# PART I
## Total Value: 60%

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

1. In which branch of Earth Science is ancient life studied?

   (A) climatology
   (B) meteorology
   (C) paleontology
   (D) volcanology

2. Which statement best represents how relative time is correctly used in Earth Science?

   (A) Dinosaurs became extinct 65 million years ago.
   (B) Dykes and sills are younger than surrounding rock.
   (C) The rock is 500 million years old.
   (D) The rock unit above is older than the rock unit below.

3. Volcanic ash was deposited at the bottom of a lake as varves. If the sequence contains 240 alternating layers of light and dark sediment, how many years ago did the volcanic eruption occur?

   (A) 30
   (B) 60
   (C) 120
   (D) 240

4. Which represents the shortest span of geologic time?

   (A) eon
   (B) epoch
   (C) era
   (D) period

5. If carbon-14 has a half-life of 5730 years, how many years have passed if 1/8 of the original amount of carbon remains?

   (A) 716
   (B) 5730
   (C) 17 190
   (D) 34 380

6. Which is the correct order of the major divisions of geologic time from oldest to youngest?

   oldest ⟶ youngest

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

7. Which sphere of Earth contains all life?

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

8. At which boundary is the Moho located?

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

9. Which layer of Earth is relatively weak and flows like plastic?

(A) asthenosphere
(B) crust
(C) inner core
(D) lower mantle

10. Which layer of Earth's interior shown below consists of molten nickel and iron?


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

11. From which source did all water on Earth originate?

(A) comet impact
(B) glacial melt
(C) photosynthesis
(D) volcanic outgassing

12. Where is the least amount of Earth's water located?

(A) glaciers
(B) ground water
(C) oceans
(D) rivers

13. What is formed when chemical bonding joins two or more elements together in definite proportions?

(A) atom
(B) compound
(C) isotope
(D) molecule

14. Which elements are most abundant in Earth's crust?

(A) aluminum and carbon
(B) aluminum and oxygen
(C) silicon and carbon
(D) silicon and oxygen

15. Which is a native element in Earth's crust?

(A) aluminum
(B) gold
(C) magnesium
(D) sodium

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

| | Chemical Formula | Mineral Group |
|---|---|---|
| (A) | $Al_2O_3$ | halides |
| (B) | $CaSO_4$ | sulfides |
| (C) | $Fe_2O_3$ | oxides |
| (D) | ZnS | sulfates |

17. Which describes the streak of a mineral?

(A) appearance in reflected light
(B) colour in its powdered form
(C) resistance to scratching
(D) splitting along fractured surfaces

18. A sample of galena has a mass of 160 g and displaces 20 mL of water. What is its specific gravity?

(A) 4
(B) 8
(C) 16
(D) 160

19. Given the information below, what is the order of minerals from softest to hardest?

- Corundum scratches quartz.
- Quartz scratches calcite.
- Calcite scratches talc.

*softest* ⟶ *hardest*

(A) corundum → quartz → calcite → talc
(B) corundum → quartz → talc → calcite
(C) talc → calcite → corundum → quartz
(D) talc → calcite → quartz → corundum

20. Which most likely forms due to high temperature and pressure?

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

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

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

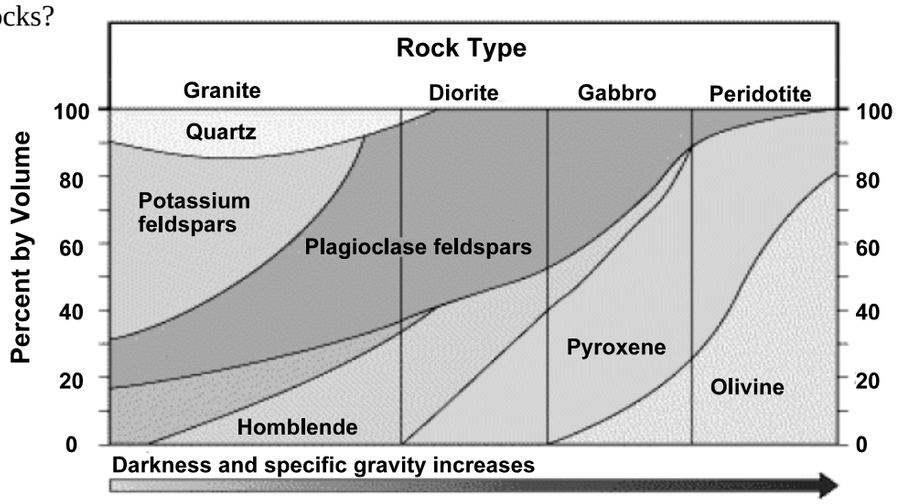
22. Which best describes the silica composition of rhyolite and basalt?

