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PRACTICE TEST - 11

Pyhsical Geography

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GENERAL STUDIES

PHYSICAL GEOGRAPHY WORLD - 1

Time Allowed: One Hour ***Maximum Marks: 100***

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES *NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number carefully without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the test booklet in the Box provided alongside. ***DO NOT*** write anything else on the Test Booklet.
4. This Test Booklet contains ***50*** items (questions). Each item is printed in English. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet in response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
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9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers:**

    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.

    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no** penalty for that question.

1. Consider the following statements:

Statement-I

The Phanerozoic Eon is the most recent eon and began more than 500 million years ago.

Statement-II

The Phanerozoic Eon is subdivided into the Permian, Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, and Cambrian periods.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I

(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I

(c) Statement-I is incorrect but Statement-II is correct

(d) Statement-I is correct but Statement-II is incorrect

2. Which of the following is the dominant cosmological model to explain the origin of universe?

(a) Big Bang Theory

(b) Heliocentric Theory

(c) Geocentric Theory

(d) Disk Instability Theory

3. Which of the following are the effects of solar flare(s) if it reaches on earth?

1. Tsunamis could occur at equatorial regions.
2. Power grids could be damaged.
3. Intense auroras could occur over much of the Earth.
4. Forest fires could take place over much of the planet.

Select the correct answer from the code given below:

(a) 1 only

(b) 2 only

(c) 2 and 3

(d) 1, 2, 3 and 4

4. Consider the following statements:

1. Hydrogen turns into helium through the nuclear fusion reaction in the innermost region of the sun known as core.
2. The outermost layer of the Sun's interior is known as the convection zone uses convection mode to transfer energy.
3. The energy in radiative layer transports outside, which travels in the form of electromagnetic radiation by photons.

How many of the statements given above is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

5. Consider the following statements:

1. A planetesimal is a solid object arising during the accumulation of orbiting bodies whose internal strength is dominated by self-gravity.
2. Asteroids and comets are leftover planetesimals from the time of formation of our own solar system.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

6. Consider the following statements:

Statement-I:

The planet earth initially was a barren, rocky and hot due to atmosphere comprises of hydrogen and helium.

Statement-II:

Various geomorphological events produced three different layers in the earth's interior and each of these contains materials with different characteristics.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I

(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I

(c) Statement-I is incorrect but Statement-II is correct

(d) Statement-I is correct but Statement-II is incorrect

7. With reference to origin of life on the earth, consider the following statements:

1. The life originated on the earth as a result of chemical reactions that generated complex organic molecules which duplicated themselves by converting inorganic matter into a living thing.
2. The life on the earth gradually evolved from single-celled organisms to complex life forms.

Which of the statements given above is/are ***incorrect***?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

8. Consider the following statements:

1. The magma chamber is the storehouse of magma found below Earth's surface.
2. A batholith is a huge mass of magma in the crust and is composed of granite.
3. A laccolith is a concordant pluton with mushroom-like geometry.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

9. Consider the following:

1. Carbonation
2. Hydration
3. Frost Action

How many of the above given processes is/are involved during Chemical Weathering?

(a) Only one

(b) Only two

(c) All three

(d) None

10. Which one of the following best describes 'Exfoliation'?

(a) Disintegration of rocks into smaller fragments affecting their chemical composition.

(b) Breaking up of rocks due to freezing of water in the rock joints and cracks.

(c) A process by which the outer layers of the rock peel out in concentric cells.

(d) The rapid heating and cooling of the rocks leading to breaking up into smaller blocks.

11. Consider the following:

1. Wave-cut cliffs
2. Terraces
3. Sea Caves
4. Sea Stacks

How many of the above given marine landforms are associated to wave erosion?

(a) Only one

(b) Only two

(c) Only three

(d) All four

12. Which of the following are the erosional landforms created by glaciers?

1. Barchan
2. U-shaped valley
3. Cirque

Choose the correct option using the code given below:

(a) Only one

(b) Only two

(c) All three

(d) None

13. Consider the following mountain chains:

1. The Rockies
2. The Andes
3. The Black Forest mountains

How many of the above have been formed due to compressional forces?

(a) Only one

(b) Only two

(c) All three

(d) None

14. Consider the following statements:

1. It has a highly eroded surface.
2. It stands detached from main peninsula.
3. It is rich in mineral resources like coal, iron, limestone and uranium.

Which among the below given Plateau is described above?

(a) Chota Nagpur Plateau

(b) Karbi Anglong Plateau

(c) Deccan Plateau

(d) Meghalaya Plateau

15. Consider the following statements:

Statement-I:

Solifluction is a gradual downslope movement of lubricated soil.

Statement-II:

Waterlogged alluvium moves down slope by gravity, supported along by freeze-and-defrost cycles that thrust the top of the soil outward from the slope.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I

(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I

(c) Statement-I is incorrect but Statement-II is correct

(d) Statement-I is correct but Statement-II is incorrect

16. Consider the following statements:

1. The Himalayas were primarily formed due to the collision between the Indian Plate and the Eurasian Plate.
2. Orogenic process inside earth is driven by the forces generated by the heat-driven convection currents within the semi-fluid asthenosphere beneath the lithosphere.

Which of the above given statements is/are ***incorrect***?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

17. With reference to Karst topography, consider the following statements:

1. It is commonly associated with carbonate rocks.
2. They do not occur in temperate and alpine environments.
3. Karst systems are vulnerable to ground water pollution due to the lack of natural filtration system.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

18. Rivers bring lots of sediments build deltas along:

(a) Submerged coasts

(b) Low sedimentary coasts

(c) Both (a) and (b)

(d) None

19. Consider the following statements regarding the Earth's discontinuities:

1. The Gutenberg discontinuity separates the Earth's crust from the mantle.
2. The Moho discontinuity is found between the mantle and the outer core.
3. The Conrad discontinuity demarcates the upper and lower crust.

How many of the statements given above is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

20. Consider the following statements:

1. Tectonic earthquakes are primarily caused by volcanic activities.
2. Collapse earthquakes are small quakes that occur in regions with underground caves and mines.
3. All explosive earthquakes are typically associated with the eruption of volcanoes.
4. Deep-focus earthquakes originate at depths greater than 700 km below the Earth's surface.

Which of the statements given above is/are ***incorrect***?

(a) 1 and 4 only

(b) 1, 3, and 4 only

(c) 1 and 3 only

(d) 1 and 2 only

21. Consider the following statements:

1. Primary waves are the first to be detected by seismographs and travel fastest through the Earth.
2. Surface waves cause the most destruction during an earthquake as they move only along the surface of the Earth.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

22. Consider the following statements about Earth's crust:

1. The crust is the heaviest layer of the Earth.
2. Oceanic crust is primarily composed of basalt, whereas continental crust is mainly granite.
3. Oceanic crust is thicker than continental crust.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) 2 and 3 only

(d) 1 and 3 only

23. Consider the following statements regarding postulates of Plate Tectonics:

1. It's not the continent, rather continental plates move over the ocean.
2. Both continental and oceanic crusts are formed as well as consumed over a period.
3. All the plates, without exception, have moved in the geological past and shall continue to move in the future period as well.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

24. Consider the following statements:

1. The reason that the P waves can travel only through solid materials proves that the outer core of the Earth is not in solid form.
2. P Waves are faster than the S-waves because the S-waves propagate transversally whereas the P-waves move longitudinally.

Which of the above statements is/are ***incorrect***?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

25. Which of the following is/are the evidences for Seafloor Spreading?

1. Rocks on either side of the crest of oceanic ridges having equidistant locations have similar properties.
2. The rocks of the oceanic crust near the oceanic ridges are much younger than the rocks of the continental crust.

Select the correct answer using the codes given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

26. Consider the following statements:

1. Triple junctions are the intersection of three divergent plate boundaries splitting off at about 120° angles from each other.
2. The Great Rift Valley and Red Sea are the result of plate tectonics in the Afar Triple Junction.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

27. Consider the following methods:

1. Rocks extracted from mining areas
2. Meteors
3. Gravitation
4. Volcanic Eruption
5. Deep Ocean Drilling

How many of the above given methods are the direct sources to be used in the study of the interior of earth?

(a) Only two

(b) Only three

(c) Only four

(d) All five

28. How many of the following statements is/are correct regarding types of volcanoes?

1. Shield Volcano is a stratovolcano which is usually tall with steep even sides and is made out of repeating layers of lava flows, volcanic ash, cinders, blocks, and volcanic bombs.
2. Composite Volcano is a broad, gently sloping dome shape volcano built almost entirely of fluid lava flows.
3. Caldera Volcano is formed during an eruption that removes the summit of a single stratovolcano.

Select the correct answer using the codes given below:

(a) Only one

(b) Only two

(c) All three

(d) None

29. Consider the following:

1. South America
2. North America
3. Madagascar
4. India
5. Arabia

How many of the following were the parts of Gondwanaland?

(a) Only two

(b) Only three

(c) Only four

(d) All five

30. Consider the following statements regarding difference between geysers and hot springs.

1. In hot springs, jet of water is usually emitted with an explosion while in geysers, the water rises to the surface without any explosion.
2. Geysers contain dissolved minerals which may be of some medicinal value while they are not found in hot springs.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

31. With respect to convectional current theory, consider the following statements:

1. The entire process of this theory is based on heat generated by radioactive materials.
2. Convective currents can be formed even in absence of heat.
3. The currents are generated due to thermal difference in the Earth's core.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

32. With reference to the Indian plate, consider the following statements:

1. It is a major tectonic plate.
2. It forms a convergent plate boundary with the Eurasian plate.
3. The Indian plate is tectonically separated from the Peninsular Indian plate.
4. The plate extends to Pakistan and Myanmar as well.

