Part I
Total Value: 50%

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

1. What is the normal progression for the development of scientific knowledge?

   (A) hypothesis - observation - law - theory
   (B) law - observation - hypothesis - theory
   (C) observation - hypothesis - theory - law
   (D) theory - hypothesis - observation - law

2. Which branch of Earth Science studies the effect of a meteorite impact on Earth's surface?

   (A) astronomy
   (B) geology
   (C) meteorology
   (D) palenotology

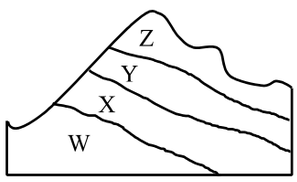
3. What scientist was responsible for proposing the principles of superposition and uniformitarianism?

   (A) Darwin
   (B) Hutton
   (C) Wegener
   (D) Wilson

4. How many half-lives have passed when $^{1}/_{64}$ of the parent isotope remains?

   (A) 3
   (B) 4
   (C) 5
   (D) 6

5. If the sequence of geological strata in the diagram below has not been disturbed, then Layer X is older than Layer Y. What geological principle does this demonstrate?



   (A) correlation
   (B) cross cutting
   (C) superposition
   (D) uniformitarianism

6. The air we breathe is composed mostly of which gas?

(A) argon
(B) carbon dioxide
(C) nitrogen
(D) oxygen

7. What elements are found in Earth's inner core?

(A) carbon and nickel
(B) iron and nickel
(C) silicon and iron
(D) sulfur and nickel

8. What **best** describes the lithosphere?

(A) a liquid layer within the mantle
(B) a rocky layer within the mantle
(C) the outer, liquid portion of Earth's core
(D) the rigid, rocky, outermost layer of Earth

9. What process explains the origin of Earth's water?

(A) photosynthesis
(B) respiration
(C) volcanic outgassing
(D) water cycle

10. What is the percentage of the total volume of rock or sediment that consists of pore space?

(A) aquiclude
(B) permeability
(C) porosity
(D) zone of saturation

11. What processes are used to define "life"?

(A) conversion of stored energy to heat energy
(B) production and consumption of a gas
(C) reproduction, growth and metabolism
(D) use of energy and consumption of food

12. What makes up the greatest percentage of freshwater in the hydrosphere?

(A) groundwater and springs
(B) polar ice and glacial ice
(C) rivers and lakes
(D) water vapor and runoff

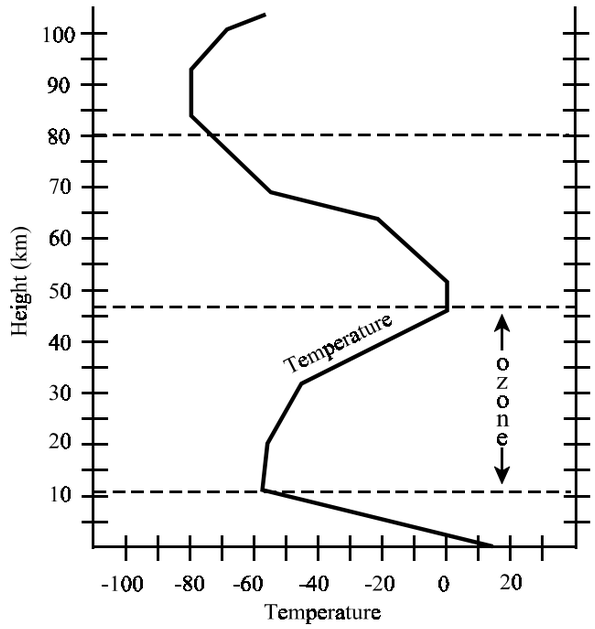
13. Which event will **most** likely lead to global warming?

(A) consumption of CO_2 during photosynthesis
(B) consumption of O_2 during respiration
(C) release of O_2 during crystallization of lava
(D) release of CO_2 during the burning of fossil fuels

14. Which substance is an example of an element?

(A) basalt
(B) granite
(C) silicon
(D) water

15. What explanation is correct concerning the trend of temperature change in the Stratosphere as shown in the diagram below?



