PART I
Total Value: 60%

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

1. Which branch of earth science studies the salinity of marine environments?

   (A) astronomy
   (B) hydrology
   (C) meteorology
   (D) oceanography

2. Which theory describes the origin of the solar system?

   (A) Big Bang
   (B) Geocentric
   (C) Nebular
   (D) Outgassing

3. Which geologic principle states that in an undisturbed sedimentary sequence, the bottom layer is oldest?

   (A) correlation
   (B) horizontality
   (C) superposition
   (D) uniformitarianism

4. Which provides an example of relative time?

   (A) comparing positions of layers in a sedimentary sequence
   (B) comparing ratios between parent and daughter isotopes
   (C) counting tree rings
   (D) counting varves

5. While taking mud samples from the bottom of a glacial lake, a geologist discovers volcanic ash covered by 200 layers of sediment. These layers alternate between light and dark colour. How many years ago did the volcanic eruption occur?

   (A) 25
   (B) 50
   (C) 100
   (D) 200

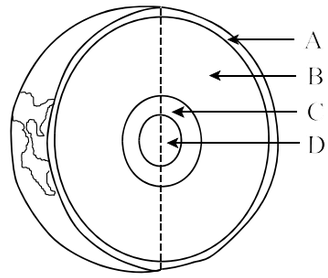
6. A sample of wood contains 25% of its original carbon-14. If the half-life of carbon-14 is 5730 years, how old is the sample of wood?

   (A) 1432 years
   (B) 5730 years
   (C) 11460 years
   (D) 22920 years

7. Which sphere includes groundwater?

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

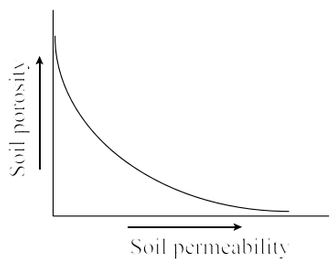
8. In the diagram below, which layer represents Earth's outer core?



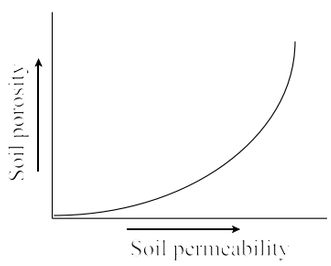
(A) A
(B) B
(C) C
(D) D

9. Which graph shows the relationship between soil permeability and soil porosity?

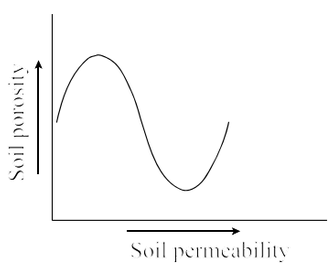
(A)



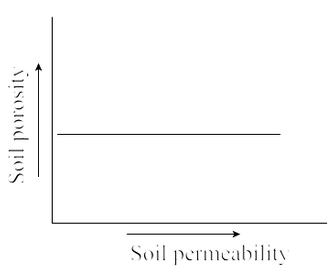
(B)



(C)



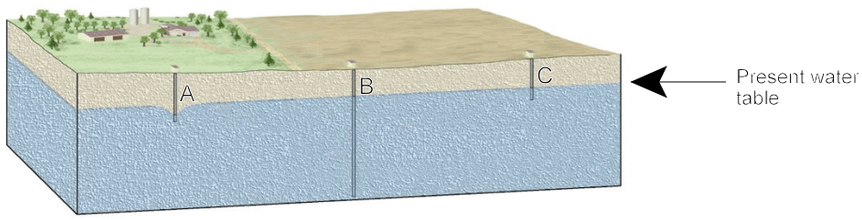
(D)



10. Which type of glacier forms in high mountain areas?

(A) alpine
(B) aréte
(C) continental
(D) ice sheet

11. In the diagram below, what would happen to water levels in wells A and C, if well B was excessively pumped for agriculture?