How many of the above given statements is/are correct?

(a) Only one

(b) Only two

(c) Only three

(d) All four

33. Consider the following statements:

1. Auroras are formed when electrically charged particles of solar wind ionize gases like oxygen and nitrogen from the Earth's atmosphere and thereby release of energy.
2. Hydrogen and helium atoms can produce blue and purple auroras when struck down by the solar wind.
3. Unlike Solar magnetic storms, auroras do not interfere with radio communications.

How many of the above statements is/are correct?

(a) None

(b) Only one

(c) Only two

(d) All three

34. Consider the following statements:

1. No lithosphere is destroyed or created, and no fold mountain chains are built at transform boundaries.
2. Transform boundaries do not occur on the continental lithosphere.
3. A Strike-Slip Fault is an example of Transform Fault.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

35. Geodynamo is a process by which a celestial body generates a magnetic field. What are the characteristics of the Earth so that it has a geodynamo?

1. Coriolis forces of the Earth cause convection currents to be spiral.
2. The liquid iron in the outer core is an excellent electrical conductor.
3. It has a solid (plasma) inner core.
4. It rotates steadily and the rotational speed of all the layers of the Earth is uniform.

Select the correct answer using the code given below:

(a) 4 only

(b) 1 and 2 only

(c) 3 and 4 only

(d) 1, 2 and 4 only

36. Consider the following pairs regarding the theories on the origin of the Earth:

Theory	***Description***
1. Laplace's nebular hypothesis	Planets were formed from material associated with the young Sun as a result of the accretion process.
2. Chamberlain and Moulton Binary Theory	Sun was a binary star or twin-star system and an intruding star approached the Sun's companion star, separating the tidal filament (and planets that originate from it)
3. Russell's Binary Star hypothesis	Another wandering star approached the sun and separated a cigar-shaped extension from the solar surface
4. Big Bang Theory	Universe, initially, was condensed into a single particle and later started expanding infinitely after a huge explosion

How many of the above pairs is/are correctly matched?

(a) Only one

(b) Only two

(c) Only three

(d) All four

37. With reference to geological time scale, consider the following statements:

1. In terms of geological time, the Archean eon marks the start of life on Earth.
2. Cyanobacteria started producing oxygen in the Proterozoic Eon.
3. The Proterozoic eon is the final eon of the Precambrian period in geological time.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

38. With respect to the formation of Cuspate Deltas, consider the following statements:

Statement-I:

Sedimentation on a straight beach with strong waves causes the formation of these deltas.

Statement-II:

The waves push the sediments to spread outwardly creating the tooth-like shape.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I

(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I

(c) Statement-I is correct but Statement-II is incorrect

(d) Statement-I is incorrect but Statement-II is correct

39. Consider the following statements regarding the features of glacial depositional landforms:

1. The deposition of the sediments in a fan-shaped body is known as an outwash fan.
2. Moraine consists of accumulated rocks, dirt, and other debris that have been deposited by a glacier.
3. Kame is usually formed when debris from a rock fall or other large volumes of debris fall through a crevasse of a glacier and accumulate in the depression.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

40. With reference to the characteristics of the coastal landforms, consider the following statements:

1. The delta landforms develop at river mouths where waves and tides influence the amount of sediment supplied by the river.
2. Estuaries are buffer zones between river and ocean environments that are affected by tidal oscillations.
3. Lagoons are protected bodies of water that are little affected by tides.

Which of the statements given above is/are correct?

(a) 2 only

(b) 1 only

(c) 2 and 3 only

(d) 1 and 2 only

41. Which of the following statement is/are ***incorrect?***

1. Sudden geomorphic movements occur mostly at the lithospheric plate margins.
2. These movements occur because of the pressure caused by the pushing and pulling of magma in the mantle.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

42. Which of the following statements is/are correct regarding the Biological activity and weathering?

1. Living organisms contribute to chemical weathering only.
2. Decaying plant and animal matter help in the production of humus, carbonic and other acids which enhance decay and solubility of some elements.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

43. Consider the following statements regarding Oblique-slip faults:

1. Oblique-slip faults includes component of both dip-slip and strike-slip faults.
2. These are caused by a combination of shearing and tension or compressional forces.
3. Many disastrous earthquakes are caused along the oblique slip.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

44. How many of the following statements is/are correct regarding Fold Mountains?

1. This type of mountains is associated with continental crust.
2. The fold mountain is formed at continental collision zones.
3. These are formed under low pressure and relatively high temperatures.
4. The Alps is an example of the Fold Mountains.

Select the correct answer using the codes given below:

(a) Only one

(b) Only two

(c) Only three

(d) All four

45. Consider the following:

1. Radioactivity
2. Rotational and Tidal Friction
3. Primordial Heat
4. Gravitational Force

How many of above forces is/are responsible for generating energy to carry out endogenic geomorphic processes?

(a) All four

(b) Only one

(c) Only two

(d) Only three

46. Match the following:

1. Normal Fault	A. It is caused by compressional forces in which the block above the fault moves up relative to the block below the fault.
2. Reverse Fault	B. It is formed when rocks are sliding past each other in horizontal direction with little or no vertical movement.
3. Strike-slip faults	C. It is caused by tensional forces in which the block above the fault has moved downward relative to the block below.

Select the correct answer using the codes given below:

(a) 1-C, 2- A, 3-B

(b) 1-B, 2-C, 3-A

(c) 1-A, 2-B, 3-C

(d) 1-B, 2-A, 3-C

47. Consider the following regarding processes involved in Mass Wasting:

Process	***Definition***
1. Soliflucation	It is a stage at which highly fluid, high velocity mixture of sediment and water has a consistency ranging between soup-like and wet concrete.
2. Slump Formation	This stage occurs during summer thaw when the eater in the soil is trapped there by frozen permafrost beneath it.
3. Mudflows	It is a type of slide wherein downward rotation of rock or regolith occurs along a concave-upward curved surface (rotational slides)

How many of the statements given above is/are correct?

(a) Only one

(b) Only two

(c) All three

(d) None

48. Which of the following statements is/are characteristic features of an Ox-bow Lake?

1. It is formed in flat, low-lying plains close to where the river empties into another body of water.
2. It is a Stillwater Lake which implies that water does not flow into or out of them.
3. It does not have a natural outlet.
4. The rivers with high sinuosity often create shorter oxbow lakes than rivers that naturally flow in straighter lines.

Select the correct answer using the codes given below:

(a) 4 only

(b) 2 and 3 only

(c) 1, 2 and 4 only

(d) 1, 2 and 3 only

49. Which of the following statements regarding Aeolian Landforms is/are correct?

1. They are features produced by either the erosive or constructive action of the wind.
2. Aeolian landforms are also observed on frozen lakes or sea ice.

Select the correct answer from the code given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

50. Consider the following statements about Mass wasting:

1. It is the erosion of soil and rock materials due to the influence of gravity.
2. It is caused by the mechanical breakdown of materials on hill slopes.
3. It involves the movement of weathered materials under the influence of water, ice, and air.

How many of the above statements is/are correct?

(a) Only one

(b) Only two

(c) Only three

(d) None

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GENERAL STUDIES

PHYSICAL GEOGRAPHY WORLD - 1

Answer Key

Q. 1 (d)	**Q. 11 (d)**	**Q. 21 (c)**	**Q. 31 (a)**	**Q. 41 (d)**
Q. 2 (a)	**Q. 12 (b)**	**Q. 22 (b)**	**Q. 32 (c)**	**Q. 42 (b)**
Q. 3 (c)	**Q. 13 (b)**	**Q. 23 (b)**	**Q. 33 (c)**	**Q. 43 (c)**
Q. 4 (c)	**Q. 14 (d)**	**Q. 24 (a)**	**Q. 34 (a)**	**Q. 44 (c)**
Q. 5 (c)	**Q. 15 (a)**	**Q. 25 (c)**	**Q. 35 (b)**	**Q. 45 (a)**
Q. 6 (b)	**Q. 16 (d)**	**Q. 26 (c)**	**Q. 36 (b)**	**Q. 46 (a)**
Q. 7 (d)	**Q. 17 (b)**	**Q. 27 (b)**	**Q. 37 (b)**	**Q. 47 (d)**
Q. 8 (c)	**Q. 18 (c)**	**Q. 28 (a)**	**Q. 38 (a)**	**Q. 48 (d)**
Q. 9 (b)	**Q. 19 (a)**	**Q. 29 (c)**	**Q. 39 (c)**	**Q. 49 (c)**
Q. 10 (c)	**Q. 20 (b)**	**Q. 30 (d)**	**Q. 40 (c)**	**Q. 50 (d)**

1. Correct Option: (d)

Explanation:

- **Statement 1 is correct:** The Phanerozoic is the current and the latest of the four geologic eons in the Earth's geologic time scale, covering the time period from 538.8 million years ago to the present.
- **Statement 2 is incorrect**: **The Paleozoic** and **not Phanerozoic eon** is subdivided into the Permian, Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, and Cambrian periods.
- The Phanerozoic is divided into three eras: **Cenozoic, Mesozoic, and Paleozoic**.