(A) Temperature decreases because less ultraviolet energy is absorbed, due to the absence of ozone.
(B) Temperature decreases because more ultraviolet energy is absorbed, due to the presence of ozone.
(C) Temperature increases because less ultraviolet energy is absorbed, due to the absence of ozone.
(D) Temperature increases because more ultraviolet energy is absorbed, due to the presence of ozone.

16. What is the **most** abundant element in Earth's crust?

(A) hydrogen
(B) iron
(C) nickel
(D) oxygen

17. What are the **most** common rock forming minerals?

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

18. Which mineral property is the **least** reliable clue to its identity?

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

19. What type of rocks form from the solidification of molten material?

(A) halides
(B) igneous
(C) metamorphic
(D) sedimentary

20. Which statement is TRUE about the rock cycle?

(A) Igneous rocks lithify to form sediments.
(B) Igneous, sedimentary, and metamorphic rocks are all subject to metamorphism.
(C) Magma crystallizes to form both igneous and metamorphic rocks.
(D) Weathering affects only sedimentary rocks.

21. Under which condition would a chemical sedimentary rock form?

(A) cementing of sand and pebbles
(B) compaction of sand and clay
(C) precipitation of dissolved materials into solid form
(D) erosion, changing mineral composition

22. What causes compaction during the process of lithification?

(A) decreasing pressure during plate movement
(B) decreasing temperature during plate movement
(C) increasing pressure during burial
(D) increasing temperature during burial

23. Where is the **most** likely location in a river system for sediment deposition?

(A) where a tributary enters the river
(B) where the gradient decreases
(C) where the river valley has steep sides
(D) where the water flow is greatest

24. On the basis of which factor are clastic sedimentary rocks classified?

(A) density
(B) mineral composition
(C) particle size
(D) sorting

25. What are stalactites?

(A) calcium carbonate deposits which grow from the floor of a cavern
(B) calcium carbonate deposits which hang from the ceiling of a cavern
(C) iron oxide deposits which grow from the floor of a cavern
(D) iron oxide deposits which hang from the ceiling of a cavern

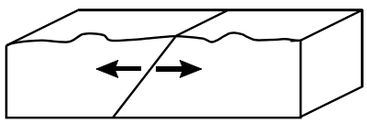
26. What was the name of the single "supercontinent" which Alfred Wegner hypothesized that today's continents were once part of?

(A) Atlantis
(B) Gondwanaland
(C) Laurasia
(D) Pangaea

27. Where would you find a divergent boundary?

(A) Andes mountains
(B) Japan trench
(C) Mid-Atlantic ridge
(D) San Andreas fault

28. What type of fault would result from the forces indicated?



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

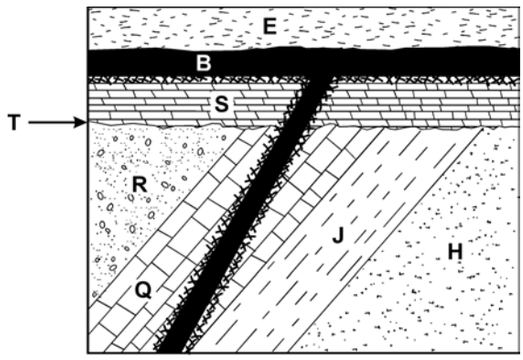
29. What type of stress causes reverse faulting?

(A) compressional
(B) expansion
(C) shearing
(D) tension

30. Why was the discovery of parallel zones of magnetic reversals in rocks on the seafloor, a crucial turning point in the development of plate tectonic theory?

(A) It explained what was making the plates move.
(B) It explained why Earth's magnetic field occasionally reverses polarity.
(C) It provided confirmation that shallow earthquakes occur in the middle of the oceans.
(D) It provided confirmation that the entire seafloor is moving.

31. What feature is indicated by "**T**"?



(A) fault
(B) fold
(C) ripple mark
(D) unconformity

32. What is the primary reason that continental drift was initially rejected by a majority of geologists?

(A) Continental reconstruction showed that continents fitted together very poorly.
(B) Fossil evidence suggested that the continents have always been where they are today.
(C) Glacial evidence suggested that the continents have always been where they are today.
(D) There was no proposed mechanism to explain continental movement.

