PART I
Total Value: 60%

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

1. Which refers to a well tested and widely accepted explanation of observed natural phenomenon?

   (A) hypothesis
   (B) law
   (C) paradigm
   (D) theory

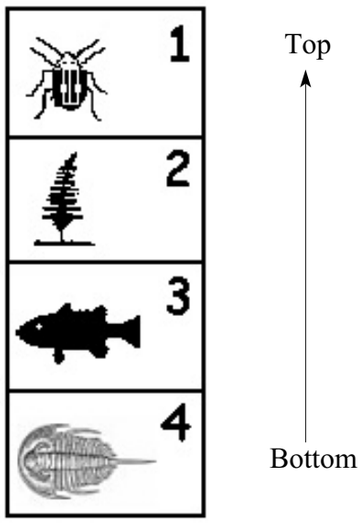
2. Which branch of earth science involves the analysis of earthquake waves?

   (A) astronomy
   (B) meteorology
   (C) sedimentology
   (D) seismology

3. Which is a non-scientific belief of how the universe formed?

   (A) big bang theory
   (B) creationism
   (C) solar nebular hypothesis
   (D) uniformitarianism

4. Which is true about the relative ages of the layers below?

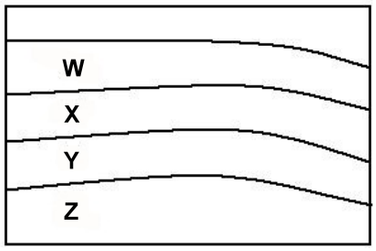


   (A) Layer 2 is younger than layer 1, but is older than layer 4.
   (B) Layer 2 is younger than layer 3, but is older than layer 1.
   (C) Layer 3 is older than layer 2, but is younger than layer 1.
   (D) Layer 3 is older than layer 4, but is younger than layer 2.

5. What part of the geologic time scale makes up the largest percentage of Earth's history?

   (A) Cenozoic
   (B) Devonian
   (C) Paleozoic
   (D) Precambrian

6. Which geological principle is used to determine that layer **X** is older than layer **W**?



(A) absolute time
(B) cross cutting relationships
(C) fossil succession
(D) relative dating

7. What is thought to be the primary reason for Earth's internal temperature remaining higher than expected?

(A) friction caused by the rubbing of plates
(B) gravitational pull from the moon
(C) increasing sedimentary layers on the surface
(D) radioactive decay of unstable elements

8. Which of Earth's layers is thinnest?

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

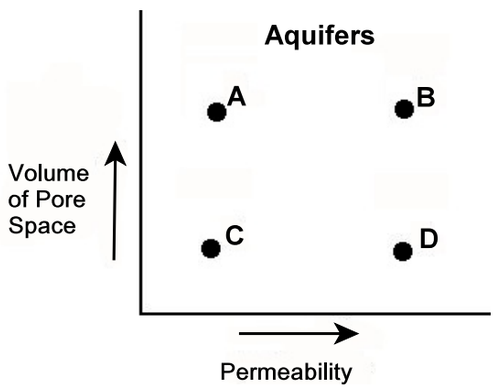
9. Which formed as a result of volcanic outgassing?

(A) atmosphere and geosphere
(B) atmosphere and hydrosphere
(C) biosphere and geosphere
(D) biosphere and hydrosphere

10. Which reservoir makes up the greatest volume of water on Earth?

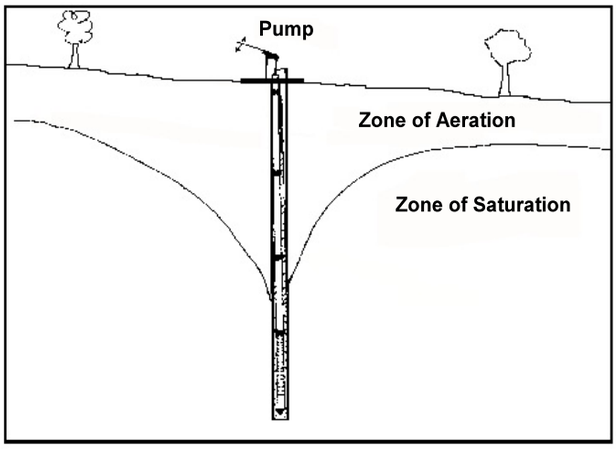
(A) glacial ice
(B) ground water
(C) oceans
(D) rivers

