

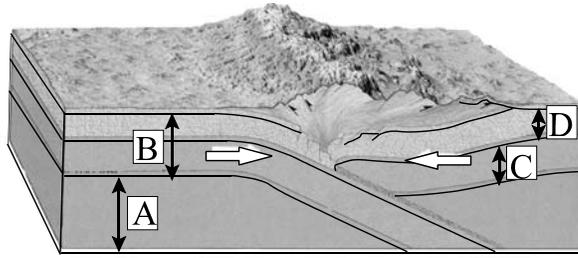
**PART I**  
**Total Value: 60%**

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

1. What is a proposed explanation that requires testing to determine its validity?  
✓ (A) hypothesis  
(B) law  
(C) paradigm  
(D) theory
  
2. Which branch of science studies the atmosphere and atmospheric phenomena?  
✓ (A) hydrology  
(B) meteorology  
(C) seismology  
(D) volcanology
  
3. Who provided information that allowed the heliocentric model to replace the geocentric model?  
(A) Anaxagoras  
(B) Aristotle  
✓ (C) Copernicus  
(D) Ptolemy
  
4. What geologic principle suggests the top layer of a sedimentary sequence is the youngest?  
(A) cross-cutting relationships  
(B) original horizontality  
✓ (C) superposition  
(D) unconformities
  
5. Which refers to annual sedimentary deposits in a glacial lake where seasonal changes occur?  
(A) growth rings  
(B) nonconformities  
(C) turbidity currents  
✓ (D) varves
  
6. The age of a rock was found to be 2.1 billion years old using uranium-235 dating (half life 0.7 billion years). What was the original amount of parent material in the rock if there are now 20 g remaining?  
(A) 2.5 g  
(B) 40 g  
(C) 60 g  
✓ (D) 160 g
  
7. How does the density of Earth's crust compare to the density of the mantle and outer core?  
(A) greater than mantle, greater than outer core  
(B) greater than mantle, less than outer core  
(C) less than mantle, greater than outer core  
✓ (D) less than mantle, less than outer core

8. Which reservoir contains the greatest percentage of water on Earth?
- (A) atmosphere
  - (B) glaciers
  - (C) groundwater
  - ✓ (D) oceans
9. Which best describes the outer core of Earth?
- ✓ (A) liquid
  - (B) plastic
  - (C) rigid
  - (D) solid
10. Which refers to the upper limit of ground water?
- ✓ (A) cone of depression
  - (B) water table
  - (C) zone of aeration
  - (D) zone of saturation
11. Which is characteristic of a good aquifer?
- (A) non porous and impermeable
  - (B) non porous and permeable
  - (C) porous and impermeable
  - ✓ (D) porous and permeable
12. Which condition is needed for a surface well to produce a continuous supply of water throughout the year?
- (A) It has to reach above the zone of aeration.
  - (B) It has to reach above the zone of saturation.
  - (C) It must pass below impermeable, solid bedrock.
  - ✓ (D) It must pass below the lowest level of the water table.
13. Which was the major cause of Earth's atmosphere changing from its original composition?
- (A) chemosynthesis
  - (B) evaporation
  - (C) melting
  - ✓ (D) photosynthesis
14. Which layers of the atmosphere decrease in air temperature with increasing altitude?
- ✓ (A) mesosphere and stratosphere
  - (B) mesosphere and troposphere
  - (C) thermosphere and stratosphere
  - (D) thermosphere and troposphere
15. Which are characteristics of life?
- ✓ (A) growth, crystallization, and absorption
  - (B) growth, metabolism, and reproduction
  - (C) metabolism, crystallization, and absorption
  - (D) metabolism, crystallization, and reproduction

16. Which layer best indicates the lithosphere?



- ✓ (A) A
- (B) B
- (C) C
- (D) D

17. Which is a negatively charged particle in an atom?

- ✓ (A) electron
- (B) neutron
- (C) nucleus
- (D) proton

18. Which elements make up the largest percentage of Earth's crust?

- (A) aluminum and iron
- (B) iron and calcium
- ✓ (C) oxygen and silicon
- (D) silicon and aluminum

19. Which is a mineral?

- (A) basalt
- (B) coal
- (C) granite
- ✓ (D) gypsum

20. Which formula is matched to the correct mineral group?

- ✓ (A)  $\text{Fe}_2\text{O}_3$  - oxide
- (B)  $\text{FeS}_2$  - sulfate
- (C)  $\text{Fe}_2\text{SiO}_4$  - carbonate
- (D)  $\text{Fe SO}_4$  - sulfide