| | rhyolite | basalt |
|---|---|---|
| (A) | high | high |
| (B) | high | low |
| (C) | low | high |
| (D) | low | low |

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

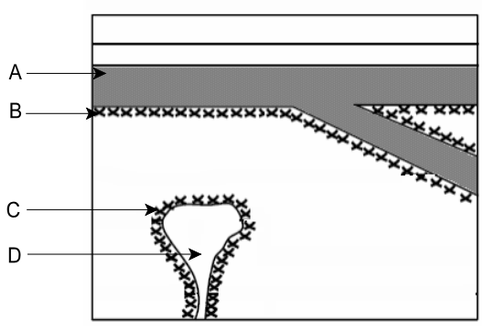
(A) large crystals of equal size
(B) large crystals surrounded by many small crystals
(C) small crystals of equal size
(D) small crystals surrounded by many large crystals

24. From the graph below, which best describes the concentration of pyroxene in felsic and mafic rocks?




| | Felsic | Mafic |
|---|---|---|
| (A) | high | high |
| (B) | high | low |
| (C) | low | high |
| (D) | low | low |

25. In the diagram below, where would you most likely find a rock with a vesicular texture?




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

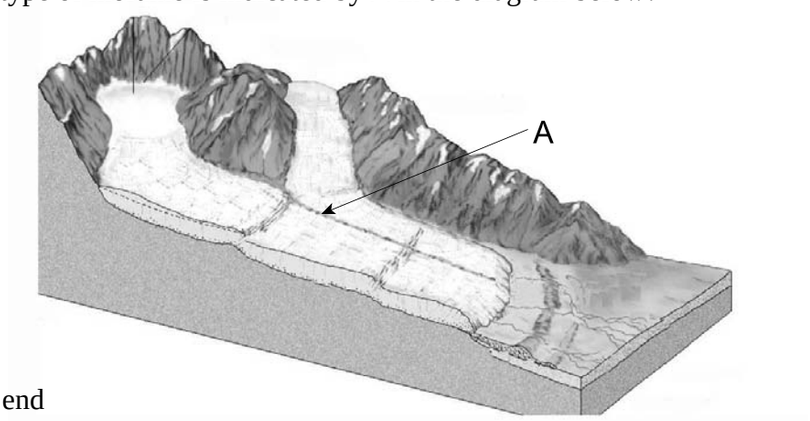
26. Which rock type would be formed furthest from the mouth of a river?

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

27. Which best represents the phrase, “well sorted”, when describing sediment?

(A) composed of distinct bedding planes
(B) composed of only one type of mineral
(C) contains grains of different sizes
(D) contains grains of similar size

28. Which type of moraine is indicated by A in the diagram below?




(A) end
(B) lateral
(C) medial
(D) terminal

29. Which results from a continental glacier?

(A) arête
(B) cirque
(C) esker
(D) horn

30. Which are erosional glacial features?

(A) drumlins
(B) eskers
(C) moraines
(D) striations

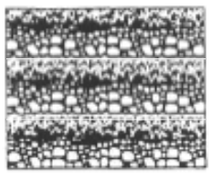
31. Which occurs at the boundary of an igneous intrusion and existing rock?

