Harvard Undergraduate Science Olympiad India
2024 Open Round
Earth Science (7th-8th Grade) Exam

Format of Earth Science Section: The Earth Science section will contain only single-select multiple choice questions with 4 answer choices each. The section will have 45 multiple choice questions.

Scoring: Each correct answer will give you 1 point. You will lose 0.25 points for an incorrect answer. You will receive 0 points for a question left blank.

Allowed Materials:
You must bring:

- #2 pencil
- Eraser

You are allowed:

- Non-programmable, non-graphing calculator
- Wrist-watch (not a smart watch)

You may not bring

- Smart watch
- Books or notes
- Electronic devices

1. Which layer of the Earth is composed of liquid iron and nickel?
   a) Crust
   b) Mantle
   c) Outer core
   d) Inner core

2. Convection in which layer of the Earth is responsible for tectonic movement? Select the best answer.
   a) Crust
   b) Mantle
   c) Outer core
   d) Inner core

3. What is the primary cause of earthquakes?
   a) Solar flares
   b) Volcanic eruptions
   c) Movement of tectonic plates
   d) Changes in atmospheric pressure

4. What type of boundary is formed where two tectonic plates move away from each other?
   a) Convergent boundary
   b) Transform boundary
   c) Divergent boundary
   d) Subduction boundary

5. Which of the following phenomena is most likely to occur at a divergent plate boundary?
   a) Earthquakes
   b) Volcanic eruptions
   c) Creation of oceanic ridges
   d) Formation of mountain ranges

6. At a continental-oceanic convergent boundary, the oceanic plate subducts under the continental plate. Which of the following statements about oceanic crust is true?
   a) Oceanic crust is thinner and denser than continental crust
   b) Oceanic crust is primarily composed of granite
   c) The uniform density of oceanic crust prevents tectonic activity
   d) Oceanic crust is thicker and less dense than continental crust

7. Which horizon of soil is typically rich in organic material and is often referred to as the "topsoil"?
   a) O horizon
   b) A horizon
   c) B horizon
   d) C horizon

8. What is the most abundant mineral in Earth's crust?
   a) Quartz
   b) Calcite
   c) Ice
   d) Feldspar

9. Which type of rock is formed from the cooling and solidification of magma or lava?
   a) Sedimentary
   b) Igneous
   c) Metamorphic
   d) Organic

10. Which of the following is NOT true of mafic rocks compared to felsic rocks?
    a) Darker in color
    b) Higher concentration of iron and magnesium
    c) More viscous lava
    d) Denser

11. According to Bowen's Reaction Series, which mineral crystallizes first from a mafic magma?
    a) Quartz
    b) Feldspar
    c) Olivine
    d) Biotite

12. Which property of a mineral refers to the outward appearance of the mineral and how it reflects light?
    a) Fracture
    b) Hardness
    c) Cleavage
    d) Luster

13. Which of the following sedimentary structures most likely formed in a high-energy river environment?
    a) Mud cracks
    b) Ripple marks
    c) Cross-bedding
    d) Graded bedding

14. A volcano erupts with basaltic, low-viscosity lava. Which of the following is most likely to form?
    a) Cinder cone (steep slopes)
    b) Shield volcano (gentle slopes)
    c) Caldera (collapsed top)
    d) Stratovolcano (medium slopes)

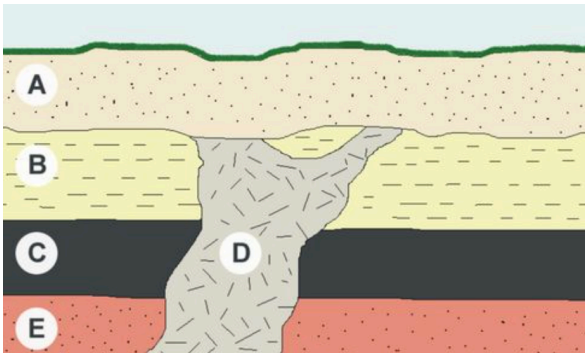
15. How do the oldest rocks on earth compare to the oldest minerals on earth?
    a) The oldest rocks are older than the oldest minerals
    b) The oldest minerals are older than the oldest rocks
    c) The oldest rocks are the same age as the oldest minerals
    d) Tests are inconclusive

16. Folds in rocks are characteristic of which kind of rock?
    a) Sedimentary
    b) Igneous
    c) Metamorphic
    d) All

17. What mineral property is (generally) the least helpful in identifying a mineral?
    a) Color
    b) Streak color
    c) Hardness
    d) Crystal structure

18. What is the most abundant gas in Earth's atmosphere?
    a) Oxygen
    b) Carbon dioxide
    c) Nitrogen
    d) Hydrogen

19. The following image depicts a geological cross-section. Which of the following statements is incorrect?



    a) E was the last to form
    b) Significant time passed between the formation of B and A
    c) A formed before D
    d) C formed before B

20. Which layer of the atmosphere contains the majority of Earth's weather phenomena?
    a) Stratosphere
    b) Mesosphere
    c) Troposphere
    d) Thermosphere

21. What are the characteristics of a maritime polar (mP) air mass?
    a) Warm and dry
    b) Cold and dry
    c) Warm and moist
    d) Cold and moist

22. What type of pressure system is associated with clear skies and calm weather?
    a) Low pressure
    b) High pressure
    c) Cyclonic pressure
    d) Frontal pressure

23. Which process is NOT part of the water cycle?
    a) Evaporation
    b) Condensation
    c) Infiltration
    d) Photosynthesis

24. What effect does a mountain range have on the local climate?
    a) It prevents rainfall entirely.
    b) It can cause more precipitation.
    c) It has no effect on climate.
    d) It causes uniform temperatures.