Supplementary notes:

Geological time scale

- A representation of time-based on Earth's rock record is called the **geologic time scale**.
- It is a method of chronological dating that makes use of geochronology and chronostratigraphy, which relate strata to time (a scientific branch of geology that aims to determine the age of rocks).
- It is largely used to explain the timing and linkages of events in the history of the Earth by Earth scientists, such as geologists, paleontologists, geophysicists, and geochemists.

Division of geologic time

- The geologic time scale is divided into several magnitudes of units of time. **The names of geologic time units are defined for chronostratigraphic units with the corresponding geochronologic unit are as follows:**

Eons

- Eons are the largest intervals of geologic time and are hundreds of millions of years in duration.
- The Precambrian is an informal unit of geologic time, subdivided into **three eons (Hadean, Archean, Proterozoic) of the geologic time scale.**
- The **Phanerozoic Eon** is the most recent eon and began more than **500 million years ago.**

Eras

- Eons are divided into smaller time intervals known as eras. The Phanerozoic is divided into three eras: **Cenozoic, Mesozoic, and Paleozoic.**
- Very significant events in Earth's history are used to determine the boundaries of the eras.

Periods

- Eras are subdivided into periods. The events that bound the periods are widespread in their extent but are not as significant as those which bound the eras.
- The Paleozoic is subdivided into the Permian, Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, and Cambrian periods.

L2: Approachable

2. Correct Option: (a)

Explanation:

- **Option (a) is correct**

Supplementary notes:

Theories related to Origin of universe

Big Bang Theory

- The Big Bang theory is the dominant cosmological model that explains the existence of the observable universe from its inception to its subsequent large-scale evolution.
- The model describes how the universe expanded from a high density and temperature starting point and provides a comprehensive explanation for a wide range of observed phenomena.

Heliocentric Theory

- This theory was first proposed by **Nicolaus Copernicus**. Copernicus was a Polish astronomer.
- He first published the heliocentric system in his book: **De revolutionibus orbium coelestium**, "On the revolutions of the heavenly bodies," which appeared in 1543. Copernicus died the same year his book was published.
- After 1,400 years, Copernicus was the first to propose a theory which differed from Ptolemy's Geocentric System, according to which the earth is at rest in the center with the rest of the planets revolving around it.

Geocentric Theory

- Ptolemy had put forth the geocentric model of the universe. According to the geocentric model, earth is at the centre of the universe.

- The Ptolemaic model was followed for over 1000 years and was adopted by the Christian church as the model of the universe.

The Disk Instability Theory

- The "Disk Stability Theory" explains the process in which a massive sized disk cools down rapidly and causes the production of fragments that are self-gravitating clumps. This theory is less popular but it is still a plausible explanation.
- According to the theory, in the very early stages of the formation of the proto–planetary disk, a rapid cooling occurred in the order of orbital timescale.
- The fragments then started to condense and formed the different heavenly bodies and planets.

L1 : Elementary

3. Correct Option: (c)

Explanation:

- **Option (c) is correct**

Supplementary notes:

Geomagnetic Storm

- A geomagnetic storm refers to the disruptions to the Earth's magnetic field caused by solar emissions.
- When a Coronal Mass Ejection (CME) or a high-speed solar stream reaches our planet, it slams into the magnetosphere.
- The Earth's magnetosphere is created by its magnetic fields and it usually protects us from the particles emitted by the Sun.
- When a CME or a high-speed stream arrives at Earth, it peels open the planet's magnetosphere, kind of like an onion. This allows energetic solar wind particles to stream down and hit our atmosphere over the poles.
- Solar weather events like this can also supercharge auroras, sometimes making them visible in places where they wouldn't have been otherwise.

Implications of Such a Storm

- **Space Weather:**
  - Not all solar flares reach Earth, but solar flares/storms, Solar Energetic Particles (SEPs), high-speed solar winds, and CMEs that come close can impact space weather in near-Earth space and the upper atmosphere.
- **Problems for Spacecraft Operations:**
  - Solar storms can hit operations of space-dependent services like Global Positioning Systems (GPS), radio, and satellite communications. Aircraft flights and space exploration programmes are vulnerable.
- **Disturbances in the Magnetosphere:**
  - It can potentially create disturbances in the magnetosphere, the protective shield surrounding the Earth.
  - Astronauts on spacewalks face health risks from possible exposure to solar radiation outside the Earth's protective atmosphere.

L4 : Incapacitated

4. Correct Option: (c)

Explanation:

- **All statements are correct**

Supplementary notes:

Structure of the Sun

- The atmosphere of the Sun is formed by its outer layers. There are primarily three layers that make up the atmosphere which is named as the core, the radiative zone, and the convective zone. These are the internal parts of the Sun.

Core

- The Centre most region of the Sun is known as the core; this is the region where **Hydrogen turns into Helium through the nuclear fusion reaction.** With temperatures believed to be reaching more than 15 million degrees Celsius, the core is considered to be the hottest region of the Sun. When we move towards the outward layers, the density and temperature decrease, and at the Centre of the core, it is about 150 g/cm3.

Radiative Zone

- Between the core and the convection zone, there lies the radiative zone; by means of radiative diffusion and thermal conduction, **the energy in this layer transports outside, which travels in the form of electromagnetic radiation by photons.** Bouncing from particle to particle, photons transfer energy. At the edge of the radiative zone, the density of this layer reduces from 20 g/cm3 to 0.2 g/cm3.

Convection Zone

- **The outermost layer of the Sun's interior is known as the convection zone.** This zone uses convection mode to transfer energy. The temperature at its base is about 2 million degrees Celsius. The temperature in this zone is low enough for the heavier ions like carbon, oxygen, nitrogen, iron and calcium to hold on to some of their electrons.

L3: Real Challenge

5. Correct Option: (c)

Explanation:

- **Both statements are correct**

Supplementary notes:

Planetesimals

- Planetesimals are the building blocks of planets.
- **Asteroids and comets** are leftover planetesimals from the time of formation of our own solar system.
- The formation of km-sized or larger planetesimals remains an open problem in planet formation theories. Once objects are larger than ~10 km, gravity helps these objects grow into planets.
- Condensation and electrostatic surface forces can explain the growth of mm to cm-sized objects in the nebula.

Formation of Planetesimals

- The stars are localised lumps of gas within a nebula. The gravitational force within the lumps leads to the formation of a core to the gas cloud and a huge rotating disc of gas and dust develops around the gas core.
- In the next stage, the gas cloud starts getting condensed and the matter around the core develops into small rounded objects. These small-rounded objects by the process of cohesion develop into what is called planetesimals.
- Larger bodies start forming by collision, and gravitational attraction causes the material to stick together. Planetesimals are a large number of smaller bodies.
- In the final stage, these large number of small planetesimals accrete to form a fewer large bodies in the form of planets.

L3: Real Challenge

6. Correct Option: (b)

Explanation:

- **Both statements are correct**

Supplementary notes:

Evolution of Earth

- The planet earth initially was a barren, rocky and hot object with a thin atmosphere of hydrogen and helium. This is far from the present day picture of the earth.
- Hence, there must have been some events–processes, which may have caused this change from rocky, barren and hot earth to a beautiful planet with ample amount of water and conducive atmosphere favouring the existence of life.
- The earth has a layered structure.
- From the outermost end of the atmosphere to the centre of the earth, the material that exists is not uniform.
- The atmospheric matter has the least density.
- From the surface to deeper depths, the earth's interior has different zones and each of these contains materials with different characteristics.

L2: Approachable

7. Correct Option: (d)

Explanation:

- **Both statements are correct**

Supplementary notes:

Origin of Life

The final phase in the evolution of earth was the origin of life

- Origin of life was triggered by a chemical reaction that generated complex organic molecules which could duplicate themselves
- These organic molecules could duplicate themselves by converting inorganic matter into a living thing
- It is said that life began on earth at least 3.5 to 4 billion years ago
- Scientists can study the origin and evolution of life on earth with the help of fossils
- When we talk about the origins of life, we should also note that life gradually evolved from single-celled organisms to complex life forms

- While the earliest known single-celled creatures appeared on Earth around 3.5 billion years ago, nearly a billion years after the Earth began
- More sophisticated forms of life evolved more slowly, with the first multicellular creatures emerging some 600 million years ago
- Lastly, the emergence of multicellular life from simpler, unicellular microorganisms was a pivotal point in Earth's biological history, radically altering the planet's environment

L2: Approachable

8. Correct Option: (c)

- **All statements are correct**

Supplementary notes:

Effect of Volcanic Eruption

- The magma chamber is the storehouse of magma found below Earth's surface. It is a large, underground pool of molten rock and gas.
- A batholith is a huge mass of magma in the crust and is composed of granite. It is a discordant pluton, which means that it cuts across the surrounding rocks.
- A laccolith is a concordant pluton with mushroom-like geometry. It is a dome-shaped intrusion that is formed when magma is injected between layers of sedimentary rock.
- Sill is a planar sheet of magma parallel to the surrounding rocks. Dyke is a mass of magma which is deposited/ intruded in such a way that it cuts across surrounding rocks.
- Vent is a hole through which magma reaches Earth's surface. Fissure is a crack in the subsurface rocks through magma reaches Earth's surface. Lava plain or lava plateau is a landform formed when magma ejected lava through a fissure. Volcano is a cone-shaped hill formed when magma ejected lava through a vent.
- The mound of a volcano is named as cone which may consist of lava or a mixture of lava and other pyroclastic material. Pipe of a volcano is used for the channel through which lava rises and the exit of the pipe is called the crater, which is usually a shallow depression. Pyroclastic material includes all the solid material ejected from volcano.