21. Which property is best to distinguish between halite and calcite?

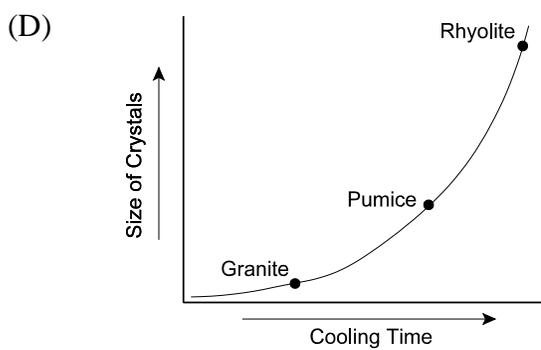
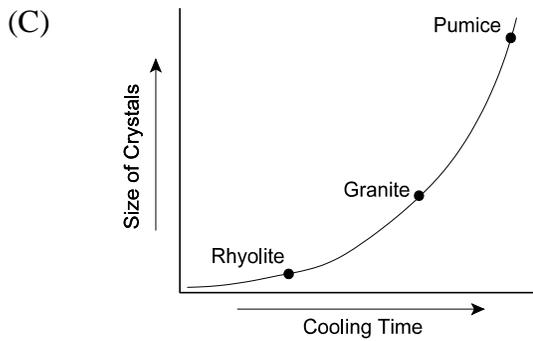
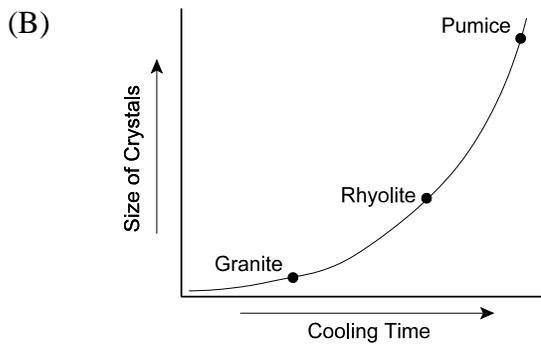
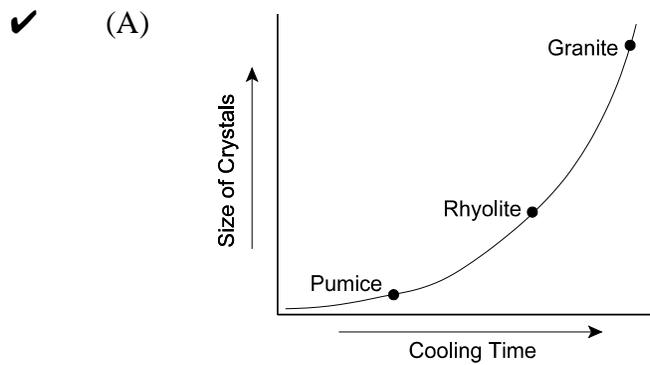
- ✓ (A) cleavage
- (B) colour
- (C) lustre
- (D) streak

22. Which refers to the colour of a mineral in its powdered form?

- (A) cleavage
- (B) hardness
- (C) specific gravity
- ✓ (D) streak

23. What is the chemical symbol for potassium?
- (A) Ar
  - ✓ (B) K
  - (C) P
  - (D) Po
24. Which compares the weight of a mineral to the weight of an equal volume of water?
- (A) crystal form
  - (B) fluorescence
  - (C) hardness
  - ✓ (D) specific gravity
25. Which mineral would be considered hardest according to Mohs hardness scale?
- (A) calcite
  - (B) fluorite
  - (C) gypsum
  - ✓ (D) quartz
26. Which rock type forms after granite melts and then solidifies?
- (A) clastic
  - ✓ (B) igneous
  - (C) metamorphic
  - (D) organic
27. Which two rocks have the most similar mineral composition?
- (A) granite and gabbro
  - (B) limestone and basalt
  - (C) marble and rhyolite
  - ✓ (D) quartzite and sandstone
28. Which is a chemical sedimentary rock?
- (A) conglomerate
  - ✓ (B) limestone
  - (C) sandstone
  - (D) shale
29. What information do glacial striations provide to geologists?
- ✓ (A) direction of glacial movement
  - (B) exact date of glaciation
  - (C) speed of the glacier
  - (D) thickness of the ice sheet
30. Which moraine indicates the furthest advance of a glacier?
- (A) lateral
  - (B) medial
  - (C) recessional
  - ✓ (D) terminal

31. Which graph below correctly shows the relative positions of granite, rhyolite, and pumice based on the cooling time of magma and the size of crystals produced?