11. Which aquifer has the highest porosity and lowest permeability?



(A) A
(B) B
(C) C
(D) D

12. What feature is evident in the diagram below?



(A) aquitard
(B) cone of depression
(C) perched water table
(D) sink hole

13. Which consists of at least two elements?

(A) atoms
(B) compounds
(C) electrons
(D) protons

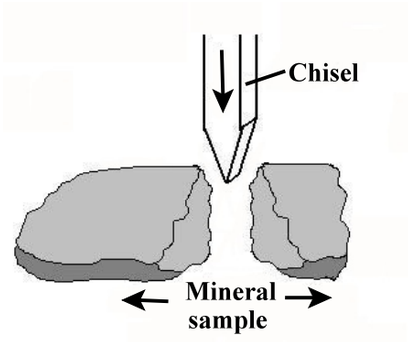
14. Which chemical formula is matched with its mineral group?

	Chemical Formula	Mineral Group
(A)	$CaSO_4$	oxides
(B)	FeS_2	sulfides
(C)	KCl	sulfates
(D)	SiO_2	carbonates

15. The specific gravity of four white-coloured minerals is listed in the chart below. A geologist has discovered a mineral sample that has a mass of 85 grams and a volume of 19.1 milliliters. What is the name of the sample?

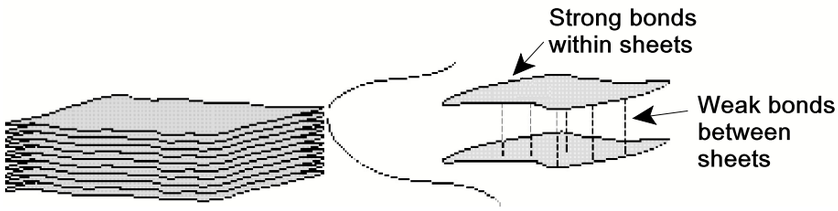
	Mineral	Specific Gravity
(A)	barite	4.45
(B)	calcite	2.71
(C)	fluorite	3.18
(D)	quartz	2.65

16. Which mineral property is evident in the diagram below?



(A) cleavage
(B) fracture
(C) hardness
(D) luster

17. Which mineral exhibits the cleavage pattern shown below?



(A) calcite
(B) feldspar
(C) halite
(D) mica

18. Which is a consolidated mixture of minerals?

(A) compounds
(B) elements
(C) fossils
(D) rocks

19. What is the primary basis for classifying clastic sedimentary rocks?

(A) colour
(B) hardness
(C) particle size
(D) ripple marks

20. Which processes are responsible for the lithification of sediments?

(A) cementation and compaction
(B) faulting and folding
(C) photosynthesis and respiration
(D) weathering and erosion

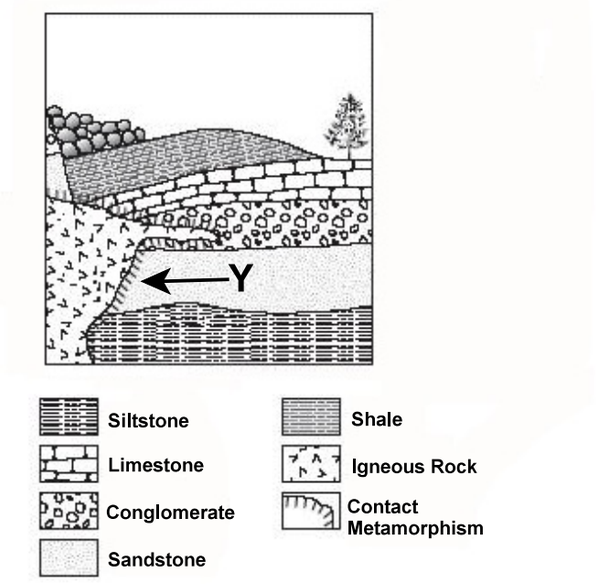
21. Which pair of rocks have the same mineral composition?