L2: Approachable

9. Correct Option: (b)

Explanation:

- **Option (b) is correct**

Supplementary notes:

Chemical Weathering

- Weathering is the general term applied to the combined action of all processes that cause rock to disintegrate physically and decompose chemically because of exposure near the Earth's surface through the elements of weather.
- Chemical change in the rocks through formation of new compounds or formation of new substances is called **chemical weathering**.
- Chemical processes include **oxidation, hydrolysis, and acid solution**.
- Chemical weathering involves **four major processes**-
  - Oxidation
  - Carbonation
  - Hydration
  - Solution
- **Frost Action: One of the most important physical weathering processes in cold climates is frost action, the alternate freezing and melting of water inside the joints of the rocks, splits them into fragments.**

L1 : Elementary

10. Correct Option: (c)

Explanation:

- **Option (c) is correct**

Supplementary notes:

Exfoliation

- Rocks are generally poor conductors of heat. As a result of intense heating the outer layers of the rock expand rapidly while the inner layers remain almost unaffected by heat.
- Due to successive expansion and contraction, the outer layer of the rock subsequently peels off from the main mass of the rock in the form of concentric shells.
- The peeling of rocks in layers by this process is very similar to the peeling of successive layers of an onion. The process is **called exfoliation.**

- Almost all rounded forms of dolerite blocks of rocks in **Singhbhum district of Bihar** are due to this process.

L1 : Elementary

11. Correct Option: (d)

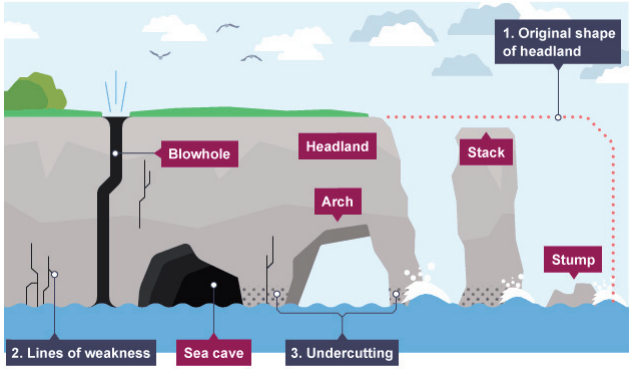
Explanation:

- **Option (d) is correct**

Supplementary notes:

Marine landforms

- **Wave-cut cliffs and terraces** are two forms usually found where erosion is the dominant shore process. Almost all sea cliffs are steep and may range from up to 30 m or even more.
- At the foot of such cliffs there may be a flat or gently sloping platform covered by rock debris derived from the sea cliff behind.
- Such platforms occurring at elevations above the average height of waves is called a **wave cut terrace**. The lashing of waves against the base of the cliff and the rock debris that gets smashed against the cliff along with lashing waves create hollows and these hollows get widened and deepened to form sea caves.
- The roofs of caves collapse and the **sea cliffs** recede further inland. Retreat of the cliff may leave some remnants of rock standing isolated as small islands just off the shore. Such resistant masses of rock, originally parts of a cliff or hill are **called sea stacks.**
- Like all other features, **sea stacks** are also temporary and eventually coastal hills and cliffs will disappear because of wave erosion giving rise to narrow coastal plains, and with onrush of deposits from over the land behind may get covered up by alluvium or may get covered up by shingle or sand to form a wide beach.



12. Correct Option: (b)

Explanation:

- **Option (b) is correct:** Barchan is a topographical feature made by wind deposition.

Supplementary notes:

Glacial Landforms

- Like running water and underground water, glacier also does the work of erosion, transportation and deposition.
- Although the zone of action of glaciers is rather limited, topographical features made by them are frequently found spread over even in areas once affected by glacial action.
- **The landforms created by glacial erosion are:**
  - Cirque
  - U-shaped Valley
  - Hanging Valley

L2: Approachable

13. Correct Option: (b)

Explanation:

- **Option (b) is correct**

Supplementary notes:

Mountains formed due to compressional forces

- Forces of compression involve pushing of the rock strata against a hard plane from one side or from both sides. The compressional forces lead to the bending of rock layers and thus lead to the formation of Fold Mountains.
- In them the rock strata primarily of sedimentary rocks get folded, into wave like structure. This process of bending, sometimes warping and twisting of rock strata is referred to as their folding. The upfolds are called anticlines and downfold are called synclines.
- When folding takes place on a gigantic scale, it represents the mountain building process.
- Most of the great mountain chains of the world viz, the **Himalaya**, the **Rockies**, the **Andes**, the **Alps** and others of this sort have been formed by compressional forces resulting in mountain building on a large scale.

- These are also called **Orogenetic Movements**. Faulting results in the formation of well-known relief features such as rift valleys and the block mountains.
- The Black Forest Mountain comes under this category.

L2: Approachable

14. Correct Option: (d)

Explanation:

- **Option (d) is correct:** Meghalaya and Karbi Anglong plateaus are part of the peninsular block but stand detached from it due to the filling of Malda fault by Ganga and Brahmaputra rivers.
- Meghalaya plateau receives highest rainfall from South-West in India and has a highly eroded surface. It is rich in mineral resources like **coal, iron, uranium and limestone**.

Supplementary notes:

Plateau in India

- Plateau is an area of raised land that is flat on top. Plateaus are often by themselves with no surrounding plateau.
- National Geographic describes plateaus as flat and elevated landform that rises sharply above the surrounding area on at least one side.

Meghalaya Plateau

- The peninsular plateau extends further east beyond the Rajmahal hills to from Meghalaya or the Shillong plateau.
- Garo-Rajmahal Gap separates this plateau from the main block.
- This gap was formed by down-faulting (normal fault: a block of earth slides downwards). It was later filled by sediments deposited by the Ganga and Brahmaputa.
- The plateau is formed by Archaean quartzites, shales and schists.
- The plateau slopes down to Brahmaputra valley in the north and the Surma and Meghna valleys in the south.
- Its western boundary more or less coincides with the Bangladesh border.
- The western, central and the eastern parts of the plateau are known as the Garo Hills (900 m), the Khasi-Jaintia Hills (1,500 m) and the Mikir Hills (700 m).
- Shillong (1,961 m) is the highest point of the plateau.

Deccan Plateau

- It covers an area of about five lakh sq. km.
- It is triangular in shape and is bounded by the Satpura and the Vindhya in the north-west, the Mahadev and the Maikal in the north, the Western Ghats in the west and the Eastern Ghats in the east.
- Its average elevation is 600 m.
- It rises to 1000 m in the south but dips to 500 m in the north.
- Its general slope is from west to east which is indicated by the flow of its major Rivers.
- Rivers have further subdivided this plateau into a number of smaller plateaus.

Chotanagpur Plateau

- Chotanagpur plateau represents the North-eastern projection of the Indian Peninsula.
- Mostly in Jharkhand, northern part of Chhatisgarh and Purulia district of West Bengal.
- The Son River flows in the north-west of the plateau and joins the Ganga.
- The average elevation of the plateau is 700 m above sea level.
- This plateau is composed mainly of Gondwana rocks.
- The plateau is drained by numerous rivers and streams in different directions and presents a radial drainage pattern.
- Rivers like the Damodar, the Subarnrekha, the North Koel, the South Koel and the Barkar have developed extensive drainage basins.
- The Damodar River flows through the middle of this region in a rift valley from west to east. Here are found the Gondwana coal fields which provide bulk of coal in India.

L3: Real Challenge

15. Correct Option: (a)

Explanation:

- **Both statements are correct**

Supplementary notes:

Solifluction

- Solifluction is the gradual downslope movement of water-saturated or lubricated soil mass or fine-grained rock debris.

- It's a kind of creep in which the movement is influenced by lubricated water. Because groundwater strata are occupied in between permanently frozen soil and rocks in permafrost zones, it primarily occurs there.
- When Water logs, Soil Flows, and this mechanism is called Solifluction.
- Solifluction is a term used for the slow downhill flow of soil in regions of the Arctic Ocean.
- It takes place slowly and is computed in millimeters or centimeters per year.
- It approximately uniformly affects the entire thickness of the soil instead of amassing in certain areas.
- It totally results from the waterlogging of sediment instead of short-lived events of saturation from storm runoff.

L2: Approachable

16. Correct Option: (d)

Explanation:

- **Both statements are correct**

Supplementary notes:

Orogenic processes

- Orogeny, or the process of mountain building, occurs when two tectonic plates converge, collide, or interact in a way that leads to the deformation and uplift of the Earth's crust.
- **This movement is driven by the forces generated by the heat-driven convection currents within the semi-fluid asthenosphere beneath the lithosphere.**
- This pressure leads to various geological phenomena, including:
- **Crustal Uplift**: The intense compression forces generated during plate convergence can uplift and push sections of the Earth's crust upward. This uplift results in the formation of mountain ranges. For example, **the collision between the Indian Plate and the Eurasian Plate gave rise to the Himalayan mountain range.**
- **Folding and Faulting**: The immense pressure from plate interactions causes rocks in the crust to fold and fault. Folded rocks create the characteristic folded layers seen in many mountain ranges, while faulting can lead to the displacement of large sections of crust.
- **Volcanism:** Orogenic processes can also trigger volcanic activity. When tectonic plates converge, one plate may be forced beneath the other (subduction), leading to the melting of rock and the formation of volcanoes. The Andes in South America are an example of a mountain range formed through volcanic activity associated with subduction.