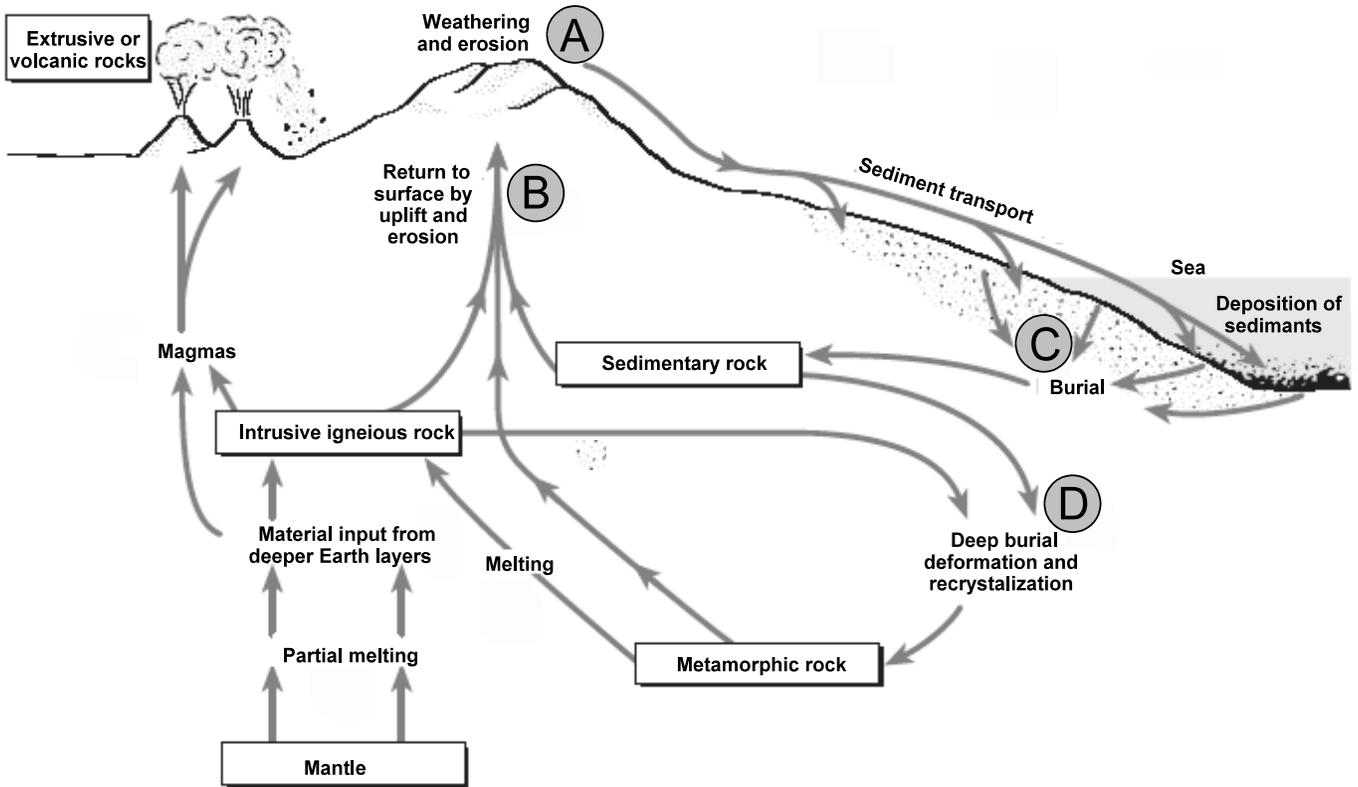


32. Which agent of erosion shaped the particles that formed the rock below?



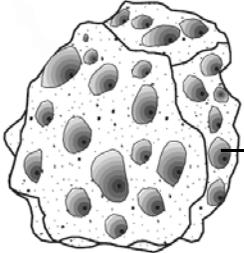
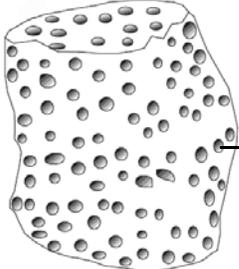
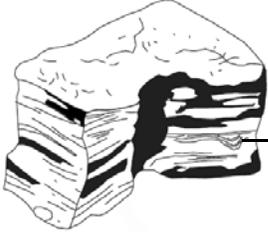
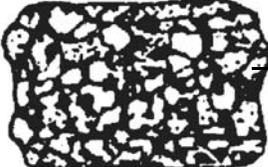
- ✓ (A) glacial ice  
 (B) mass movement  
 (C) running water  
 (D) wind

33. Which letter in the diagram below indicates where lithification is occurring?

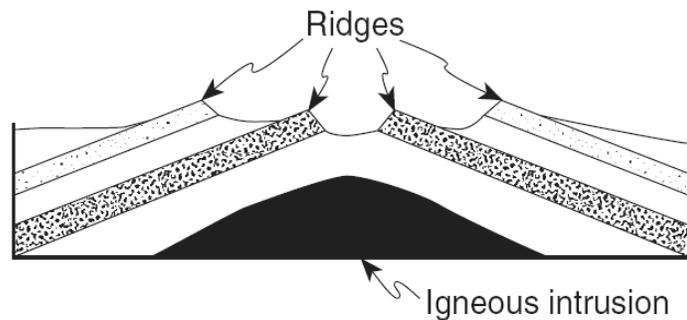


- (A) A
- (B) B
- ✓ (C) C
- (D) D

34. Which sample most probably formed directly from lava cooling quickly at Earth's surface?

- (A)  Pebbles cemented in sand matrix.
- ✓ (B)  Gas pockets in glass.
- (C)  Mica crystals in foliated layers.
- (D)  Large intergrown crystals.

35. Which best describes the cause of the ridges below?



- (A) More deposition occurred at the ridge sites after uplift.
- ✓ (B) Some rock layers were more resistant to weathering and erosion.
- (C) The igneous intrusion flowed over the surface.
- (D) The rock layers were evenly weathered.

36. Which results from the metamorphism of limestone?

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

37. Which metamorphic rock forms under the lowest temperature and pressure conditions?

- (A) gneiss
- (B) phyllite
- (C) schist
- ✓ (D) slate

38. Which most likely causes convection currents in the mantle?

- (A) cooling effects of sea water
- (B) density of continental rocks
- (C) friction between plates
- ✓ (D) temperature differences

39. Why is all oceanic crust younger than 200 million years?

- (A) It is constantly being created at mid-ocean ridges.
- ✓ (B) Older oceanic crust has been subducted beneath oceanic trenches.
- (C) Plate tectonics did not commence until the early Jurassic.
- (D) Some oceanic crust has been uplifted into mountain ranges.