(A) decrease due to the cone of depression in well B
(B) decrease due to the cone of uplift in well B
(C) increase due to the cone of depression in well B
(D) increase due to the cone of uplift in well B

12. If an oil spill occurs on land, which would prevent groundwater pollution?

(A) a deposit of sandstone at the surface
(B) a layer of shale at the surface
(C) mature forest growth at the site
(D) slow moving rivers nearby

13. Which describes the covalent bonding that occurs between atoms in a water molecule ?

(A) sharing of electrons
(B) sharing of protons
(C) transfer of electrons
(D) transfer of protons

14. Which is the most common mineral group in Earth's crust?

(A) carbonates
(B) oxides
(C) silicates
(D) sulfates

15. What is being tested when a mineral is scraped along a white porcelain plate?

(A) cleavage
(B) density
(C) hardness
(D) streak

16. Which compares the weight of a mineral to the weight of an equal volume of water?

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

17. According to Moh's hardness scale, which mineral is softest?

(A) apatite
(B) diamond
(C) gypsum
(D) quartz

18. Which is true if the specific gravity of several different sized pyrite samples are determined under identical conditions?

(A) All samples have the same specific gravity.
(B) Each sample has a different specific gravity.
(C) Rough samples have a lower specific gravity than smooth samples.
(D) Smooth samples have a lower specific gravity than rough samples.

19. Which is the tendency of a mineral to break along planes of weak bonding?

(A) cleavage
(B) hardness
(C) lustre
(D) streak

20. Which volcanic cone is correctly paired with its tectonic feature?

	Cone	Feature
(A)	composite	hot spot
(B)	composite	transform fault
(C)	shield	hot spot
(D)	shield	transform fault

21. Which is a felsic rock with a coarse-grain texture?

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

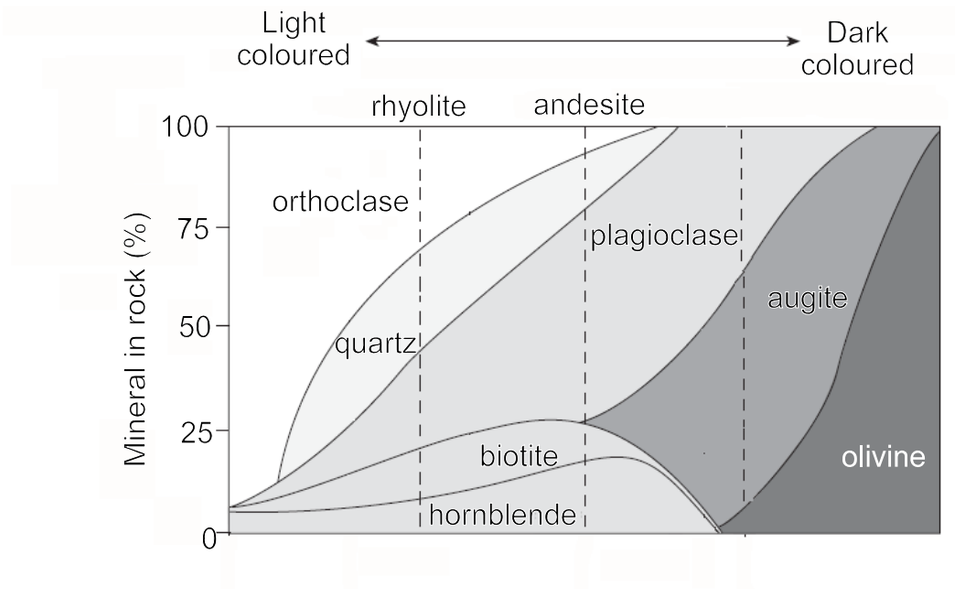
22. Which rock forms at mid-ocean ridges?

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

23. Which best explains the difference in density between continental and oceanic crust?

(A) composition
(B) crystallization
(C) porosity
(D) state

24. Which mineral is found in a greater percentage in andesite than in rhyolite?



(A) biotite
(B) orthoclase
(C) plagioclase
(D) quartz

25. Which best describes a rock with a porphyritic texture?

(A) large crystals of equal size
(B) large crystals surrounded by many small crystals
(C) small crystals of equal size
(D) small crystals surrounded by many large crystals

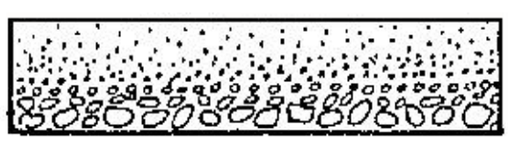
26. Which igneous texture indicates the fastest cooling rate?