L2: Approachable

17. Correct Option: (b)

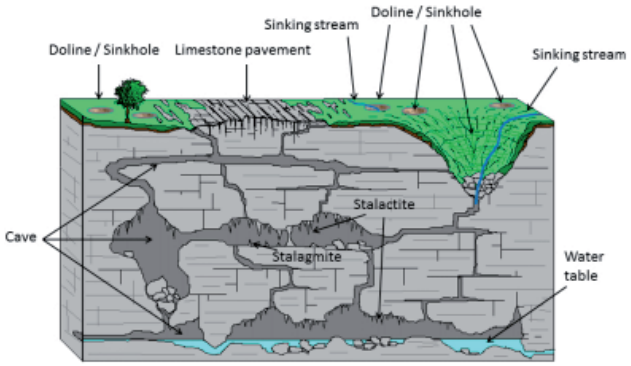
Explanation:

- **Statement 1 is correct:** The term karst describes a distinctive topography that indicates dissolution (also called chemical solution) of underlying soluble rocks by surface water or ground water.
- Although commonly associated with carbonate rocks (limestone and dolomite) other highly soluble rocks such as evaporates (gypsum and rock salt) can be sculpted into karst terrain.
- **Statement 2 is incorrect:** Though most abundant in humid regions where carbonate rock is present, karst terrain occurs in temperate, tropical, alpine and polar environments.
- **Statement 3 is correct:** Although karst processes sculpt beautiful landscapes, karst systems are very vulnerable to ground water pollution due to the relatively rapid rate of water flow and the lack of a natural filtration system.

Supplementary notes:

Karst topography

- Karst is a landscape which is underlain by limestone which has been eroded by dissolution, producing towers, fissures, sinkholes, etc.
- It is so named after a province of Yugoslavia on the Adriatic sea coast where such formations are most noticeable
- Karst topography is a landscape formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum.
- It is characterized by underground drainage systems with **sinkholes, caves etc.**



L3: Real Challenge

18. Correct Option: (c)

Explanation:

- **Option (c) is correct**

Supplementary notes:

Formation of Delta

- Assuming sea level to be constant, two types of coasts are considered to explain the concept of evolution of coastal landforms: **(i) high, rocky coasts (submerged coasts); (ii) low, smooth and gently sloping sedimentary coasts (emerged coasts).**
- When waves break over a gently sloping sedimentary coast, the bottom sediments get churned and move readily building bars, barrier bars, spits and lagoons.
- Lagoons would eventually turn into a swamp which would subsequently turn into a coastal plain.
- The maintenance of these depositional features depends upon the steady supply of materials.
- Storm and tsunami waves cause drastic changes irrespective of supply of sediments. Large rivers which bring lots of sediments build deltas along low sedimentary coasts.

L1 : Elementary

19. Correct Option: (a)

Explanation:

- **Statement 1 is incorrect:** The Mohorovičić discontinuity, or Moho, is the boundary separating the Earth's crust from the mantle.
- **Statement 2 is incorrect:** The Gutenberg discontinuity delineates the boundary between the solid mantle and the liquid outer core.
- **Statement 3 is correct:** The Conrad discontinuity is found within the Earth's crust, distinguishing the upper crust from the lower crust.

Supplementary notes:

Earth's discontinuities

- The Earth's interior is classified into various layers based on seismic observations. At boundaries where there's a noticeable change in seismic velocities, these are termed discontinuities. The main types of discontinuities are:
  - Conrad Discontinuity
  - Mohorovičić (Moho) Discontinuity
  - Gutenberg Discontinuity
- Lehmann Discontinuity: A boundary within the inner core, demarcating the difference between the solid inner core and its outer parts.
- These discontinuities help geologists understand the layered structure and composition of the Earth's interior.

L2: Approachable

20. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** Tectonic earthquakes are not primarily caused by volcanic activities. They are a result of the Earth's tectonic plates moving and are the most common type of earthquake.
- **Statement 2 is correct**: Collapse earthquakes are indeed minor tremors that occur in regions with underground caves, mines, or even due to the caverns formed when magma vacates a chamber. They are not very powerful but occur frequently in mining areas.
- **Statement 3 is incorrect:** Explosive earthquakes are not typically associated with the eruption of volcanoes. While volcanic eruptions can cause earthquakes, they are not termed as 'explosive earthquakes.' An explosive earthquake is typically associated with nuclear and chemical explosions.
- **Statement 4 is incorrect:** Deep-focus earthquakes do originate at significant depths, often more than 300 km below the Earth's surface, but not necessarily more than 700 km.

Supplementary notes:

Factors Affecting Magma Viscosity

- The viscosity or "stickiness" of magma is primarily influenced by its temperature, composition, and gas content.

- More silica-rich magmas are typically more viscous than those with less silica.

Magma and Volcanism

- Once formed, magma can ascend through the Earth's crust due to buoyancy. If it reaches the surface, it can erupt as a volcano.
- The nature of the volcanic eruption—whether explosive or effusive—depends largely on the magma's viscosity and gas content.

L4 : Incapacitated

21. Correct Option: (c)

Explanation:

- **Both statements are correct**

Supplementary notes:

Earthquake

- Earthquake waves, or seismic waves, propagate from an earthquake's epicenter. They include Primary (P-waves) and Secondary (S-waves).
- **P-waves (Primary waves)**: Fastest seismic waves, P-waves travel through solids, liquids, and gases. They compress and expand the ground like an accordion, causing vibrations parallel to the wave direction.
- Primary waves, or P-waves, are compressional waves that travel the fastest of all seismic waves and can move through solid, liquid, or gas. They are the first waves to be detected by seismographs during an earthquake.
- Surface waves, which include Love and Rayleigh waves, move along the surface of the Earth. They produce the shaking and rolling motions that cause most of the destruction during an earthquake.
- **S-waves (Secondary waves)**: Slower than P-waves, S-waves move only through solids. They induce shear stresses, causing ground to move perpendicularly to the wave direction, resulting in more noticeable shaking.

L2: Approachable

22. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** The Earth's crust is indeed the outermost layer it crust represents less than 1% of Earth's volume. Below the crust is the mantle, composed mainly of solid silicate rocks, and even further below lies the core, differentiated into the outer core and the inner core. The core, particularly the inner core, is much denser and is composed primarily of iron and nickel, making it significantly heavier on a per volume basis than the crust.
- **Statement 2 is correct:** Oceanic crust is chiefly made up of basalt, a mafic rock formed from the rapid cooling of lava. Basalt is dense and often appears dark-grey to black. On the other hand, continental crust is predominantly made of granite, a felsic rock that forms from the slow crystallization of magma. Granite's composition includes lighter minerals like quartz and feldspar, giving it a lighter color and making it less dense than basalt.
- **Statement 3 is incorrect:** The thickness of the Earth's crust varies based on whether it's continental or oceanic. Oceanic crust, which underlies our oceans, is indeed thinner, averaging between 5 to 10 km in thickness.
- In contrast, continental crust, which forms the continents, is much thicker, often ranging between 20 to 70 km. This thickness variation plays a significant role in plate tectonics, especially during subduction, where the denser oceanic crust is forced under the lighter continental crust

L2: Approachable

23. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** Both continental and oceanic plates move, form and destroyed; and ocean is not a fixed entity (as declared by the Continental Drift theory).
- **Statement 2 is correct:** Crusts are formed as well as consumed over a period (though geological).
- **Statement 3 is correct:** All the plates have moved in the geological past and shall continue to move in the future period as well.

Supplementary notes:

Postulates of the Plate Tectonic Theory

- The Earth's surface is covered by a series of some 25 major and minor crustal plates.
- Both continental and oceanic plates move, form and destroyed.

- The ocean floors are continually moving, spreading from the center, sinking at the edges, and being regenerated. Convection currents beneath the plates move the crustal plates in different directions.
- These lithospheric plates have been constantly moving over the globe throughout the history of the earth.
- It is not the Continent that moves as believed by Wegener rather, continents are part of a plate and what moves is the plate.
- All the plates, without exception, have moved in the geological past and shall continue to move in the future period as well.
- Thus, there is no such thing as supercontinent Pangaea or superocean Panthalassa and continental masses, resting on the plates, have been wandering all through the geological period, and Pangaea was a result of converging of different continental masses that were parts of one or the other plates.
- There have been many forms, structure, shape, and location of Pangaea and what Wegner suggested is just one example of it.
- Crusts are formed as well as consumed over a period (though geological).
- Wegner's idea about Tethys Sea was right only with some modification that the sea was not shifted but consumed in the process of plate tectonic by Indo-Australian plate and the Tethys' convergent boundary interaction.
- More modifications will occur such as-breaking of African plate as there is seafloor spreading happening around East Africa rift valley system, consumption of the Mediterranean Sea, etc.

L3: Real Challenge

24. Correct Option: (a)

Explanation:

- **Statement 1 is incorrect:** P waves can travel through gaseous, liquid and solid materials. On the other hand, S-Waves can travel only through solid materials, make broader shadow zone, proves that the outer core of the Earth is not in solid form.

Supplementary notes:

Earthquake Waves

- The Earthquakes Waves are recorded on the seismograph.
- There are basically two types of Earthquake Waves – body waves and surface waves.

Body Waves

- Body waves are generated at the focus and move in all the directions through the body of the Earth (3-dimensional). They are the fastest in reaching to the surface.
- They are of two types viz. Primary waves/P-waves and Secondary waves/S-waves.