(A) andesite and granite
(B) andesite and rhyolite
(C) basalt and diorite
(D) basalt and gabbro

22. Which rock-forming process will result in a glassy texture?

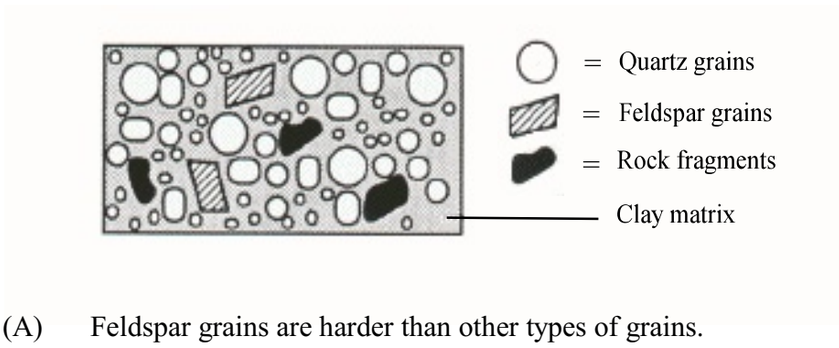
(A) alignment of minerals as a result of stress
(B) cementing together of large, angular crystals
(C) rapid cooling of lava at Earth's surface
(D) recrystallization of a rock during metamorphism

23. What type of rock will form from the contact metamorphism at **Y** in the diagram below?



(A) marble
(B) quartzite
(C) schist
(D) slate

24. What would a geologist determine from the section of sedimentary rock below?

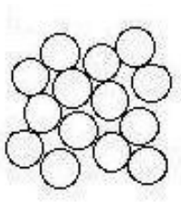


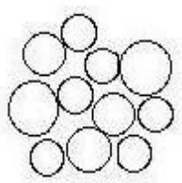
(A) Feldspar grains are harder than other types of grains.
(B) Feldspar grains have traveled a shorter distance than other types of grains.
(C) Quartz grains are softer than other types of grains.
(D) Quartz grains have traveled a shorter distance than other types of grains.

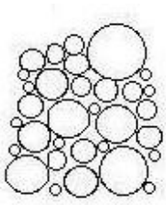
25. Which is an erosional feature caused by glaciers?

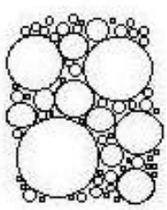
(A) cirques
(B) erratics
(C) medial moraine
(D) stratified drift

26. Which diagram shows a well-sorted sediment?

(A) 

(B) 

(C) 

(D) 

27. Which group of sedimentary features are depositional in origin?

(A) cross bedding, arête, striations
(B) drumlin, deep sea fan, sand dune
(C) esker, sea arch, desert pavement
(D) sink hole, sea cave, terminal moraine

28. Which is directly responsible for the formation of a sea stack?

(A) glacier
(B) rivers
(C) waves
(D) wind

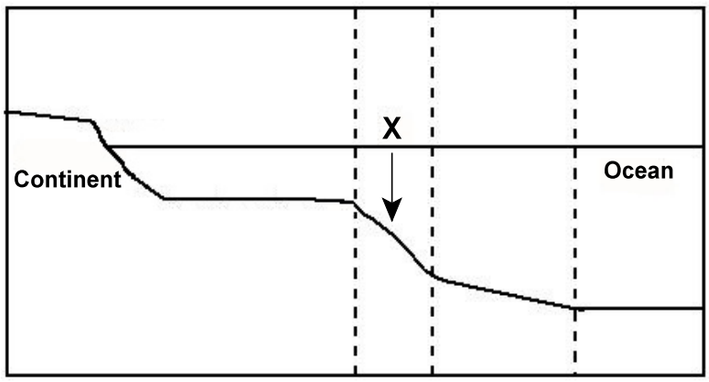
29. Which rock has been subjected to the highest temperature and pressure conditions?