40. Where does a folded mountain range form?

- ✓ (A) continental-continental plate collisions
- (B) divergent plate boundaries
- (C) oceanic-oceanic plate collisions
- (D) volcanic island arcs

41. How were the Hawaiian Islands formed?

- (A) continental intraplate volcanism
- (B) divergence of two continental plates
- (C) divergence of two oceanic plates
- ✓ (D) oceanic intraplate volcanism

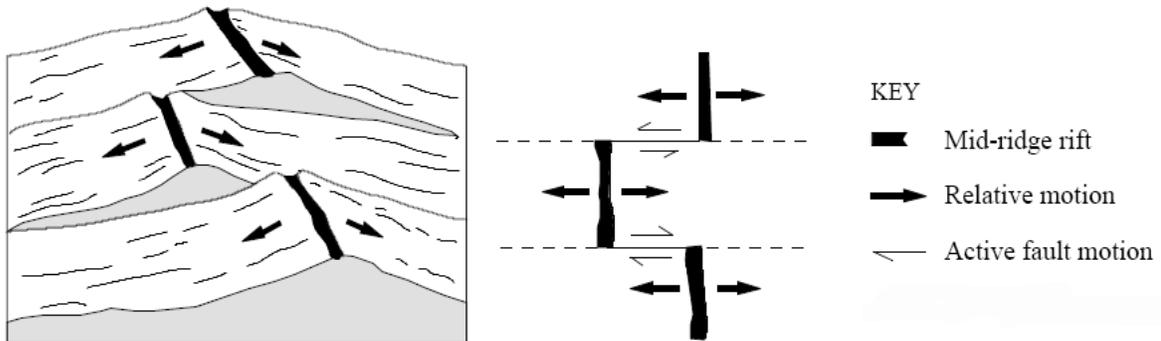
42. Which plate boundary has crust neither created nor destroyed?

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

43. Which part of a stream's load is carried along the bottom of a stream?

- ✓ (A) bed
- (B) dissolved
- (C) invisible
- (D) suspended

44. Which type of faults are shown in the diagram below?



- (A) normal
- (B) reverse
- (C) thrust
- ✓ (D) transform

45. Which type of fault occurs in a compressional environment?

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

46. Which scientist developed the theory of Continental Drift?

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

47. Which accounts for the sudden release of a large amount of energy during an earthquake?

- ✓ (A) crustal folding
- (B) elastic rebound
- (C) fault creep
- (D) seismic waves

48. What are the differences in the arrival times of P and S waves at a seismograph station used to determine?

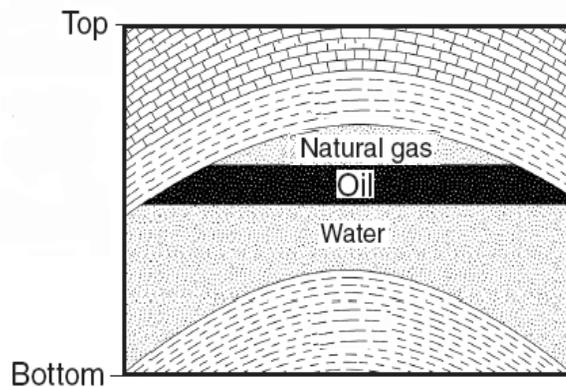
- ✓ (A) amount of damage
- (B) distance from the epicenter
- (C) intensity of energy released
- (D) when the next earthquake occurs

49. Which is an example of a trace fossil?
- (A) carbon outlines of plant fossils
  - (B) insects preserved in amber
  - (C) mineral replacement in ancient trees
  - ✓ (D) trilobite tracks and trails

50. Which geological time frame is known as the “age of mammals”?

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

51. In the diagram below, oil and water are trapped within the top of the sandstone and do not move upward through the shale. Which property of shale accounts for this?



- (A) larger particles
- (B) larger pore spaces
- (C) less foliation
- ✓ (D) lower permeability

52. A coral fossil most likely indicates which type of environment?

- (A) deep ocean
- (B) desert
- (C) forest
- ✓ (D) marine shelf

53. Why is radiometric dating more precise than superposition when determining a rocks age?

- ✓ (A) Radioactive decay occurs at a constant rate.
- (B) Some sedimentary layers may be very large.
- (C) The amount of material can be measured relatively.
- (D) The rate that wind redistributes sediments is constant.

54. Which type of coal is correctly matched with its rock type?

	Coal	Rock type
(A)	anthracite	igneous
(B)	anthracite	sedimentary
(C)	bituminous	igneous
✓ (D)	bituminous	sedimentary

55. Which process is correctly matched with the atmospheric change it causes?

	Process	Atmospheric change
(A)	photosynthesis	increases nitrogen
(B)	photosynthesis	decreases oxygen
(C)	respiration	increases nitrogen
✓ (D)	respiration	decreases oxygen

56. Which area on the island of Newfoundland is thought to have been a part of present day Africa?

- (A) central
- ✓ (B) eastern
- (C) northern
- (D) western

57. Which best supports the concept of sea floor spreading?

- ✓ (A) new rocks form closest to the oceanic ridge
- (B) new rocks form furthest from the oceanic ridge
- (C) old rocks are destroyed closest to a transform fault
- (D) old rocks are destroyed furthest from a transform fault