33. In which locality would coal deposits **most** likely form?

(A) continental shelves
(B) deltas
(C) fjords
(D) swamps

34. What is the correct matching for a metallic mineral and its use?

	mineral	use
(A)	bauxite	copper production
(B)	hematite	iron production
(C)	pyrite	aluminum production
(D)	sphalerite	lead production

35. What fundamental criteria must a mineral meet in order to be classified as an ore?

(A) It must be able to be mined for profit.
(B) It must contain at least one metallic element.
(C) It must contain at least one non-metallic element.
(D) It must not be difficult to separate from its host rock.

36. Which condition will **most** likely cause the formation of a mineral concentrate by hydrothermal activity?

(A) changes in temperature and pressure
(B) hot water flowing upward
(C) rain water leaching surrounding material
(D) water flowing on the ground

37. What is the correct mineral - element match?

	mineral	element
(A)	chalcopyrite	iron
(B)	fluorite	copper
(C)	galena	lead
(D)	hematite	sulfur

38. What is the hardness of a mineral that can be scratched by your fingernail?

(A) between 1 and 2.5
(B) between 3 and 4.5
(C) between 4.5 and 6
(D) between 6 and 7.5

39. What type of volcano is produced from an eruption of fluid basaltic lava?

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

40. What **best** describes glacial tills?

(A) poorly sorted and poorly stratified
(B) poorly sorted and well stratified
(C) well sorted and poorly stratified
(D) well sorted and well stratified

41. What is true of oceanic crust?

(A) It becomes progressively older toward the mid-ocean ridges.
(B) It is no more than 200 million years old.
(C) It is the same age as the continental crust.
(D) It is the same age throughout a given ocean basin.

42. Which rock was subjected to the highest temperature and pressure conditions?

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

43. Which fossil is **most** useful to geologists in correlating widely separated sedimentary rock outcrops?

(A) One that has worldwide distribution and confined to sediments deposited during the Ordorician.
(B) One that has worldwide distribution and ranges from Cambrian to Triassic.
(C) One that is found in one region of the world and is confined to sediments of Cambrian age.
(D) One that is found in one region of the world and is different in appearance from other species.

44. Which era was dominated by dinosaurs?

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

45. What is the **most** likely way for the original remains of an organism to be preserved?

(A) as a cast
(B) as a trace fossil
(C) as a mold
(D) in amber

46. What plate boundary activity is presently occurring at the western edge of North America?

(A) continent - continent collision
(B) ocean - ocean collision
(C) seafloor spreading
(D) seafloor subduction

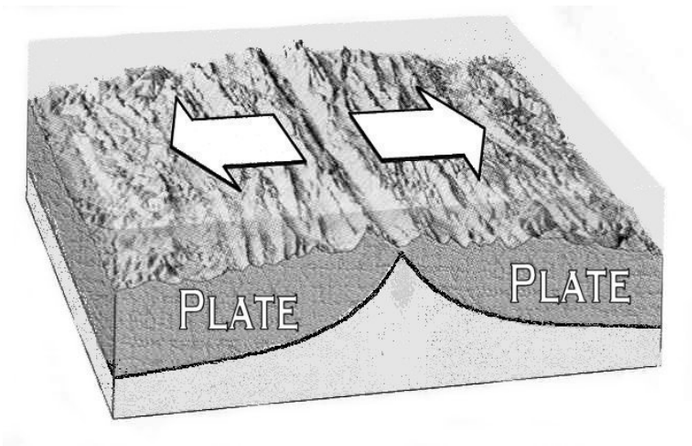
47. Rocks from which era would contain fossils of trilobites?