(A) gneiss
(B) phyllite
(C) shale
(D) slate

30. Which is the correct sequence for a rock being metamorphosed?

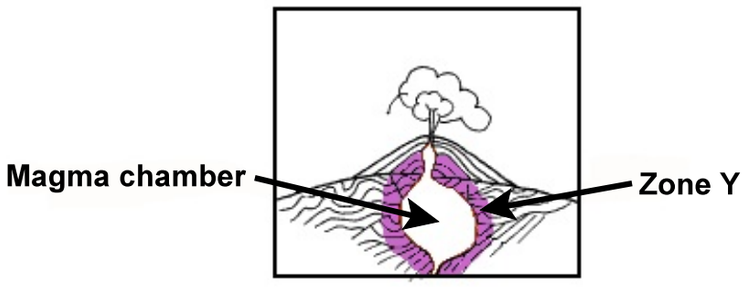
(A) gneiss → phyllite
(B) limestone → marble
(C) quartzite → sandstone
(D) slate → shale

31. Which part of the continental margin is indicated by the letter **X**?



(A) abyssal plain
(B) continental rise
(C) continental shelf
(D) continental slope

32. What will occur to the rocks surrounding the magma chamber in zone **Y**?



(A) contact metamorphism
(B) lithification
(C) regional metamorphism
(D) sedimentation

33. Which explains the observation below?

Scientists believe that Glossopteris, an extinct seed fern, had no effective means of seed dispersal between continents. Today, fossilized Glossopteris have been found on all continents dating back 360 million years.

(A) dispersal of seeds by birds
(B) breaking up of a supercontinent
(C) erosion of continental margins
(D) evolution on separate continents

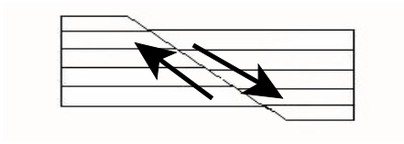
34. Which layer of Earth is composed of solid iron and nickel?

(A) inner core
(B) lithosphere
(C) mantle
(D) outer core

35. What is considered to be a driving force for the movement of Earth's tectonic plates?

(A) fault creep
(B) isostatic adjustment
(C) magnetic reversals
(D) mantle convection

36. What fault type is shown in the diagram below?

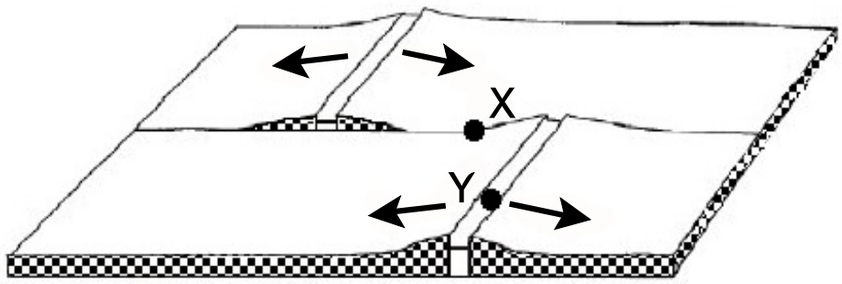


(A) normal
(B) reverse
(C) strike-slip
(D) thrust

37. What type of plate boundary is associated with volcanic island arcs in central Newfoundland?

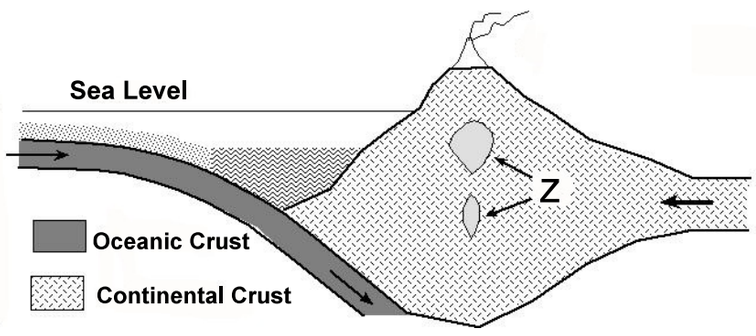
(A) convergent
(B) divergent
(C) normal
(D) transform

38. Which forces caused faulting at points **X** and **Y** in the diagram below?



	X		Y	
	Force	**Fault Type**	**Force**	**Fault Type**
(A)	compressional	reverse	tensional	reverse
(B)	shear	normal	compressional	reverse
(C)	shear	transform	tensional	normal
(D)	tensional	reverse	compressional	normal

39. Which rock type will form at location **Z** in the diagram below?



(A) chemical sedimentary
(B) clastic sedimentary
(C) extrusive igneous
(D) intrusive igneous