(A) contact metamorphism
(B) cross bedding
(C) pillow basalts
(D) regional metamorphism

32. Which rock is formed when a lithified sand dune becomes metamorphosed?

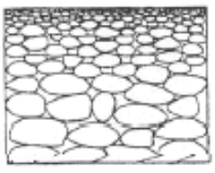
(A) gneiss
(B) marble
(C) quartzite
(D) slate

33. Which best represents sediment deposited by a glacier?

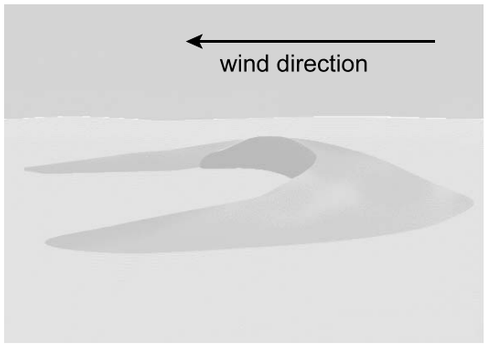
(A) 

(B) 

(C) 

(D) 

34. Which type of dune is represented in the diagram below?




(A) barchan
(B) longitudinal
(C) star
(D) transverse

35. Which evidence was used by Alfred Wegener to support the Continental Drift theory?

(A) jigsaw fit of continents
(B) movement along faults
(C) sea stacks located along shorelines
(D) shallow-focus earthquakes at ridges

36. What evidence was used to support the Plate Tectonic theory?

(A) crustal uplifting
(B) hanging valleys
(C) isostatic adjustment
(D) seafloor spreading

37. Which plate boundary is associated with island arc volcanoes?

(A) convergent
(B) divergent
(C) rift valley
(D) transform

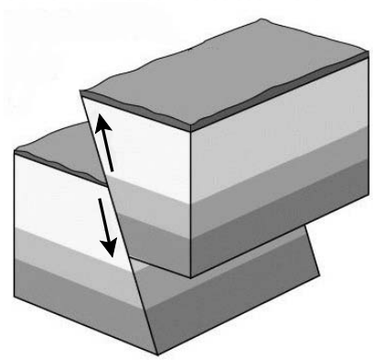
38. Which best explains why region 1 of the mid-Atlantic ridge has wider magnetic stripes than those found nearby in region 2?

(A) In region 1, sea floor spreading was at a greater rate.
(B) In region 1, sea floor spreading was at a slower rate.
(C) There is less rhyolite in region 1.
(D) There is less rhyolite in region 2.

39. A region is found to contain folding and areas with abundant outcrops of silica-rich rocks. Which best describes what happened to create the geology of this region?

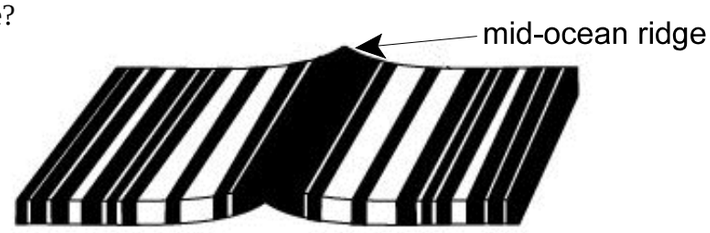
(A) hot spot activity
(B) ocean closed
(C) ocean opened
(D) transform movement

40. Which feature would be found in the same tectonic environment as shown in the diagram below?



(A) drumlin
(B) folded rocks
(C) rift valley
(D) shield volcano

41. The diagram below represents a sea floor at a mid-ocean ridge. What does the striped pattern indicate?




(A) continental drift
(B) magnetic reversals
(C) polar wandering
(D) subduction

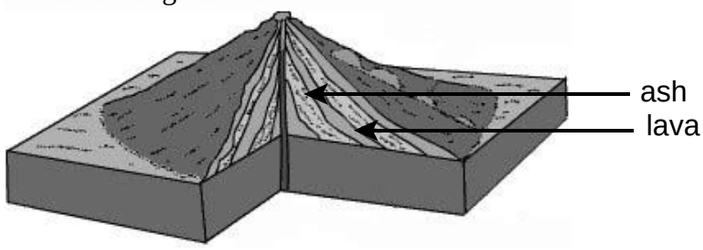
42. Which is an example of hotspot volcanism?