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

48. What are **most** episodes of mass extinction in Earth's history believed to be a result of?

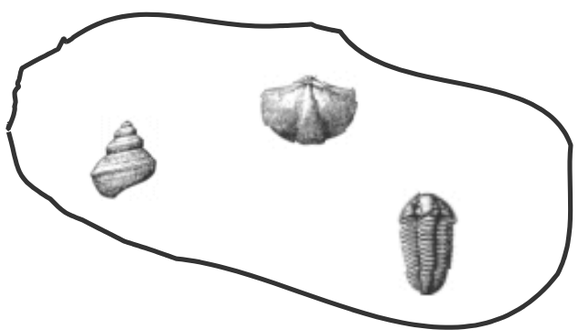
(A) abrupt climate change due to plate tectonics
(B) abrupt climate change due to volcanism
(C) gradual climate change due to plate tectonics
(D) gradual climate change due to volcanism

49. Which rock type would **most** likely be found in the environment shown below?



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

50. A geologist discovered the fossils shown below in a sedimentary sequence. What is the **most** likely depositional environment for these sediments?



(A) deep water and high energy
(B) fresh water delta and high energy
(C) salt flats and low energy
(D) shallow marine and low energy

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) Calculate the age of a rock using K - 40 → Ar - 40 (half - life 1.3 billion years) if you know that 12.5% of the parent material now remains in the sample. (Show your workings.)

2% b) With the aid of a specific example, explain how uniformitarianism can be used to understand past catastrophic events.

2% c) Explain the origin of the solar system using the Solar Nebula hypothesis.

2% d) Explain how porosity influences permeability.

Value

2% 51.e) Explain how contaminated ground water can be purified by passing through Earth's materials.

2% f) Explain how the addition of Earth's biosphere was responsible for changing the composition of Earth's atmosphere over time.

2% 52.a) Diamond and graphite have identical chemical composition (both are composed of carbon). Explain why the cleavage of these two minerals is different.

3% b) With reference to Moh's Scale and some common objects of known hardness, explain how a geologist would determine the hardness of an unknown mineral.

Value

2% 52.c) Citing two differences, distinguish between a rock and a mineral.

4% d) Explain how texture and color could be used to classify igneous rocks.

2% 53.a) Using examples, distinguish between foliated and nonfoliated metamorphic rocks.

2% b) A geologist examines a rock outcrop and finds it to contain a layer of gypsum, a layer of conglomerate, and a layer of sandstone with ripple marks. Explain the depositional environment for any two layers.

Value

4% 53.c) With the aid of well labelled diagrams, explain what happens at:
(i) a divergent plate boundary, **and**
(ii) any one of the convergent plate boundaries.

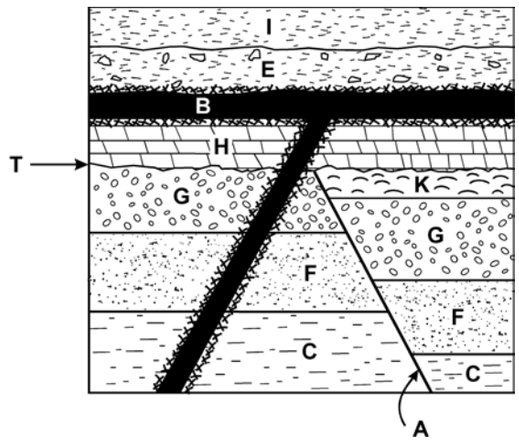
d) Earthquakes commonly occur at plate boundaries.

2% (i) With reference to elastic rebound, what causes an earthquake?

2% (ii) What do P-waves and S-waves tell us about earth's internal structure?

Value

54.a) Use the diagram below to answer the following questions.



2% (i) Is layer "B" extrusive or intrusive? Explain your answer.

2% (ii) Arrange the letters in the order they occur beginning with the oldest and ending with the youngest.

OLDEST ⟶ **YOUNGEST**

2% b) Use a diagram to explain the four stages involved in the formation of anthracite coal.

Value

2% 54.c) With the aid of a labelled diagram describe a typical oil trap.

4% 55.a) Fossils are commonly formed by the following methods:

- formation of molds and casts
- petrification by replacement

Describe these, including in your description, the conditions necessary for fossilization to occur.

3% b) With the aid of a labelled diagram explain how the Hawaiian Island Chain formed.