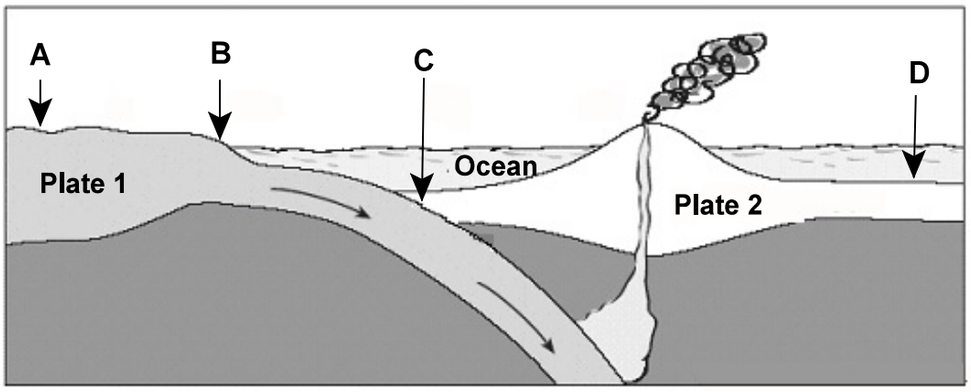
40. Why are S-waves not recorded on the opposite side of Earth during an earthquake?

(A) S-waves cannot travel through liquids.
(B) S-waves cannot travel through solids.
(C) S-waves travel too fast.
(D) S-waves travel too slow.

41. Compared to a magnitude 4 earthquake, how many times greater is the wave amplitude of a magnitude 6 earthquake?

(A) 20
(B) 60
(C) 100
(D) 900

42. Where would the greatest number of shallow focus earthquakes occur?



(A) A
(B) B
(C) C
(D) D

43. What process is employed if a geologist uses fossils and the physical properties of a given rock sequence to match rock layers over several kilometres?

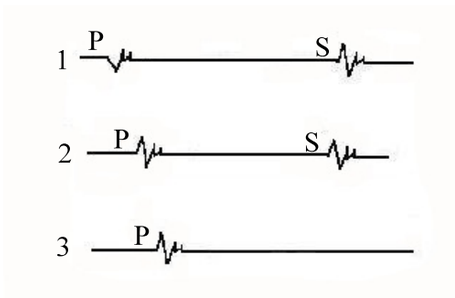
(A) correlation
(B) crosscutting relations
(C) inclusions
(D) superposition

44. Which is a non-metallic mineral resource?

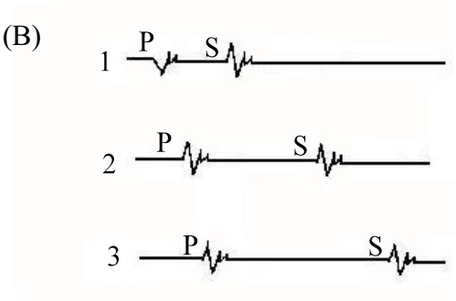
(A) bauxite
(B) diamond
(C) galena
(D) magnetite

45. An earthquake occurs and seismic waves are recorded by three seismic stations. Station 1 is 4000 km away; Station 2 is 7000 km away; and Station 3 is on the opposite side of Earth. Which set of seismograms would have been recorded?

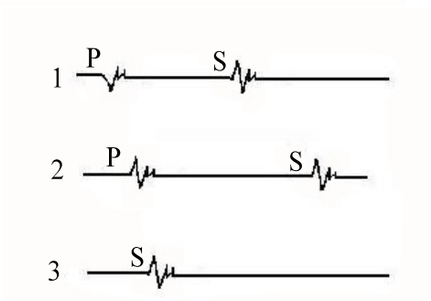
(A)



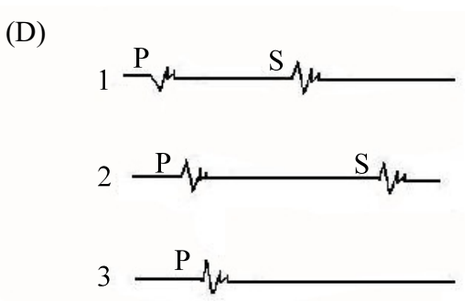
(B)