25. What does the term "lapse rate" refer to in meteorology?
    a) The rate at which pressure increases with altitude
    b) The rate at which temperature decreases with altitude
    c) The rate of humidity change with altitude
    d) The rate of wind speed change with altitude

26. In a scenario where the land and ocean have similar temperatures, what weather phenomenon is likely to develop?
    a) Cold, clear skies
    b) Storm systems, such as hurricanes or tropical storms
    c) Mild temperatures with little wind
    d) Mid-latitude cyclones

27. What is the primary cause of the El Niño phenomenon?
    a) Cold ocean currents
    b) Changes in atmospheric pressure
    c) Warm ocean surface temperatures in the eastern Pacific
    d) Volcanic eruptions

28. An air parcel rises from sea level, where the temperature is 20°C, to an altitude of 3,000 meters. Assume the air parcel undergoes adiabatic cooling as it rises and it follows the dry adiabatic lapse rate.

    What is the temperature of the air parcel at 3,000 meters?
    a) -10°C
    b) -5°C
    c) 0°C
    d) 5°C

29. If this air parcel then descends back to sea level, undergoing adiabatic heating with the wet adiabatic lapse rate of around 5°C, what will be its final temperature?
    a) -10°C
    b) -5°C
    c) 0°C
    d) 5°C

30. Which of the following factors most significantly contributes to the formation of trade winds?
    a) Earth's gravitational pull
    b) Differences in atmospheric pressure between the poles and equator
    c)The rotation of Earth (Coriolis effect)
    d) The seasonal variations in solar radiation

31. If Earth's rotation slowed down by half, what would most likely happen to the direction and strength of trade winds?
    a) Trade winds would remain the same in direction and strength.
    b) Trade winds would become stronger but continue blowing from east to west.
    c) Trade winds would weaken and have a less defined east-west direction.
    d) Trade winds would reverse direction, blowing from west to east.

32. What is the formula to calculate the discharge of a river?
    a) Discharge = Area × Velocity
    b) Discharge = Area ÷ Velocity
    c) Discharge = Velocity × Time
    d) Discharge = Area + Velocity

33. A river experiences increased discharge due to heavy rainfall. What is the most likely ecological impact of this change?
    a) Increased biodiversity in river ecosystems
    b) Decreased water temperature
    c) Erosion of riverbanks leading to habitat loss
    d) Stabilization of sediment transport

34. If a glacier is retreating due to climate change, what is one likely consequence for nearby rivers?
    a) Increased sedimentation rates in the river
    b) Decreased river discharge during dry seasons
    c) Higher water temperatures in the river
    d) Decreased biodiversity in the river ecosystem

35. Why does the ocean absorb more solar radiation at the equator than at the poles?
    a) The Earth's surface is smoother at the equator.
    b) The ocean is shallower at the equator.
    c) There is less atmospheric reflection at the equator.
    d) The angle of sunlight is more direct at the equator.

36. Why do polar regions have higher salinity than might be expected, despite low evaporation rates?
    a) Ice formation excludes salt from the ice
    b) Increased wind-driven mixing of surface waters
    c) Higher rates of volcanic activity
    d) Greater rates of precipitation

37. What is the primary cause of ocean tides?
    a) Wind-driven surface currents
    b) Earth's rotation alone
    c) Heat exchange between the ocean and atmosphere
    d) Gravitational pull of the moon and sun

38. What happens to a wave as it approaches shallow water near the coast?
    a) Its height increases and speed decreases.
    b) Its height decreases and wavelength increases.
    c) It dissipates without change
    d) Its speed increases and wavelength decreases.

39. How does increased atmospheric CO_2 affect the oceans?
    a) CO_2 dissolves in seawater and decreases pH by forming carbonic acid.
    b) CO_2 displaces oxygen in the water, reducing pH.
    c) CO_2 increases temperature, causing evaporation and higher salinity.
    d) CO_2 reacts with calcium carbonate, increasing pH levels.

40. Which of the following is most likely to decrease over the course of a river?
    a) Channel roughness
    b) Discharge
    c) Channel Size
    d) Velocity

41. A geologist wants to estimate the age of a rock sample by using a radioactive isotope with a half-life of 1,250 years. If 50% of the original isotope remains in the rock, approximately how old is the rock?
    a) 1,250 years
    b) 2,500 years
    c) 3,750 years
    d) 5,000 years

42. A region has soils rich in iron (Fe) and is frequently exposed to oxygen due to weathering processes. Over time, you notice a red coloration in the soil. This color change is most likely due to which chemical process?
    a) Oxidation
    b) Reduction
    c) Hydrolysis
    d) Carbonation

43. A weather balloon filled with helium expands as it rises into the atmosphere. Which of the following best explains this phenomenon?
    a) The temperature decreases with altitude, causing the helium to expand.
    b) The balloon gains kinetic energy as it rises, increasing the pressure inside it.
    c) Atmospheric pressure decreases with altitude, allowing the helium to expand.
    d) The helium's mass decreases as it moves higher in the atmosphere.

44. The release of pollen and dust from plant activity can influence cloud formation. How might large amounts of pollen contribute to precipitation?
    a) Pollen dissolves in the atmosphere and directly forms rain droplets.
    b) Pollen acts as condensation nuclei, allowing water vapor to condense and form rain droplets.
    c) Pollen absorbs moisture, leading to increased evaporation and rain.
    d) Pollen lowers humidity, which cools the atmosphere and causes rain.

45. What are the key factors that contribute to the development of a hurricane?
    a) Warm ocean water, low atmospheric pressure, and high wind shear
    b) Cold ocean water, high atmospheric pressure, and low humidity
    c) Warm ocean water, high atmospheric pressure, and low wind speed
    d) Cold air masses, high humidity, and strong surface winds