(A) coarse grained
(B) fine grained
(C) glassy
(D) pegmatitic

27. In which sedimentary environment would you least likely find gravel?

(A) beach
(B) deep ocean
(C) desert
(D) river channel

28. Which sedimentary feature is shown below?



(A) cross bedding
(B) graded bedding
(C) mud cracks
(D) ripple marks

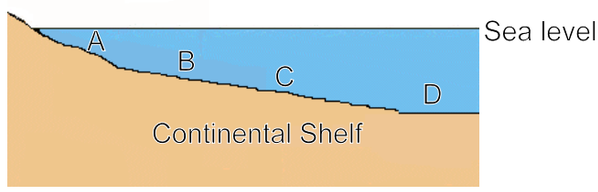
29. Which is formed by deposition from ocean waves?

(A) sea arch
(B) sea cave
(C) spit
(D) stack

30. Which is a glacial depositional feature?

(A) cirque
(B) drumlin
(C) fiord
(D) striation

31. At which point below would the coarsest sediment be located?



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

32. Which describes metamorphic rock texture?

(A) cross-bedded
(B) foliated
(C) porphyritic
(D) vesicular

33. Which has the **least** impact during regional metamorphism?

(A) faulting
(B) fluids
(C) pressure
(D) temperature

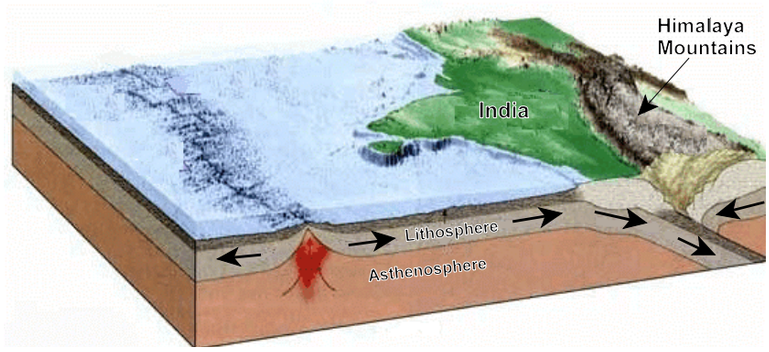
34. Which scientist proposed mantle convection to support the theory of continental drift?

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

35. How many times more energy is released in a 6.5 Richter magnitude earthquake than in one with a Richter magnitude of 4.5?

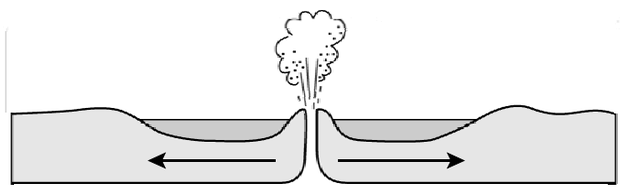
(A) 20
(B) 60
(C) 100
(D) 900

36. Based on the diagram below, what type of plate collision formed the Himalaya mountain range?



(A) continent-continent
(B) ocean-continent
(C) ocean-ocean
(D) seafloor-ocean

37. Which type of boundary is represented in the diagram below?

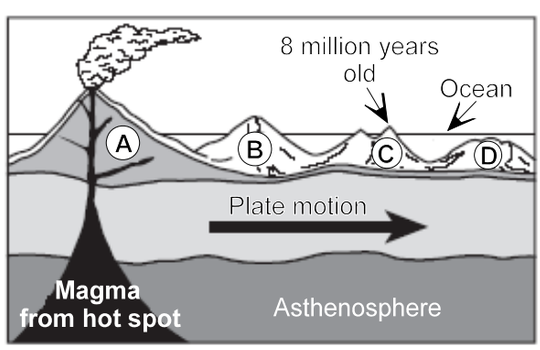


(A) convergent
(B) divergent
(C) hot spot
(D) transverse

38. Which occurs at a transform plate boundary?

(A) collision of plates
(B) formation of crust
(C) sliding of plates along each other
(D) subduction

39. The cross-section below shows the direction of movement of an oceanic plate over a mantle hotspot. The age of volcano C is shown. What are the most likely ages of volcanoes B and D?