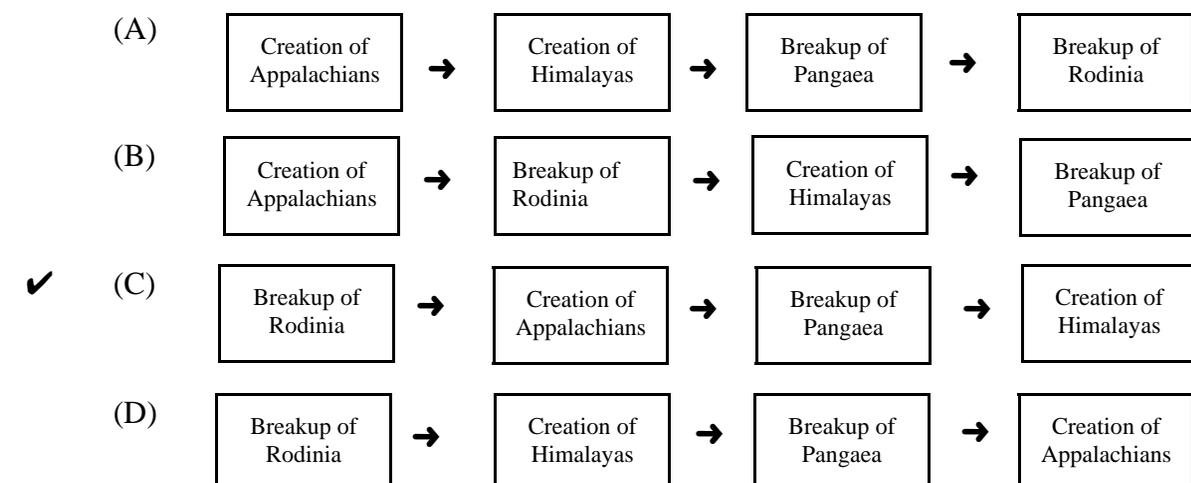
58. Which rock would most likely contain fossils?

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

59. Which term supports the idea that mass extinctions will continue to occur in the future?

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

60. Which is the correct order of events in Earth's history?



**PART II**  
**Total Value: 40%**

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

**Value**

2% 61. Describe how the geocentric and heliocentric models of the solar system represent a paradigm shift.

**Answer:**

A paradigm is a person's ideals or views on a particular concept. Earlier scientist, Ptolemy being one, believed the ideal that Earth was the center of the solar system and all heavenly bodies revolved around a stationary Earth, which is referred to as the Geocentric model of the solar system. At a later time in history, other scientist revealed evidence to suggest that Earth was one of several planets which revolved around a centralized sun, which is referred to as the Heliocentric model of the solar system. This shift in the way scientist viewed our solar system demonstrates a paradigm shift.

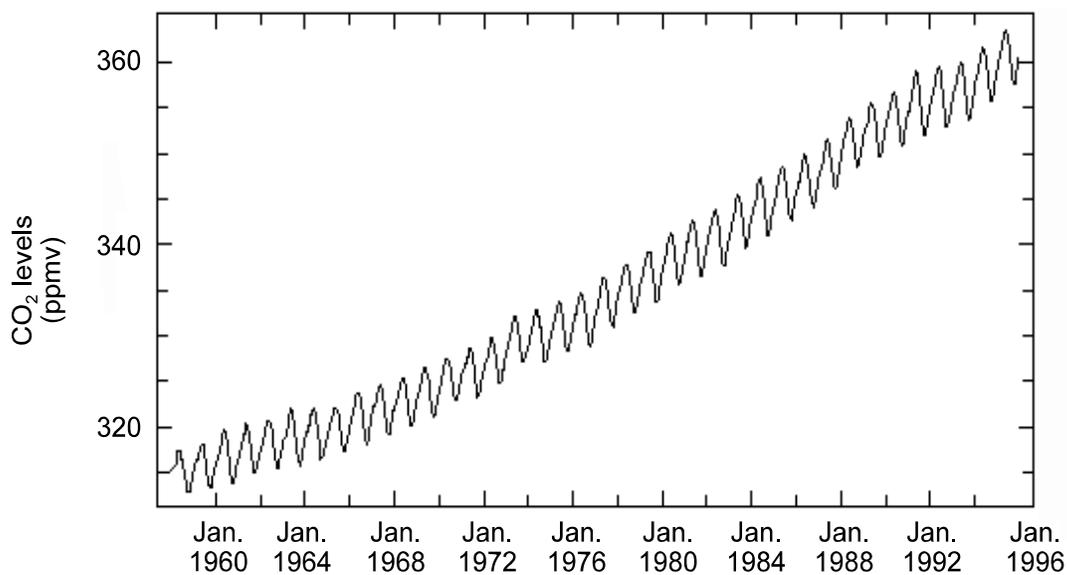
2% 62.(a) Give two reasons why glaciers are found at high altitudes and high latitudes.

**Answer:**

Glaciers are found at high altitudes and high latitudes mainly because of;

- 1) relatively lower temperatures.
- 2) less energy due to the angle of sunlight.

2% 62.(b) Refer to the graph below to answer questions (i) and (ii).



(i) Describe short term changes in CO<sub>2</sub> levels within a single year.

**Answer:**

Carbon Dioxide levels tend to fluctuate on a yearly basis as seen in the graph above. During the fall and winter months (around January), carbon dioxide levels tend to rise. This is followed by a drop in carbon dioxide levels in the spring and summer months. This fluctuation of an increase and decrease in carbon dioxide is seen throughout each successive year.

(ii) Describe long term changes in CO<sub>2</sub> levels over the thirty year period.

**Answer:**

During the thirty year period from 1960<sup>s</sup> to 1990<sup>s</sup>, there is a steady increase in the carbon dioxide levels as seen in the graph above. Thus carbon dioxide levels have continued to rise in the past thirty years.

**Value**

2% 62.(c) Describe how Earth's interior separated into its layers.

**Answer:**

The interior of Earth was a solid homogeneous mixture of materials when Earth first formed approximately 5 billion years ago. Throughout early history of Earth, the surface was bombarded with meteoroid and asteroids. This caused particles within to collide and heat up due to friction. This friction coupled with the decay of radioactive elements within Earth caused its interior to heat up and eventually start to melt. At this point Earth's interior began to separate into distinctive layers based on the density of the material. Heavier, more dense materials (iron and nickel) moved to the interior of Earth to form the centralized core and the lighter, less dense materials (silicates) moved to toward Earth's surface to form the outer shell called the crust. In between these inner most and outer most layers is another distinct layer called the mantle. Today these layers are further divided.