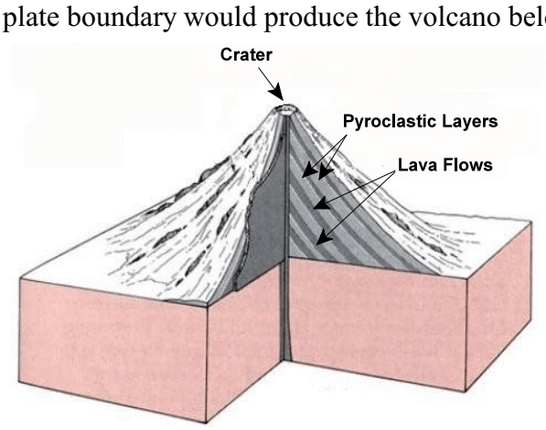
(C)



(D)



46. What type of plate boundary would produce the volcano below?



(A) convergent
(B) divergent
(C) hot spot
(D) transform

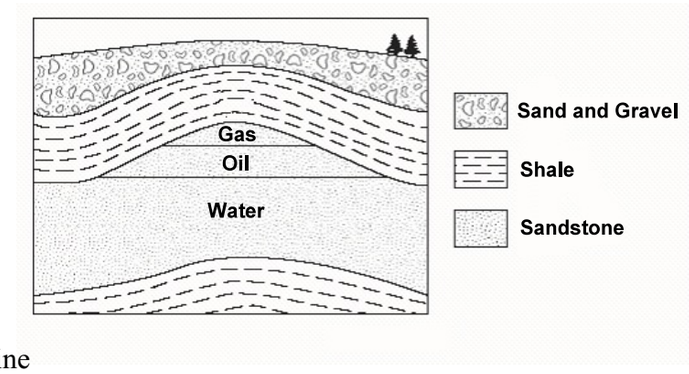
47. Which is the correct match for a mineral and its economic use?

	Mineral	Economic Use
(A)	bauxite ($Al(OH)_3 \cdot H_2O$)	aluminum
(B)	chalcopyrite ($CuFeS_2$)	plastics
(C)	fluorite (CaF_2)	cement
(D)	hematite (Fe_2O_3)	copper