	Volcano B	Volcano D
(A)	5 million years old	12 million years old
(B)	2 million years old	6 million years old
(C)	9 million years old	9 million years old
(D)	10 million years old	4 million years old

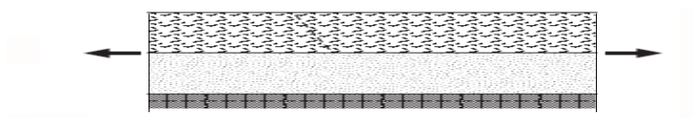
40. Which is true of the continental crust as compared to the oceanic crust?

(A) The continental crust is older and has a different composition.
(B) The continental crust is younger and has a different composition.
(C) The continental crust is older and has the same composition.
(D) The continental crust is older and has the same composition.

41. Which is the point of origin of an earthquake?

(A) epicentre
(B) epicycle
(C) fault
(D) focus

42. Which forces are acting on the geologic feature below?



(A) compression
(B) shear
(C) tension
(D) torque

43. What is used to determine the distance from a seismograph station to the epicentre of an earthquake?

(A) amplitude of the largest P-wave
(B) amplitude of the largest S-wave
(C) distance between the P-waves and S-waves
(D) time between the arrival of P-waves and S-waves

44. Which event most often causes a tsunami?

(A) earthquakes
(B) folding
(C) hurricanes
(D) tides

45. Which led to the discovery of the Moho?

(A) location of plate boundaries
(B) mapping of the sea floor
(C) occurrence of volcanic eruptions
(D) study of seismic waves

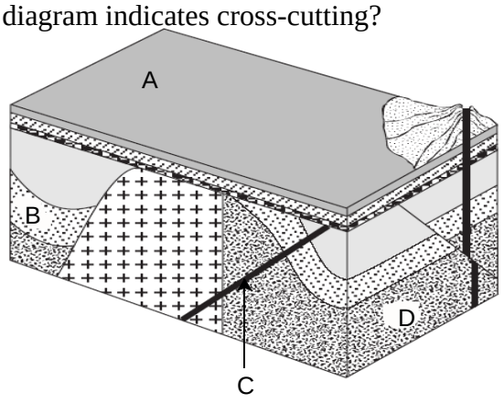
46. Which mineral is correctly matched with its economic use?

	Mineral	Economic Use
(A)	barite	copper wire
(B)	galena	lead pipe
(C)	pyrite	copper wire
(D)	sphalerite	lead pipe

47. Which is the correct sequence for the formation of coal?

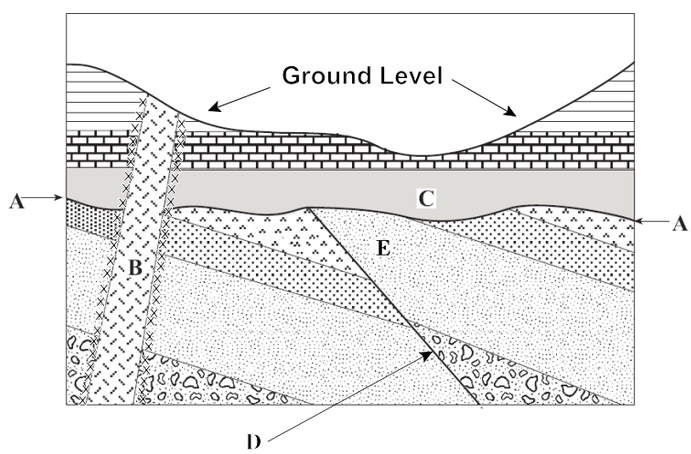
(A) anthracite → peat → bituminous → lignite
(B) anthracite → bituminous → lignite → peat
(C) peat → anthracite → lignite → bituminous
(D) peat → lignite → bituminous → anthracite

48. Which letter in the diagram indicates cross-cutting?



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

49. Which is correct regarding the cross-section below?



(A) B is the youngest rock in the cross-section
(B) C has folding at its base
(C) E was faulted after the formation of A
(D) D is the result of tensional forces

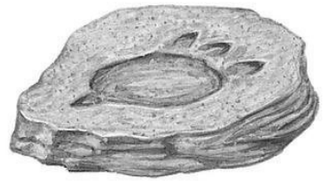
50. Which would form the best cap rock for an oil reservoir?