(A) Aleutian Trench
(B) Hawaiian Islands
(C) Himalayan Mountains
(D) San Andreas Fault

43. How much more energy is released from an earthquake of magnitude 7 on the Richter scale compared to an earthquake of magnitude 4?

(A) 3
(B) 90
(C) 1000
(D) 27 000

44. Which is represented in the diagram below?




(A) cinder cone
(B) composite volcano
(C) pyroclastic cone
(D) shield volcano

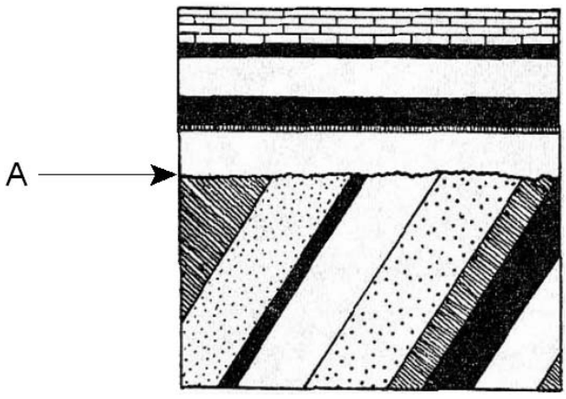
45. Which volcano will produce basaltic lava when it erupts?

(A) cinder
(B) composite
(C) shield
(D) stratovolcano

46. Which mineral is the main source of zinc?

(A) galena
(B) gypsum
(C) hematite
(D) sphalerite

47. What is indicated by the letter "A" in the diagram below?

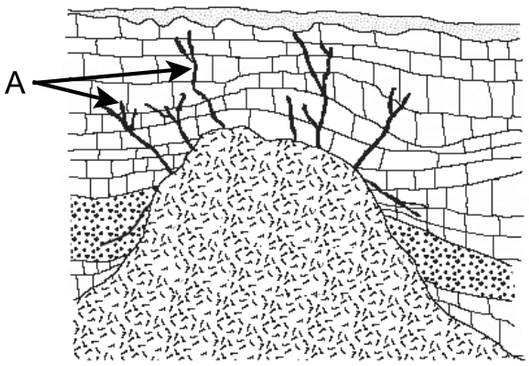



(A) contact metamorphism
(B) regional metamorphism
(C) thrust fault
(D) unconformity

48. Which type of deposit would concentrate gold within a river system?

(A) enriched
(B) hydrothermal
(C) leached
(D) placer

49. What type of mineral deposit will form at the locations indicated by letter "A" in the diagram below?




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

50. Which resource is present at the Voisey's Bay site in Labrador?

(A) asbestos
(B) crude oil
(C) iron
(D) nickel

51. Which is a hard, black coal which generates high energy when burned?

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

52. Which type of fossil is represented by footprints and worm burrows?

(A) body
(B) external mold
(C) internal mold
(D) trace

53. In which rock will fossils most likely form?

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

54. Which factor is most important for the formation of a fossil?

(A) burial in coarse sediment
(B) high rates of mechanical weathering
(C) presence of hard body parts
(D) slow burial in a deep water environment

55. In which era did fossils first become abundant in the rock record?

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

56. The table below shows four layers of sedimentary rock found in a cliff section.

| | | | | |
|---|---|---|---|---|
| Layer 1 | |  | |  |
| Layer 2 | |  | |  |
| Layer 3 |  |  |  |  |
| Layer 4 |  |  |  | |

A geologist working at another cliff section has discovered a layer of similar sedimentary rock that contains brachiopods and snails. The newly discovered layer is most similar to which layer?

