that results when the melt water from glaciers washes the finer sediment from the till and deposits it down stream.

Value

2% 53.a) Describe the conditions under which a very coarse-grained granite forms.

Answer:

**Granite forms in a plutonic environment where the cooling rate of the magma is slow giving the minerals time to form (grow) which is needed to form a coarse texture. Temperature of the magma is approximately 600 °C, and the magma has a high silica content.**

3% b) Describe one possible condition under which regional metamorphism can occur.

Answer:

**Regional metamorphism is often associated with extensive mountain building where enormous amounts of heat and pressure are generated. High heat and high pressure cause the parent rock to behave plastically which results in the recrystallization and deformation (folding) of the parent rock. This often changes the appearance and mineralogy of the rock. Fluids present in the parent rock also aid in the formation of metamorphic rock. A foliated texture is often seen in this type of metamorphic environment.**

2% c) Describe two pieces of evidence that Wegener used to support the theory of Continental Drift.

Answer:

**Any two of the following can be described.**

**1) Fit of the continents. Coastlines appear to fit if the continents were repositioned, but the continental shelf would show a better fit than the coastlines.**

**2) Fossil correlation. Similar fossils found in rocks on adjacent coastlines (ex. Mesosaurus).**

**3) Rock types and structures. Rocks and mountains match in appearance and age on adjacent regions of continents if repositioned.**

**4) Ancient climates. Evidence of glacial deposits in tropical regions and coal deposits in northern landmasses.**

2% d) Contrast the characteristics of Primary and Secondary waves.

Answer:

***P - wave.* Push - pull waves which vibrate in the same direction in which they move. They are the fastest earthquake wave and is the first to arrive at seismograph stations. They also pass through all states of matter, solids, liquids, and gases.**

***S - wave.* Shake the particles which cause them to vibrate in a perpendicular direction to their motion. They are slower than P - wave and is the second earthquake wave to arrive at seismic stations. They can only pass through solids.**

## Value

- 4% 53.e) Why are volcanoes at convergent boundaries more explosive than those at divergent boundaries?

Answer:

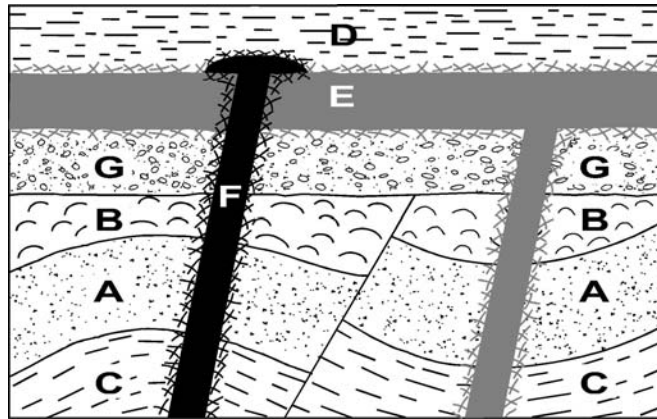
**Volcanoes at convergent boundaries are more explosive than those at divergent boundaries primarily for three reasons;**

**1) magma contain higher silica content, thus are more viscous.**

**2) temperature of the magma is lower which makes it more viscous.**

**3) magma contains more gases.**

- 4% 54.a) Describe the sequence of events that lead to the formation of this geological cross-section.



Sequence of events include the following:

- 1) Deposition of layers C, A, and B.
- 2) Folding of layers C, A, and B.
- 3) Faulting of layers C, A, and B.
- 4) Uplift of folded and faulted layers.
- 5) Erosion of folded and faulted layers.
- 6) Sinking followed by deposition of layers G and D.
- 7) Intrusion of rock unit E.
- 8) Intrusion of rock unit F.

- 4% 54.b) Distinguish between hydrothermal and depositional methods of the formation of economic mineral deposits.

Answer:

***Hydrothermal* - hot solutions react with rocks in which they pass and as a result the hot solutions becomes concentrated with metals in solution. When the hot solution enters a cooler environment, the metals precipitate from the solution and form metallic mineral deposits.**

**Ex. gold in quartz.**

***Depositional* - form by a process of sedimentation. Mineral deposits form as a result of chemical precipitation, evaporation, and density deposits in water environments.**

**Ex. gypsum and halite deposits or gold accumulating in water environments as placer deposits.**

**Value**

2% 55.a) Give two reasons why we know so little about Precambrian life forms.  
Answer:

**Evidence of Precambrian lifeforms are scarce for several reasons;**

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**1) Rocks of this time are greatly metamorphosed and deformed, extensively eroded, and covered by layers of rock strata.**

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**2) Life forms from this time are microscopic and are not easily seen.**

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**3) Most life forms from this time were thought to be soft bodied and would not be recorded in the rock record.**

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2% b) It is hypothesized that a large asteroid or comet may have collided with Earth about 65 million years ago. Explain how this impact was responsible for the mass extinctions at the end of the Mesozoic.

Answer:

**It is believed that a large dust cloud formed when the asteroid hit Earth. This restricted the amount of sunlight reaching Earth and resulted in the death of many species of plants.**

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**This then affected the food chain because plant eaters died in turn followed by meat eating organisms. This resulted in the collapse of the food chain and is thought to have caused numerous extinctions of different species of organisms.**

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**Another concern came with global forest fires and later acid rain. This also put stress on the environment and may have led to the extinction of several species.**

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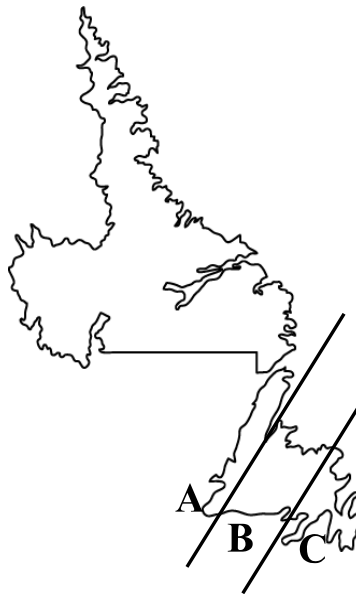


**Value**

3%

55.c)

Use the diagram below and your knowledge of the theory of Plate Tectonics to explain how the three geologic zones of the island portion of Newfoundland and Labrador were formed.



It is thought that the geology of Island Newfoundland resulted long ago when the proto-Atlantic ocean was closing. The North American plate collided with the African plate and as a result a portion of the ancestral Atlantic Ocean floor was sandwiched in between. Region A is referred to as the Humber Zone and was part of the North American plate. Region C is referred to as the Avalon zone and is thought to part of the African plate. Region B is referred to as the Central Mobile Belt and is thought to be once part of the ancestral Atlantic Ocean.

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