Primary waves/P-waves

- P-waves move longitudinally. The propagation and vibration are in the same direction similar to the sound waves.
- They are the fastest of all the earthquake waves.
- P-waves are compression waves that apply a force in the direction of propagation. As the interior of the Earth is almost incompressible, P-waves transmit their energy quite easily through the medium and thus travel quickly.
- They travel through gaseous, liquid and solid materials.

Secondary waves/S-waves

- S-waves are second to reach the surface after P-waves.
- As they can travel only through solid materials of the Earth, they cannot pass through Earth's outer core, therefore their shadow zone is broader than that of P-waves. This reveals that the outer core of the Earth is not in solid form.
- S-waves are shear waves, which means that the motion of the medium is perpendicular to the direction of propagation of the wave. The energy is thus less easily transmitted through the medium, and S-waves are slower.

L2: Approachable

25. Correct Option: (c)

Explanation:

- **Both statements are correct.**

Supplementary notes:

Sea Floor Spreading

- Seafloor spreading is a geologic process in which tectonic plates—large slabs of Earth's lithosphere—split apart from each other.
- Seafloor spreading and other tectonic activity processes are the result of mantle convection. Mantle convection is the slow, churning motion of Earth's mantle. Convection currents carry heat from the

lower mantle and core to the lithosphere. Convection currents also "recycle" lithospheric materials back to the mantle.

- Seafloor spreading occurs at divergent plate boundaries. As tectonic plates slowly move away from each other, heat from the mantle's convection currents makes the crust more plastic and less dense. The less-dense material rises, often forming a mountain or elevated area of the seafloor.
- Eventually, the crust cracks. Hot magma fueled by mantle convection bubbles up to fill these fractures and spills onto the crust.
- This bubbled-up magma is cooled by frigid seawater to form igneous rock. This rock (basalt) becomes a new part of Earth's crust.

Evidence for Seafloor Spreading

- Rocks on either side of the crest of oceanic ridges having equidistant locations from the crest were found to have similarities both in terms of their constituents, their age and magnetic orientation.
- Rocks closer to the mid-oceanic ridges have normal polarity and are the youngest and the age of the rocks increases as one move away from the crest (ridge).
- The rocks of the oceanic crust near the oceanic ridges are much younger than the rocks of the continental crust.

L2: Approachable

26. Correct Option: (c)

Explanation:

- **Both statements are correct**

Supplementary notes:

Triple Junctions

- Seafloor spreading and rift valleys are common features at "triple junctions."
- Triple junctions are the intersection of three divergent plate boundaries. The triple junction is the central point where three cracks (boundaries) split off at about 120° angles from each other.
- In the Afar Triple Junction, the African, Somali, and Arabian plates are splitting from each other. The Great Rift Valley and Red Sea (a major site of seafloor spreading) are the result of plate tectonics in the Afar Triple Junction.

L3: Real Challenge

27. Correct Option: (b)

Explanation:

- **Option (b) is correct**

Supplementary notes:

Sources of Earth's Interior

Direct Sources

- Rocks extracted from mining areas: The process of taking out minerals from rocks buried under the earth's surface is called mining.
- Minerals that lie at shallow depths are taken out by removing the surface layer; this is known as open-cast mining.
- Deep bores, called shafts, have to be made to reach mineral deposits that lie at great depths. This is called shaft mining.
- Petroleum and natural gas occur far below the earth's surface. Deep wells are bored to take them out, this is called drilling.
- Minerals that lie near the surface are simply dug out, by the process known as quarrying.
- Deep Ocean Drilling: Scientists world over are working on two major projects such as "Deep Ocean Drilling Project" and "Integrated Ocean Drilling Project". The deepest drill at Kola, in Arctic Ocean, has so far reached a depth of 12 km. This and many deep drilling projects have provided large volume of information through the analysis of materials collected at different depths.
- Volcanic Eruption: Volcanic eruption forms another source of obtaining direct information. As and when the molten material (magma) is thrown onto the surface of the earth, during volcanic eruption it becomes available for laboratory analysis. However, it is difficult to ascertain the depth of the source of such magma.

Indirect Sources

- Meteors: Another source of information are the meteors that at times reach the earth. However, it may be noted that the material that becomes available for analysis from meteors, is not from the interior of the earth.
  - The material and the structure observed in the meteors are similar to that of the earth. They are solid bodies developed out of materials same as, or similar to, our planet.

- Gravitation: The other indirect sources include gravitation, magnetic field, and seismic activity. The gravitation force (g) is not the same at different latitudes on the surface.
    - It is greater near the poles and less at the equator. This is because of the distance from the centre at the equator being greater than that at the poles.
    - The gravity values also differ according to the mass of material. The uneven distribution of mass of material within the earth influences this value.
    - Gravity anomalies give us information about the distribution of mass of the material in the crust of the earth.
- Magnetic surveys also provide information about the distribution of magnetic materials in the crustal portion, and thus, provide information about the distribution of materials in this part.

L2: Approachable

28. Correct Option: (a)

Explanation:

- **Statement 1 is incorrect:** Shield Volcano – It is a broad, gently sloping dome shape volcano built almost entirely of fluid lava flows.
- **Statement 2 is incorrect:** Composite Volcano – It is stratovolcano usually tall with steep even sides and is made out of repeating layers of lava flows, volcanic ash, cinders, blocks, and volcanic bombs.

Supplementary notes:

Types of Volcanoes

Shield volcano

- They are built almost entirely of fluid lava flows.
- Lava pours out of vents in all directions, either from the summit (top) or along two to three rift zones (fractures) that radiate out from the summit like spokes on a bicycle wheel.
- As lava flows overlap one another, they construct a broad, gently sloping dome shape that from far away appears similar to a warrior's shield.
- Shield volcanoes build up slowly by the growth of thousands of lava flows that spread widely over great distances, and then cool as thin sheets.
- Mauna Kea and Mauna Loa are shield volcanoes.

Composite Volcano

- Some of the Earth's grandest mountains are composite volcanoes—sometimes called stratovolcanoes.
- They are usually tall with steep even sides and are made out of repeating layers of lava flows, volcanic ash, cinders, blocks, and volcanic bombs.
- Some composite volcanoes rise over 8,000 feet above their surroundings, but they reach much higher elevations when compared to the level of the sea (called above sea level).
- Ojos del Salado in Chile is the tallest composite volcano on Earth with a summit elevation (height above sea level) of 22,615 feet.
- Some of the most famous and beautiful mountains in the world are composite volcanoes, including Mount Fuji in Japan, Mount Cotopaxi in Ecuador, Mount Shasta in California, Mount Hood in Oregon, and Mount St. Helens in Washington.

Caldera Volcano

- Magma is stored beneath a volcano in a magma chamber.
- When a very large, explosive eruption occurs that empties the magma chamber, the roof of the magma chamber can collapse to form a depression or bowl with very steep walls on the surface. These are calderas and can be tens of miles across.
- Calderas can also be formed during an eruption that removes the summit of a single stratovolcano. Caldera-forming eruptions can remove massive portions of a single stratovolcano.

L3: Real Challenge

29. Correct Option: (c)

Explanation:

- **Option (c) is correct.**

Supplementary notes:

Gondwanaland

- Gondwanaland is a large supercontinent that existed in the southern hemisphere, clustered near the Antarctic Circle, before it began to break up ~200 million years ago, consisting of the modern day continents of Antarctica, India, Arabia, Australia, South America, Madagascar and Africa.

- Laurasia is a large supercontinent that existed in the northern hemisphere before it began to break up ~200 million years ago, consisting of the modern day continents of North America, Europe and Asia.
- Tethys is an east-west trending ocean that separated Gondwanaland from Laurasia.

L2: Approachable

30. Correct Option: (d)

Explanation:

- **Statement 1 is incorrect:** In geysers, jet of water is usually emitted with an explosion while in hot springs, the water rises to the surface without any explosion.
- **Statement 2 is incorrect:** Hot springs contain dissolved minerals which may be of some medicinal value while they are not found in Geysers.

Supplementary notes:

Hot Springs

- A hot spring is a spring that is produced when geothermally heated groundwater emerges from the Earth's crust.
- Some hot springs have waters that are cool enough for bathing, but in volcanic areas water may come into contact with rock that has been heated by magma.
- These hot springs sometimes produce water that is hot enough to kill animals that enter them.
- In non-volcanic areas, water can still be heated geothermally because the temperature of rocks within the Earth increases with depth, and if water percolates deeply enough into the crust, it can gain heat from these rocks and then flow to the surface.

Geysers

- A geyser is a rare geothermal feature.
- When a large amount of groundwater that is trapped in underground cavities in a volcanic area is heated by the presence of magma and magma heated rocks, the extreme heat turns the water into steam very quickly.
- This causes sudden and immense pressure, which forces huge quantities of water up out of the ground, producing stunning sprays of water shooting up to hundreds of feet into the air. This type of eruption can happen regularly or in cycles

L2: Approachable

31. Correct Option: (a)

Explanation

- **Statement 1 is correct:** The entire process of convection currents is based on heat generated by radioactive materials in the substratum (now mantle), however numerous scientists have questioned whether the needed amount of heat generated by radioactive elements is available.
- **Statement 2 is incorrect:** Convective currents may not be formed if heat is insufficient, and so the entire mechanism and working of the theory will be impossible. It's also worth noting that rising currents condense their heat into the crust.
- **Statement 3 is incorrect:** Arthur Holmes in 1930s discussed the possibility of convection currents in the mantle. These currents are generated due to radioactive elements causing thermal differences in the mantle.