3% 63.(a) A geologist found an unknown colourless, transparent mineral. List and describe two mineral properties that can be used to identify this mineral.

**Answer:**

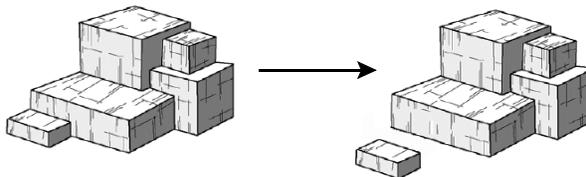
A scientist could rely on a number of different physical properties to identify minerals, however, the four most reliable include the following; hardness, cleavage, specific gravity and streak. The streak, which is the true color of the mineral in powdered form may not be of much use in this case since the minerals in question are colorless and transparent. Hardness, which is the resistance of a mineral to scratching would be one property used to help identify the colorless mineral. Cleavage, which is the minerals ability to split or break along definite planes of weak bonding would be another property used to identify the colorless mineral. Specific gravity, which is the weight of a mineral compared to that of an equal volume of water could also be used to identify the colorless mineral. Other properties can be used depending on the minerals in question, such as, fluorescence, and acid test.

2% 63.(b) With reference to atomic arrangement, explain why the cleavage of the following minerals is different.

Mineral "A"



Mineral "B"



**Answer:**

Cleavage within minerals depends on strength of bonding between atoms and the general arrangement of the atoms. These two minerals display different cleavages due to the fact that mineral "A" has atoms arranged in sheets and splits in one direction only, whereas, mineral "B" has atoms arranged in a cubic arrangement and splits in three directions at 90 degree angles.

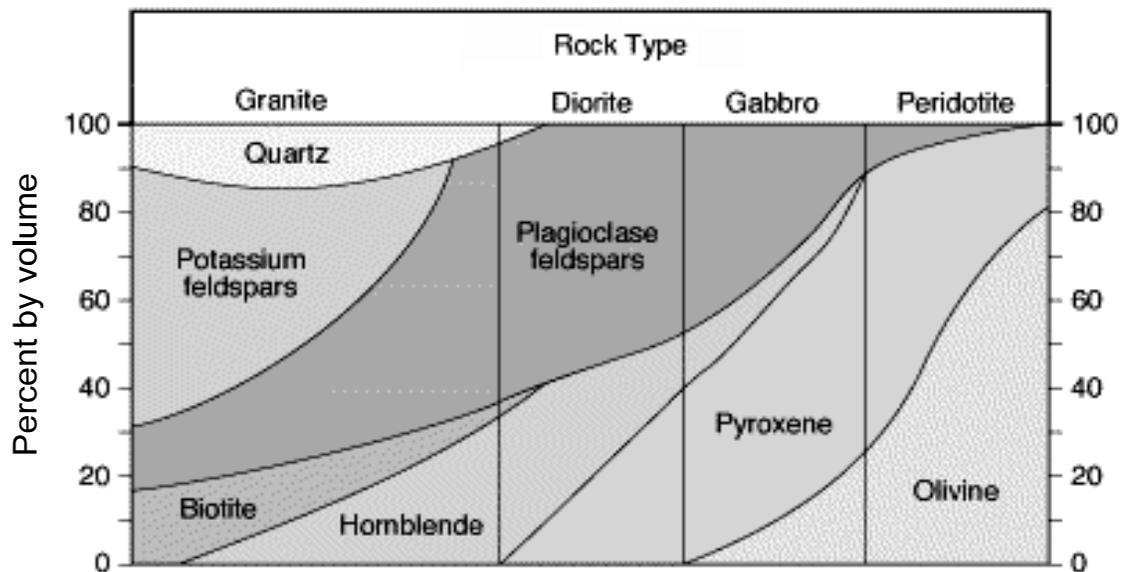
**Value**

2% 63.(c) Use the rock cycle to explain how a sedimentary rock, like conglomerate, can contain small pieces of other sedimentary, igneous, and metamorphic rocks.

**Answer:**

Conglomerate is a clastic (detrital) sedimentary rock which forms when sediment is cemented and consolidated to form solid rock, a process called lithification in the rock cycle. The sediment found within conglomerate generally consist of rounded particles of various sizes. As seen through the rock cycle all rock types can be eroded to form these particles. They become rounded as they are transported by moving waters, usually rivers and deposited in an environment (shallow marine) where it forms the solid rock conglomerate.

2% 63.(d) Using the chart below, compare the chemical composition of a sample of granite with that of peridotite.



**Answer:**

The chemical composition refers to what minerals are found in each rock type. With reference to the diagram above granite and peridotite are found on opposite ends of the chart and are composed of different minerals. Granite has a felsic composition and contain minerals such as quartz, potassium feldspar, plagioclase feldspar, biotite, and hornblende (amphibole). Peridotite has a mafic composition and contain minerals such as, plagioclase feldspar, pyroxene, and olivine.