48. Which forms by metamorphism?

(A) anthracite coal
(B) bituminous coal
(C) sandstone
(D) shale

49. What type of petroleum trap is shown below?

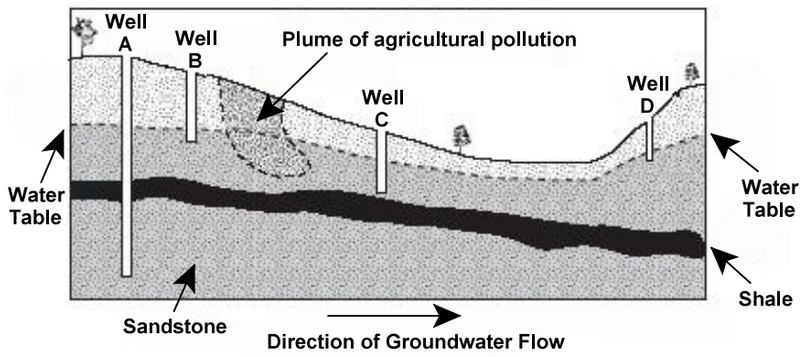


(A) anticline
(B) fault trap
(C) salt dome
(D) unconformity

50. What type of mineral deposit concentrates copper in a vein system?

(A) hydrothermal
(B) magmatic
(C) placer
(D) residual

51. Which well is most likely to produce an abundant, long-term supply of pure drinking water?

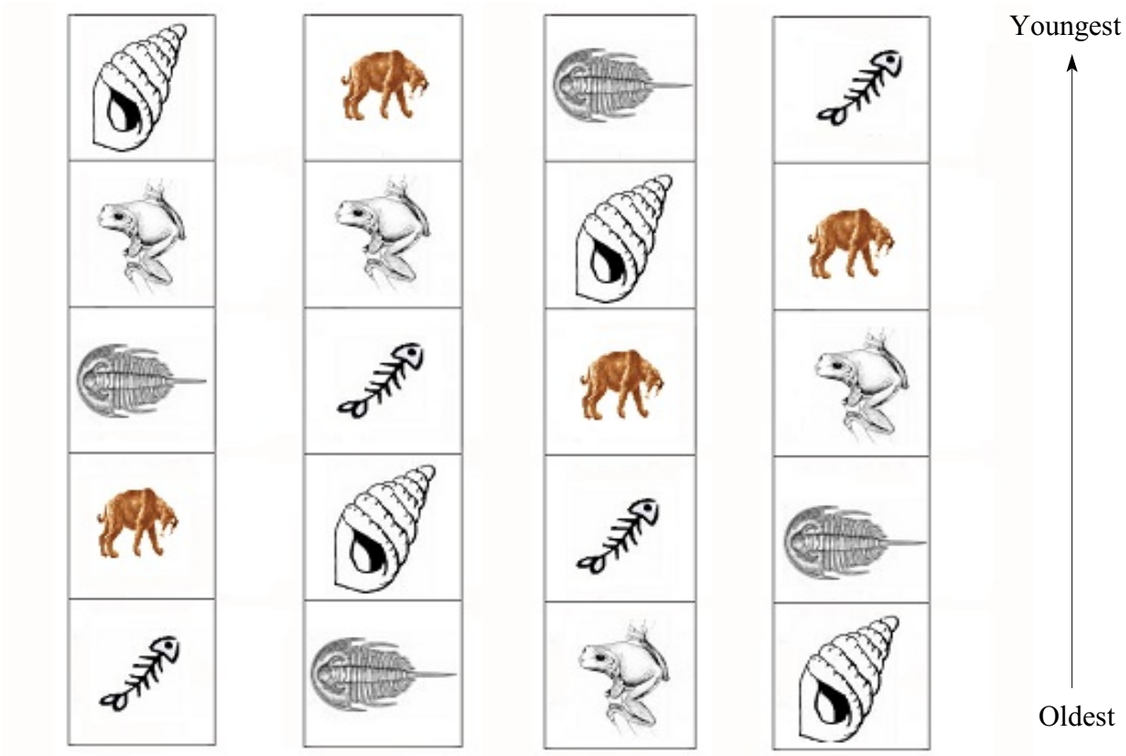


(A) A
(B) B
(C) C
(D) D

52. What type of fossil is a dinosaur footprint?

(A) carbonized
(B) petrified
(C) replacement
(D) trace

53. Which represents the correct evolutionary sequence in the cross-sections below?



(A) A
(B) B
(C) C
(D) D

54. During which era did trilobites live?

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

55. Which rock type forms at divergent plate boundaries?

(A) andesite
(B) basalt
(C) granite
(D) rhyolite

56. Which best explains how the Appalachian Mountains formed?

(A) continent - continent collision
(B) diverging continents
(C) polar wandering
(D) ocean - ocean collision

57. What information is required to calculate the rate of seafloor spreading?

(A) distance from ridge and age of rock
(B) ocean depth and fossil types
(C) rock type and distance from the ridge
(D) seismic activity and age of rock

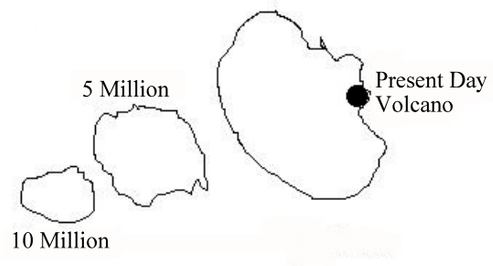
58. Which human activity contributes most to climate change?

(A) burning fossil fuels
(B) mining iron ore
(C) replanting trees
(D) building roads

59. Which is considered a non-renewable energy resource?

(A) hydro power
(B) oil
(C) solar
(D) tidal power

60. What tectonic setting would best explain a linear chain of basaltic oceanic islands varying in age from 10 million years to the present day?



(A) convergent
(B) divergent
(C) hotspot
(D) transform

PART II
Total Value: 40%

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

Value

2% 61.(a) Explain how the principles of superposition and cross-cutting relationships are applied when using relative dating.