L3: Real Challenge

32. Correct Option: (c)

Explanation:

- **Statement 1 is correct:** Plates are divided between major and minor plates based on their geographical coverage. Indian plate is thus a major plate.
- **Statement 2 is correct:** The subduction zone along the Himalayas forms the northern plate boundary in the form of continent- continent convergence.
- **Statement 3 is incorrect:** Peninsular plate is an integral part of the Indian plate.
- **Statement 4 is correct:** In the east, it extends through Rakinyoma Mountains of Myanmar towards the island arc along the Java Trench. The Western margin follows Kirthar Mountain of Pakistan.

L3: Real Challenge

33. Correct Option: (c)

Explanation:

- **Statement 3 is incorrect:** Magnetic storms and active auroras can sometimes interfere with communications.

Supplementary notes:

Aurora formation

- The sun is a ball of superhot gases made up of electrically charged particles called

ions. The ions, which continuously stream from the sun's surface, are called the solar wind. As solar wind approaches the Earth, it meets the Earth's magnetic field.

- Although most of the solar wind is blocked by the magnetosphere, some of the ions become briefly trapped in ring-shaped holding areas around the planet. These areas, in a region of the atmosphere called the ionosphere, are centered on the Earth's geomagnetic poles.
- In the ionosphere, the ions of the solar wind collide with atoms of oxygen and nitrogen from the Earth's atmosphere. The energy released during these collisions causes a colorful glowing halo around the poles—an aurora. Most auroras happen about 97-1,000 kilometers (60-620 miles) above the Earth's surface. The most active auroras happen when the solar wind is the strongest.
- Magnetic storms and active auroras can sometimes interfere with communications. They can disrupt radio and radar signals. Intense magnetic storms can even disable communication satellites.
- The colors of the aurora vary, depending on altitude and the kind of atoms involved. If ions strike oxygen atoms high in the atmosphere, the interaction produces a red glow. This is an unusual aurora—the most familiar display, a green-yellow hue, occurs as ions strike oxygen at lower altitudes. Reddish and bluish light that often appears in the lower fringes of auroras is produced by ions striking atoms of nitrogen. Ions striking hydrogen and helium atoms can produce blue and purple auroras, although our eyes can rarely detect this part of the electromagnetic spectrum.

L3: Real Challenge

34. Correct Option: (a)

Explanation:

- **Statement 2 is incorrect:** A smaller number of transform faults cut continental lithosphere e.g., San Andreas Fault Zone and East African Rift Valley.
- **Statement 3 is incorrect:** A Strike-Slip Fault is not a Transform Fault.

Supplementary notes:

Transform boundary

- A transform boundary occurs when two tectonic plates move past one another. Shear stress operates at transform boundaries, which involves sliding motion. No lithosphere is destroyed or created, and mountain chains are not built at transform boundaries.
- Most transform boundaries are associated with the spreading centers at mid-ocean ridges. They occur near these divergent boundaries because the spreading rate changes along a ridge. Because the surrounding rock along the ridge is hard and brittle, it accommodates these shifts in spreading rates with sliding motions.
- Many transform boundaries are found on the sea floor, where they connect segments of diverging mid-ocean ridges. A smaller number of transform faults cut continental lithosphere. The most famous example of this is the San Andreas Fault Zone of western North America. The East African Rift Valley (EAR) is a developing divergent plate boundary in East Africa. Here the eastern portion of Africa, the Somalian plate, is pulling away from the rest of the continent that comprises the Nubian plate.
- Transform boundaries can cause both large faults and a series of smaller associated faults. Transform faults refer to the lateral displacement of large rock units due to the shearing motion caused by a transform boundary.
- Transform faults can be distinguished from the typical strike-slip faults because the sense of movement is in the opposite direction (see illustration). A strike-slip fault is a simple offset; however, a transform fault is formed between two different plates, each moving away from the spreading center of a divergent plate boundary.

L3: Real Challenge

35. Correct Option: (b)

Explanation:

- **Option (b) is correct**

Supplementary notes:

Earth's magnetic field

- Earth's magnetic field is created in the swirling outer core. Magnetism in the outer core is about 50 times stronger than it is on the surface. It might be easy to think that Earth's magnetism is caused by the big ball of solid iron in the middle. But in the inner core, the temperature is so high the magnetism of iron is altered. Once this temperature, called the Curie point, is reached, the atoms of a substance can no longer align to a magnetic point. Some geoscientists describe the outer core as Earth's "geodynamo."

- For a planet to have a geodynamo, it must rotate, it must have a fluid medium in its interior, the fluid must be able to conduct electricity, and it must have an internal energy supply that drives convection in the liquid. Variations in rotation, conductivity, and heat impact the magnetic field of a geodynamo.
- Mars, for instance, has a totally solid core and a weak magnetic field. Venus has a liquid core, but rotates too slowly to churn significant convection currents. It, too, has a weak magnetic field.
- Jupiter, on the other hand, has a liquid core that is constantly swirling due to the planet's rapid rotation.
- Earth is the "Goldilocks" geodynamo. It rotates steadily, at a brisk 1,675 kilometers per hour (1,040 miles per hour) at the Equator. Coriolis forces, an artifact of Earth's rotation, cause convection currents to be spiral. The liquid iron in the outer core is an excellent electrical conductor, and creates the electrical currents that drive the magnetic field. The energy supply that drives convection in the outer core is provided as droplets of liquid iron freeze onto the solid inner core. Solidification releases heat energy. This heat, in turn, makes the remaining liquid iron more buoyant.
- The liquid outer core separates the inner core from the rest of the Earth, and as a result, the inner core rotates a little differently than the rest of the planet. It rotates eastward, like the surface, but it's a little faster, making an extra rotation about every 1,000 years.

L4 : Incapacitated

36. Correct Option: (b)

Explanation:

- **Pair 1 is correctly matched**: Laplace's nebular hypothesis-The Sun was encircled by a solar nebula mainly made up of hydrogen, helium, and dust. Particle impact and friction creates a disk-shaped cloud. Planets were formed from material from the sun through accretion process
- **Pair 2 is incorrectly matched:** Chamberlain and Moulton's Binary Theory: A wandering star approached the sun and a cigar-shaped extension from the solar surface was separated. The sun releases high-temperature material called the prominences. The particles of this material coalesced to form the planets and a lot of heat. The separated material condensed into a planet while the passing star moved away, and the sun continued to spin.
- **Pair 3 is incorrectly matched:** Russell's Binary Star hypothesis: Sun was a binary star or twin-star system and an intruding star approached the Sun's companion star, separating the tidal filament (and planets that originate from it)
- **Pair 4 is correctly matched:** Big Bang Theory: All of the matter that made up the universe resided in a single location with a volume smaller than an atom, an unlimited temperature, and an infinite density. The theory suggests that the Universe, at some point in time, was condensed into a single particle and later started expanding infinitely after a huge explosion. The expansion later gave birth to nebulae that in turn, coalesced into stars and planets.

L4 : Incapacitated

37. Correct Option: (b)

Explanation:

- **Statement 1 is correct:** This eon marked the beginning of life on Earth in geological time scale. Henceforth this holds supreme importance in the pages of history and evolutionary biology. The presence of life forms was restricted to the emergence of single-celled organisms like nuclei.
- **Statement 2 is incorrect:** The tiny organisms such as cyanobacteria, or blue-green algae. These microbes conduct photosynthesis: using sunshine, water and carbon dioxide to produce carbohydrates and started producing oxygen first appeared in the Archean. But became common and widespread in the Proterozoic. Their photosynthetic activity was primarily responsible for the rise in atmospheric oxygen.
- **Statement 3 is correct:** Proterozoic is the last eon of the supreon. Precambrian of geological time scale. It expands from the emergence of oxygen in Earth's atmosphere to the formation of complex forms on Earth. The bacteria started producing oxygen and embarked on the emergence of life forms. Eukaryotes marked their emergence in this eon, along with a few multicellular organisms.

Supplementary notes:

Geological Time Scale Chart

- It is a tool for organizing the immensity of geologic time and correlating geologic

events on a worldwide scale. The divisions of the geologic time scale are organized stratigraphically, with the oldest at the bottom and youngest at the top. The recognition of formal subdivisions of geologic time is determined by international committees.

- The main eras of the geological time scale are the Cenozoic, Mesozoic, and paleozoic. These were further segregated into major periods and Boundary ages are in millions of years ago (mya).
- The chart elaborates on the dominance of the species and the occurrence of major events during particular periods.

L3: Real Challenge

38. Correct Option: (a)

Explanation:

- **Both statements are correct**
- Cuspate Deltas is formed where sediments are deposited onto a straight shoreline with strong waves. The waves push the sediments to spread outwardly creating the tooth-like shape. Example, Tiber River of Italy.