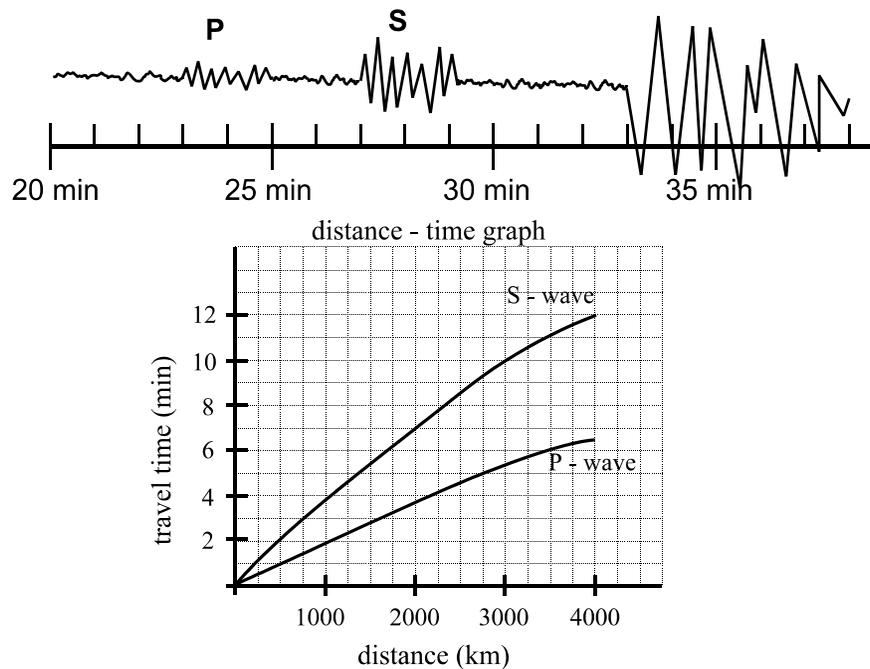
2% 63.(e) How does the porosity and permeability of sediments change as the sediments form solid rock? Explain.

**Answer:**

The porosity and permeability, whether it is loose sediment or solid sedimentary rock, is directly dependant on the space between the particles. As loose sediment consolidates (lithifies) through the processes of compaction and cementation to form solid sedimentary rock, the space between the particles (pore space) is reduced. This results in a decrease in both porosity and permeability as sediment changes to form solid sedimentary rock.

Value

3% 63.(f) The seismogram below was obtained from an earthquake.



(i) What is the distance from the recording station to the epicentre?

**Answer:**

Acceptable answers range from 2400 km to 2600 km.

(ii) Explain the procedure used to find the distance in (i).

**Answer:**

First find the arrival time interval between the P-wave and the S-wave. From the seismogram above, this value equals 4 minutes. Next we find the corresponding distance between the P-wave line and the S-wave line on the travel-time graph above. At a distance of 2500 km the distance between P-wave and S-wave lines is 4 minutes. Thus the epicentre of the earthquake is 2500 km away from the seismic station.

2% 63.(g) Use an example to show how the texture seen in a metamorphic rock is different than the rocks they formed from?

**Answer:**

Metamorphic textures seen in metamorphic rocks are different from its parent rock because of two reasons;

1. Minerals become recrystallized and result in a more dense crystalline rock. For example, in both marble and quartzite the mineral grains reorganize on the atomic scale to form larger crystals with a denser texture. This results in a harder more dense crystalline rock.

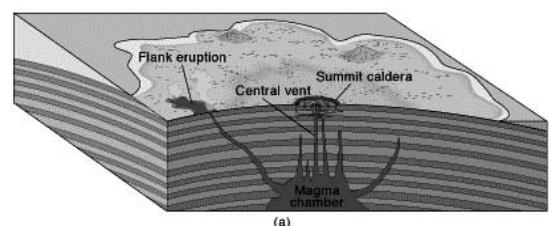
2. Minerals tend to realign to form a foliated texture. For example, Gneiss forms when the minerals in granite realign to form a banded appearance of similar minerals. The atoms reorganize on the atomic scale to form bands of lighter and darker minerals.

2% 63.(h) Draw a typical shield volcano and describe the properties of the lava that produces this type of volcanic cone.

**Answer:**

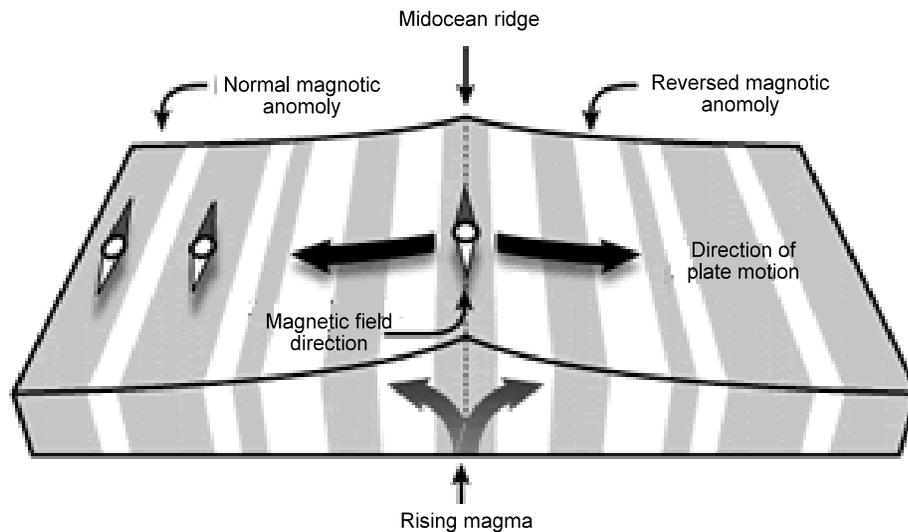
Lavas that lead to the formation of a shield volcanoes have the following properties;

- basaltic in composition
- consist of fluid lavas (not explosive)
- little gas content
- low silica content



Value

2% 63.(i) How do the magnetic stripes on the ocean floor below support seafloor spreading?