(A) 1
(B) 2
(C) 3
(D) 4

57. Which is the correct evolutionary sequence of organisms from oldest to youngest?

oldest ⟶ youngest

(A) amphibian → fish → mammals → reptiles
(B) amphibian → fish → reptiles → mammals
(C) fish → amphibian → mammals → reptiles
(D) fish → amphibian → reptiles → mammals

58. In which environment did the trilobite fossils most likely form?

(A) deep water and high energy
(B) deep water and low energy
(C) shallow marine and high energy
(D) shallow marine and low energy

59. Which became extinct at the end of the Mesozoic era?

(A) birds
(B) dinosaurs
(C) invertebrates
(D) mammals

60. How have geologists been able to determine the angle of a descending plate at a subduction zone?

(A) measuring the amount of radioactive decay
(B) measuring the height of local mountains
(C) plotting the depth of every earthquake epicentre
(D) plotting the depth of every earthquake focus

## PART II
## Total Value: 40%

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

**Value**

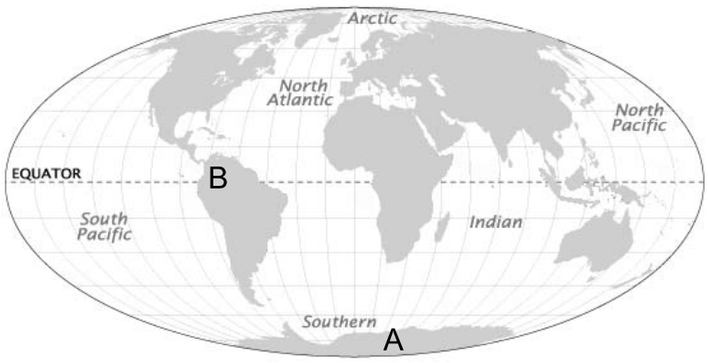
2% 61.(a) The Orion nebula is a cloud of dust and gas in space. Explain how this nebula could form a solar system similar to the one in which we live.

2% (b) With reference to uniformitarianism, describe how mass extinctions may occur on Earth again.

**Value**

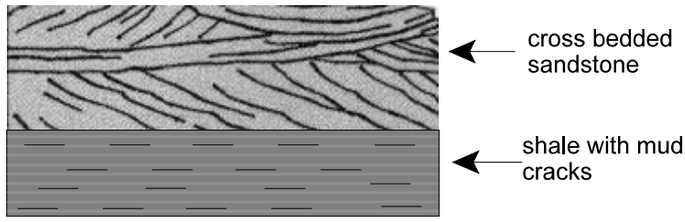
2% 62.(a) Describe two characteristics of an aquifer that would make it a reliable water source.

2% (b) Why is it that glaciers can occur in locations A and B on the map below?

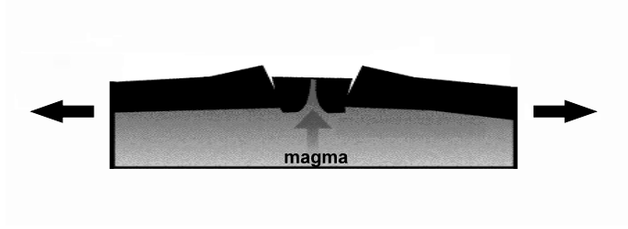


**Value**

2% 63.(a) Describe the environment of formation for the rock layers below.




4% (b) Use the cross-section below to answer questions (i) and (ii).




(i) Describe the type of faulting and the eruptive style present in the cross-section.

faulting:

eruptive style:

(ii) Name and describe the intrusive and extrusive igneous rocks associated with the feature represented in the cross-section.

**Value**

4% 63.(c) Use the photograph below to answer questions (i), (ii), and (iii).

(i) What type of volcano is shown?

_____

(ii) Describe a plate tectonic environment in which this type of volcano occurs.

_____

_____

_____

_____

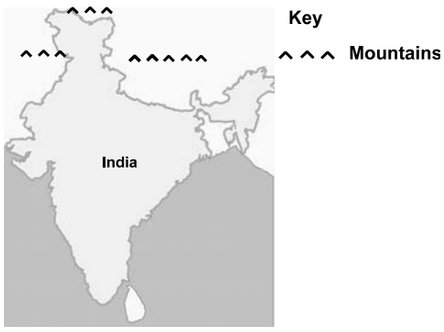
_____

_____

(iii) Give an example where this type of volcanic activity is occurring on Earth.

_____

4% (d) Use the diagram below to answer questions (i) and (ii).