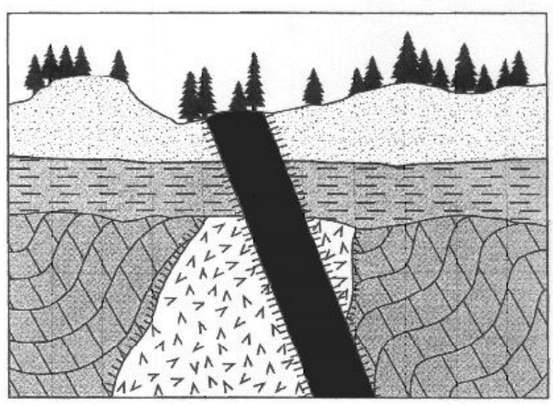
2% (b) The half-life of element X is 200 000 years. If a sample originally held 256 g of parent isotope and the rock sample has been determined to be 1 million years old, what mass of parent now remains? Show calculations.

2% 62.(a) Briefly describe the evolution of our solar system according to the solar nebular hypothesis.

Value

2% 62.(b) Using an example, explain how a rock can be very porous, yet impermeable.

3% 63.(a) (i) Interpret the geological history of this area by arranging the letters of the sequence of events in order from oldest to youngest.



Youngest

E

Oldest

A	Deposition of Shale
B	Folding of pre-existing Limestone
C	Intrusion of Granite
D	Deposition of Limestone
E	**Erosion of present day surface**
F	Intrusion of Basalt
G	Deposition of Sandstone

3% (ii) Draw an arrow on the diagram to show where an unconformity is located and explain how it formed.

Value

2% 63.(b) Explain how Moh's scale and items of known hardness are used to assist in the identification of an unknown mineral.

3% (c) Describe two things that can be determined by examining the crystal size of minerals in igneous rocks.

2% (d) Describe two depositional features of glaciation that can be used to determine the direction of ice movement.

Value

4% 63.(e) Using an example for each, describe the formation of clastic/detrital and chemical sedimentary rocks.

i) clastic/detrital:

example:

ii) chemical:

example:

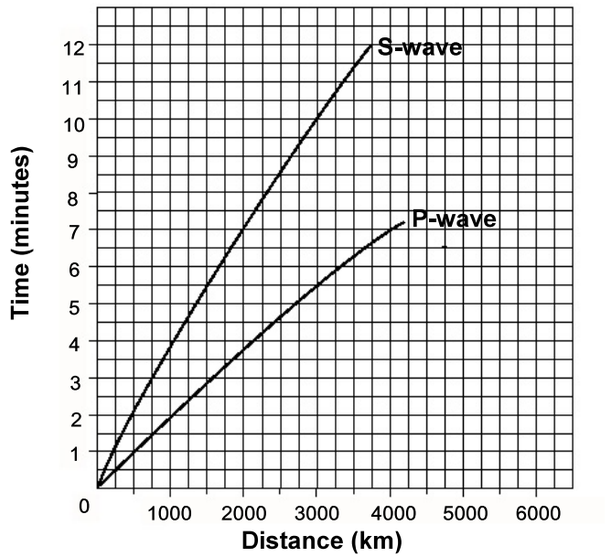
(f) A pencil lead contains the mineral graphite which is composed of pure carbon. A diamond is also composed of pure carbon.

1% (i) How do their values for hardness compare on Moh's Scale?

2% (ii) Explain why the difference in hardness exists between diamond and graphite.

Value

63.(g) A seismic station is known to be 3000 km away from an earthquake's epicenter.



1% (i) What is the difference in arrival time of the P and S waves?

1% (ii) Explain why a difference in arrival time exists between the P and S waves.

2% (iii) During another earthquake, at a station located 750 km from the epicenter, the P waves arrived at 8:42:00 AM. At what time would the first S wave arrive?

2% (h) A company has discovered a mineral deposit and is assessing its economic potential. Many factors must be considered before the site can go into production. Describe two factors that could determine if the mine gets started.

Value

2% 64.(a) A caribou dies and is laying on the edge of a river. Describe two conditions that favour the preservation of the remains of this specimen.

2% (b) A current theory that explains the mass extinction at the end of the Mesozoic era involves the impact of a meteorite with Earth. Describe two resulting environmental changes that led to this extinction.

2% (c) Advancements in Global Positioning Systems, Computer Mapping and Satellite Imagery have permitted geoscientists to examine Earth in great detail. Briefly describe two benefits of these advancements to society.