(A) conglomerate
(B) limestone
(C) sandstone
(D) shale

51. Which mineral concentrates in Earth's crust due to placer deposits?

(A) bauxite
(B) gold
(C) halite
(D) hematite

52. Which type of fossil is shown in the diagram below?



(A) carbonization
(B) cast
(C) petrification
(D) trace

53. In which rock will fossils form?

(A) basalt
(B) gneiss
(C) granite
(D) shale

54. In which era did dinosaurs exist?

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

55. Which area of the island of Newfoundland is composed of rocks similar to an ancient ocean floor?

(A) Avalon
(B) Central
(C) Southern
(D) Western

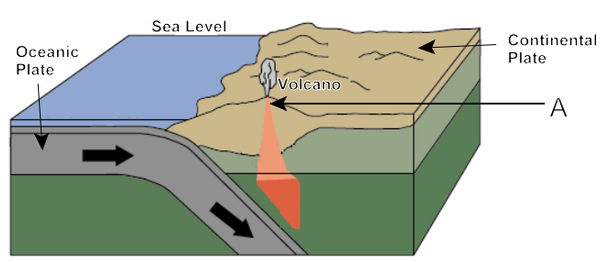
56. A mass extinction of trilobites occurred at the end of which geologic time span?

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

57. Which is a non-renewable resource?

(A) fish
(B) iron ore
(C) solar energy
(D) trees

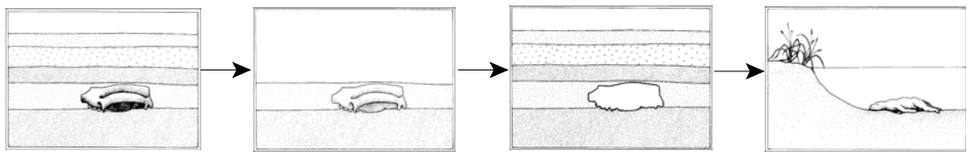
58. Which rock type will form at A in the diagram below?



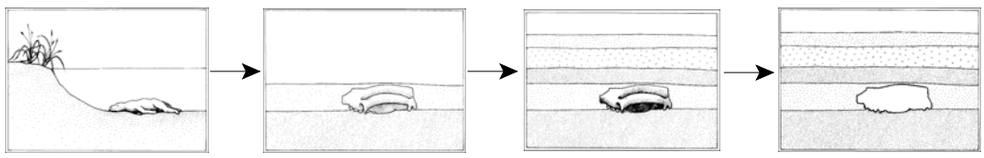
(A) andesite
(B) basalt
(C) diorite
(D) granite

58. Which is the correct order in forming a mold?

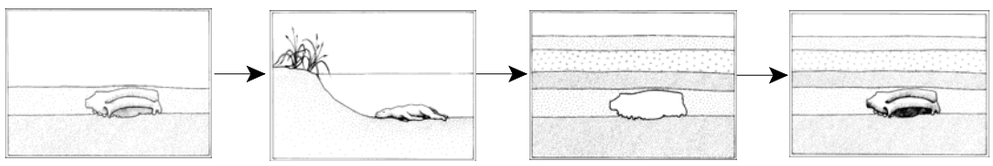
(A)



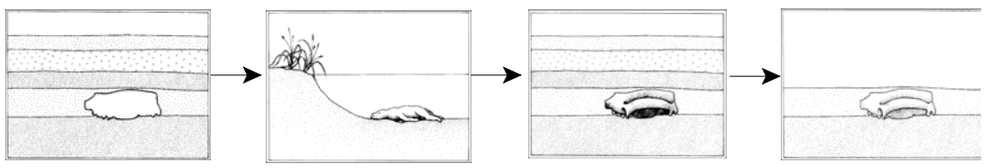
(B)



(C)

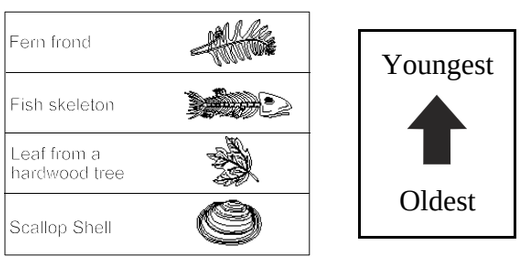


(D)