(i) Describe the process that formed the mountain range.

_____

_____

_____

_____

_____

_____

(ii) Explain why fossils of marine organisms are found in this mountainous region.

_____

_____

_____

_____

_____

_____

**Value**

3% 63.(e) In the diagram below, choose the location (A or B) where earthquakes are most likely to occur and the location where they are least likely to occur. Justify each choice.


most likely**:** _____

_____

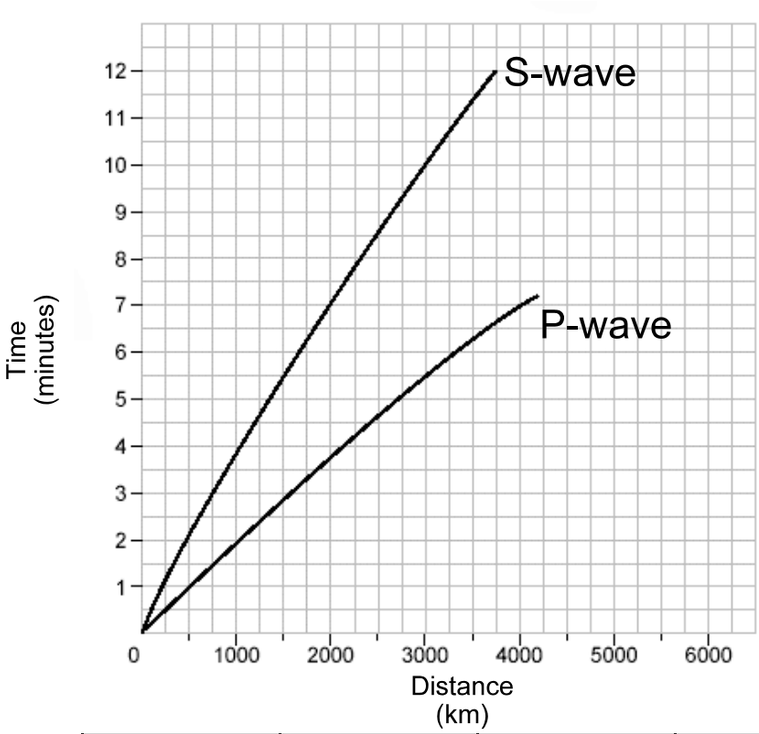
_____

least likely: _____

_____

_____

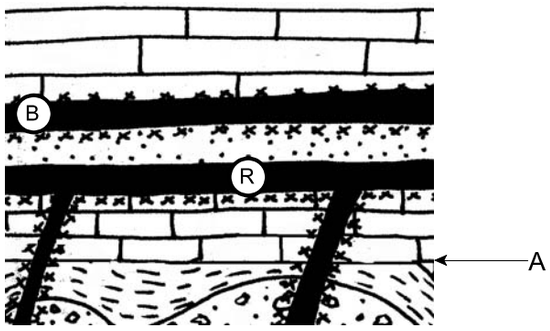
2% (f) Use the graph below to complete the table.




| | P-Wave Arrival Time (minutes) | S-Wave Arrival Time (minutes) | Time Difference (minutes) | Distance from Epicenter (km) |
|---|---|---|---|---|
| Seismic Station A | 6.5 | | 2.5 | |
| Seismic Station B | | 11.5 | | 3500 |

**Value**

4% 63.(g) Use the diagram below to answer questions (i) and (ii).




(i) What feature is indicated by A and what process formed it?

(ii) Units R and B are basaltic in composition. Describe the difference between the formation of each unit.

3% (h) Draw a cross-section of a fault-type oil trap. Label the cap rock, reservoir rock, and the location of oil, natural gas, and water. Indicate on the cross-section the best drill hole location.

**Value**

3% 64.(a) Recently, linear chains of volcanoes, metamorphic rocks, and numerous outcrops of rhyolite and granite were found on a planet. Reverse faulting was also observed. Describe three features of the plate tectonic environment on this planet.

3% (b) Name one renewable and one non-renewable resource found in Newfoundland and Labrador and explain why each resource is classified this way.