**Answer:**

As seen in the diagram above, the magnetic pattern preserved within igneous rock (basalt) on both sides of an oceanic ridge are identical. Alternating patterns of normal and reverse magnetic polarity is seen as you move away from the ridge. Since new ocean floor is formed at oceanic ridges and the same magnetic pattern is seen at regular distances from the ridge, it can be concluded that the ocean floor is spreading outward from the center of an oceanic ridge. This supports the concept of seafloor spreading.

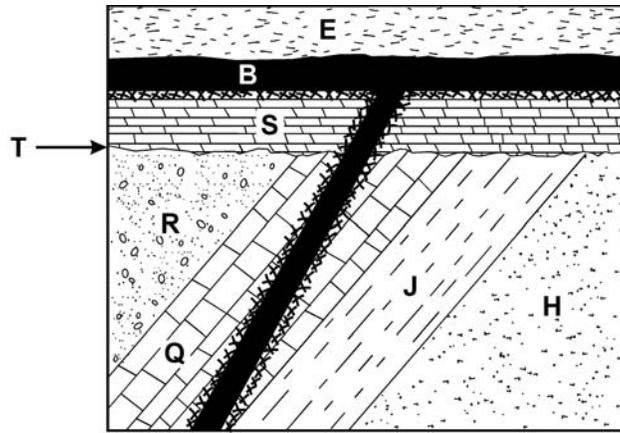
2% 63.(j) Describe the process involved in the formation of an economic mineral deposit associated with a large igneous intrusion.

**Answer:**

Economic minerals found associated with large igneous intrusions usually form as a result of hydrothermal activity. During this process, cold ocean waters move down through the ocean floor and become hot as it approaches the igneous intrusion. This hot water dissolves minerals rich in metals and carries it back toward the surface of the crust. The metals in the hot solutions precipitate (fall out of solution) as the water cools within the cracks in the ocean floor or it settles on the ocean floor as the hot solution re-enters the cold ocean water. This forms either metallic vein deposits or metallic sedimentary deposits on the ocean floor.

**Value**

63.(k) Use the diagram below to answer questions (i) and (ii).



2% (i) Arrange all letters in the diagram above in the order in which they occurred beginning with the oldest.

**Answer:**

Oldest H → J → Q → R → T → S → B → E Youngest

2% (ii) Explain why rock unit “B” is a buried lava flow.

**Answer:**

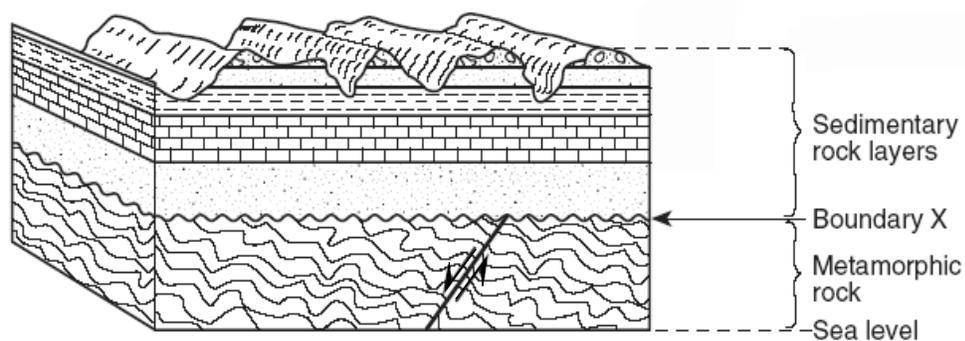
Rock unit “B” is considered a buried lava flow because of the lack of contact metamorphism (represented by xxxx’s) above rock unit “B”. This suggests that layer “E” was not present when rock unit “B” intruded and was deposited at a later time. If layer “E” was present before the intrusion of rock unit “B”, then it would have contact metamorphism (represented by xxxx’s) on the base of layer “E”.

2% 63.(l) Explain why iron-rich sedimentary rock on Bell Island may no longer be considered an ore.

**Answer:**

An ore is defined as any material that can be mined for a profit. The mining and processing iron-rich rocks around Bell Island is not feasible at this time because of the markets elsewhere in the world can provide equal or higher grade iron for cheaper prices. Therefore it would not be profitable to mine the iron-rich sediments at this time.

2% 63.(m) Describe two stages which resulted in the formation of boundary “X” in the diagram below.

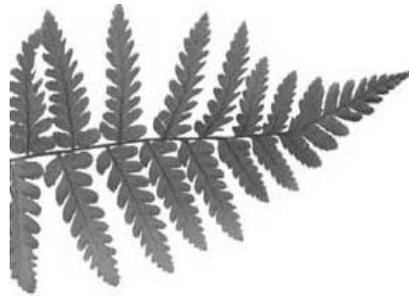


**Answer:**

First, metamorphic rocks are uplifted above sea level and eroded. Next, the eroded rock subsides (sinks) below sea level where sediment buries the erosion surface to form a nonconformity represented by boundary X.

**Value**

- 2% 64. If the organism below gets buried after it dies, describe the most common method by which fossilization would occur.



**Answer:**

The most common method of fossilization of delicate materials like a fern leaf is through a process called carbonization. Fossilization through carbonization occurs when an organism is buried rapidly by sediment in oxygen poor environment. As burial increases and more sediment accumulates on top, the pressure increases and liquid and gaseous components of the delicate organism is lost leaving a thin carbon film behind which outlines the external features of the organism.