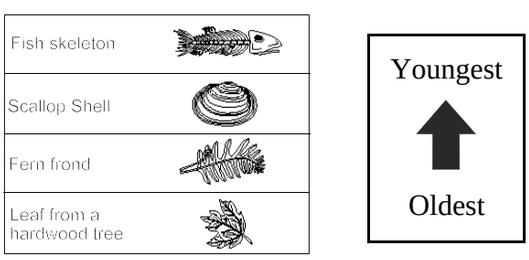


60. Which sedimentary rock succession best represents an area that changed from a freshwater lake to a forest?

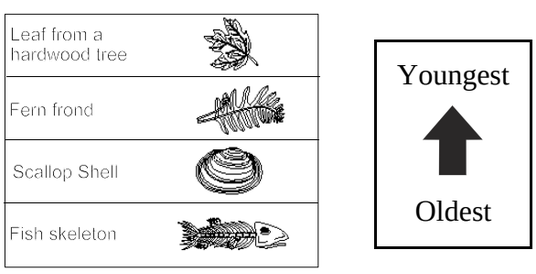
(A)



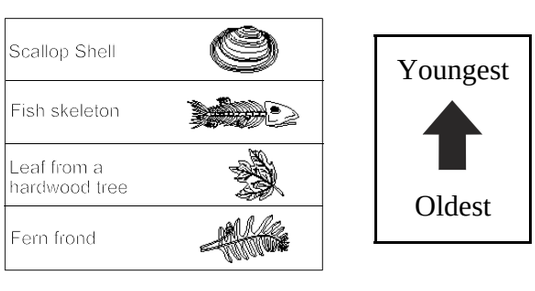
(B)



(C)



(D)



PART II
Total Value: 40%

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

Value

61. The information below was collected from radioactive isotopes found in two different rock samples from a volcanic island.

Rock sample	Half-life (million years)	Amount of parent material remaining
A	2.5	$\frac{1}{128}$
B	4.3	$\frac{1}{16}$

2% (i) Determine the number of half-lives that have passed for each sample. Show your workings.

2% (ii) State which rock sample is older. Show workings to justify your answer.

Value

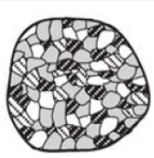
2% 62.(a) With the aid of a fully labelled diagram, briefly describe the conditions necessary to produce a flowing artesian well.

2% (b) Describe how the interaction of two of Earth's spheres resulted in the formation of oil.

Value

2% 63.(a) Two mineral samples that look similar are known to be quartz and calcite. Explain two ways how you can distinguish quartz from calcite.

3% (b) Distinguish between igneous, metamorphic, and sedimentary rocks by completing the table below.

Rock	Type	Distinguishing feature
		
		
		

2% (c) Describe two sedimentary features that can be used to determine if a sedimentary bed has been inverted (i.e., overturned).

Value

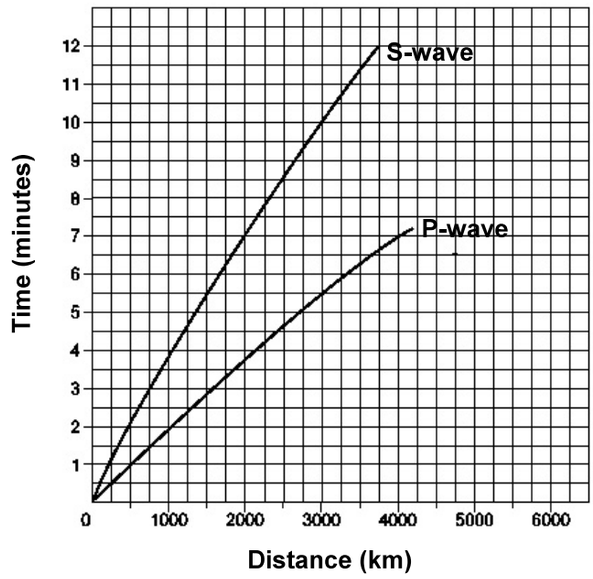
3% 63.(d) Using arrows to indicate the direction of forces associated with each fault, draw diagrams of a normal, reverse, and transform fault.

normal	reverse	transform

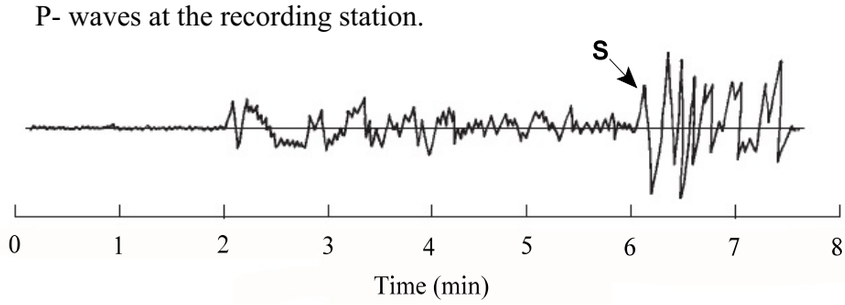
2% (e) With the aid of a labelled diagram, explain how hot spots can be used to support the Theory of Plate Tectonics.

Value

4% 63.(f) The travel-time graph below shows the arrival times of P- and S-waves at a seismograph station.



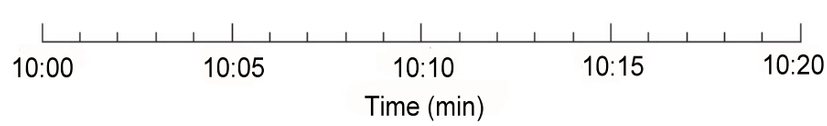
(i) The seismogram below was recorded at the seismic station. Draw and label an arrow on the seismogram below to indicate the arrival time of the P- waves at the recording station.



(ii) Determine the difference in the arrival time between the two waves.

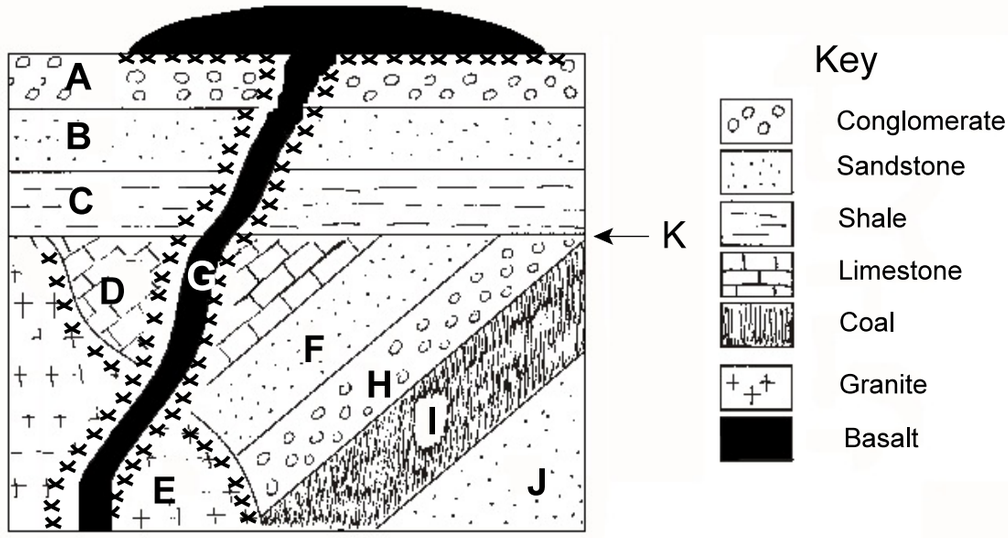
(iii) Determine the distance from the epicentre to the recording station.

(iv) Draw a seismogram on the scale below that is obtained from a recording station located 3500 km from the epicentre. Assume that the P-waves arrived at 10:05.



Value

4% 63.(g) Use the diagram below to answer the questions that follow.



(i) List the geologic events, represented by letters A to K, from oldest to youngest.

oldest ⟶ *youngest*

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

(ii) Which type of unconformity is represented by K?

_____

(iii) Explain how you know which letter identifies the oldest igneous rock unit.

_____

_____

_____

_____

_____

_____

_____

2% (h) A large oil reservoir was discovered in a deformed sedimentary basin located in a shallow ocean. Use a labelled diagram to show how the oil is trapped and indicate on the diagram the best location for drilling a well.

Value

2% 63.(i) Explain how economic minerals are concentrated in hydrothermal deposits.

2% (j) Explain how both regional and contact metamorphism can occur at a subduction zone.

3% 64.(a) Explain how a meteorite impact could cause a mass extinction on Earth today.

Value

3% 64.(b) Using Plate Tectonic Theory, explain how the island of Newfoundland formed.