Supplementary notes:

Deltas

- A river's delta is a feature created by deposition at the river's mouth. These are the wetlands that are created when rivers discharge their water and sediment into another body of water, such as the ocean, a lake, or another river. On the basis of the shape, following are various types of Deltas:
  - Arcuate Delta is fan-shaped Delta. A bowed or curved Delta with the convex margin facing the body of water. Relatively coarse sediments are formed in this type of Delta. The river activity is balanced with the wind. Example, the River Nile Delta in Egypt and the Ganges Delta in India.
  - Delta 'Bird's foot' named from the claw-like shape of a bird foot. When the river flow is greater and the waves are smaller, this shape is produced. They were created as a result of river water depositing finer elements.
  - The river is divided into smaller distributaries by deposited alluvial material. Due to the fact that the waves are frequently stronger than the river current, this Delta rarely occurs along ocean shores. These Deltas are also known as finger Deltas. American Mississippi River Delta as an example.
  - Estuarine Delta is formed at the mouth of submerged rivers depositing down the sides of the estuary. Example, the Seine River of France, the Deltas of Narmada and Tapi (formerly Tapti) rivers of India.
  - Lacustrine Delta is formed when a river flows into a lake. Example, Lough Leanne river Delta, Ireland.
  - Truncated Delta: Sea waves and ocean currents modify and even destroy Deltas deposited by the river through their erosional work. Thus, eroded and dissected Deltas are called truncated Deltas.
  - Abandoned Delta: When the river shifts its mouth, the Delta already made is left abandoned. Such a Delta is called an abandoned Delta. Example, Yellow river Delta, China and the Western part of Ganga Delta made by Hoogly River, India.

L2: Approachable

39. Correct Option: (c)

Explanation:

- **All statements are correct**

Supplementary notes:

Glacial depositional landforms

- Although today's glaciers are small and constantly disappearing as a result of climate change, the situation was substantially different in the past. Almost the entire surface of the Earth was once covered in ice and snow, according to scientists. Evidence for the aforementioned fact can be seen in the glacial erosional and depositional structures still present on Earth's surface.

Depositional landforms created by glaciers and how such landforms are formed:

- **Outwash Fan:** When the braided streams of a flowing glacier deposit sediments on a flat plain, it results in the formation of an outwash fan. Usually, such landforms are produced by valley glaciers. As a glacier flows down the mountain slope, it picks up debris from the bedrock. After flowing through a valley, the glacier enters a wider and flatter plain. Here, it deposits the sediments in a fan-shaped body known as an outwash fan.

- **Moraine:** A moraine is another glacial depositional feature. It consists of accumulated rocks, dirt, and other debris that have been deposited by a glacier. The size of deposits in moraines vary from tiny particles of sand to large boulders. The deposits accumulate on the surface in an unstratified manner without any type of sorting. Moraines are commonly occurring glacial landforms and are often seen in the Himalayan and Alpine mountain regions, Greenland, etc.
- **Kame:** A kame is another depositional landform of a glacier. It is a hill or mound that lacks a proper shape. Kames are composed of till, gravel, and sand that can be observed after the retreat of glaciers. Such a feature is usually formed when debris from a rockfall or other large volumes of debris fall through a crevasse of a glacier and accumulate in the depression. When the glacier retreats, the kame becomes visible as an elevation of land on the bedrock through which the glacier previously flowed. Kames are common in Edmonton, Alberta where they make up the Prosser Archaeological Site. The Fonthill Kame located in Ontario, Canada, is also an example of a kame area.

L3: Real Challenge

40. Correct Option: (c)

Explanation:

- **Statement 1 is incorrect:** Delta Landforms develops at river mouths where waves and tides do not influence the amount of sediment supplied by the river.
- Over time, the interaction of coastal processes and an area's geologic setting leads to the development of characteristic and dramatic coastal landforms.

Supplementary notes:

Types of Coastal Landforms

- The Coastal Landforms are delta landforms, estuary landforms, lakeshore landforms, rocky coast landforms, sandy coast landforms, and tropical coast landforms.
- Delta Landforms: This characteristic shape develops typically at river mouths, where waves and tides do not influence the amount of sediment supplied by the river. Such systems, exemplified by the Mississippi River delta, are called river-dominated deltas. Waves dominate riverine deposits in coastal areas where wave energy is high. Wave erosion and strong long shore currents disperse the sediment away from the river mouth, producing a relatively straight coast with only slight seaward bulges of the shoreline. In some regions, a large tidal range overshadows river and wave effects, creating tidal-dominated deltas. The strong flood and ebb tidal currents rearrange the river-supplied sediment into long, linear submarine ridges and islands that tend to fan out from the river mouth, creating funnel-shaped basin geometries.
- Estuary Landforms: The term "estuary" is derived from the Latin word "aestuarium," which means tidal. In a geomorphic sense, a typical estuary is a semi-enclosed, elongated coastal basin that receives an inflow of both freshwater and saltwater. From a chemical and physical standpoint, estuaries are buffer zones between river (freshwater) and ocean (saltwater) environments that are affected by tidal oscillations.
- Geologically speaking, most estuaries are young basins, established by the flooding of fluvial (river-eroded) or glacially-scoured valleys during the Holocene rise of sea level. Estuaries are generally short-lived: they are quickly destroyed by rapid sediment infilling that is fostered by the high influx of river sediment. Circulation in estuaries not only traps large amounts of river sediment but also imports sand and mud from offshore areas.
- Not all semi-enclosed coastal bodies of water are estuaries. For example, lagoons are protected bodies of water that are little affected by tides. Lagoons may receive inputs of seawater and freshwater but are typically dominated by one or the other, making their water motions less complex than the mixing and circulation patterns associated with true estuaries.

L3: Real Challenge

41. Correct Option: (d)

Explanation:

- **Both statements are correct**

Supplementary notes:

Sudden Movements

- Sudden geomorphic movements occur mostly at the lithospheric plate margins (tectonic plate margins).
- The plate margins are highly unstable regions due to pressure created by pushing and pulling of magma in the mantle (convectional currents).
- These movements cause considerable deformation over a short period.

- There are some movements that cause sudden changes in the crust.
- Earthquakes and volcanoes are two examples of sudden movements that generate significant deformation in a short period of time.
- Sudden movements such as earthquakes and volcanoes create widespread devastation on the planet's surface.
- However, it can be concluded that these sudden movements are important to maintaining the Earth's crust's unique structure.

L2: Approachable

42. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** Living organisms contribute to both mechanical and chemical weathering.

Supplementary notes:

Biological activity and weathering

- Biological weathering is the removal of minerals from the environment due to growth or movement of organisms.
- Living organisms contribute to both mechanical and chemical weathering.
- Lichens and mosses grow on essentially bare rock surfaces and create a more humid chemical microenvironment.
- On a larger scale, seedlings sprouting in a crevice and plant roots exert physical pressure as well as providing a pathway for water and chemical infiltration.
- Burrowing and wedging by organisms like earthworms, rodents etc., help in exposing the new surfaces to chemical attack and assists in the penetration of moisture and air.
- Decaying plant and animal matter help in the production of humus, carbonic and other acids which enhance decay and solubility of some elements.
- Algae utilise mineral nutrients for growth and help in the concentration of iron and manganese oxides.

L2: Approachable

43. Correct Option: (c)

Explanation:

- **All statements are correct**

Supplementary notes:

Oblique-slip faults

- A fault which has a component of dip-slip and a component of strike-slip is termed an oblique-slip fault.
- Nearly all faults have some component of both dip-slip and strike-slip.
- Many disastrous earthquakes are caused along the oblique slip.
- This is caused by a combination of shearing and tension or compressional forces. Nearly all faults will have some component of both dip-slip (normal or reverse) and strike-slip, so defining a fault as oblique requires both dip and strike components to be measurable and significant.

L3: Real Challenge

44. Correct Option: (c)

Explanation:

- **Statement 3 is incorrect:** Fold Mountains are composed primarily of sedimentary rock and metamorphic rock formed under high pressure and relatively low temperatures.

Supplementary notes:

Fold Mountains

- Fold Mountains are created where two or more of Earth's tectonic plates are pushed together. At these colliding, compressing boundaries, rocks and debris are warped and folded into rocky outcrops, hills, mountains, and entire mountain ranges.
- Fold Mountains are often associated with continental crust. They are created at convergent plate boundaries, sometimes called continental collision zones or compression zones.
- Convergent plate boundaries are sites of collisions, where tectonic plates crash into each other. Compression describes a set of stresses directed at one point in a rock or rock formation. At a compression zone, tectonic activity forces crustal compression at the leading edge of the crust formation. For this reason, most fold mountains are found on the edge or former edge of continental plate boundaries.
- Rocks on the edge of the continental crust are often weaker and less stable than rocks found in the continental interior. This can make them more susceptible to folding and warping.

- Most Fold Mountains are composed primarily of sedimentary rock and metamorphic rock formed under high pressure and relatively low temperatures. Many fold mountains are also formed where an underlying layer of ductile minerals, such as salt, is present. Some examples of Fold Mountains are the Himalayas, the Rockies, The Alps, the Aravalli's, etc.

L2: Approachable

45. Correct Option: (a)

Explanation:

- **Option (a) is correct**

Supplementary notes:

Endogenic Geomorphic Processes

- The energy emanating from within the earth is the main force behind endogenic geomorphic processes.
- Earth's internal heat is a result of mainly radioactive decay (50% of the earth's internal heat) and gravitation (causes pressure gradients).
- This energy is mostly generated by radioactivity, rotational and tidal friction and primordial heat from the origin of the earth.
- This energy due to geothermal gradients and heat flow from within induces diastrophism and volcanism in the lithosphere.
- Due to variations in geothermal gradients and heat flow from within, crustal thickness and strength, the action of endogenic forces are not uniform and hence the tectonically controlled original crustal surface is uneven.

L2: Approachable

46. Correct Option: (a)

Explanation:

- **Option (a) is correct**

Supplementary notes:

Fault

- A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other.
- This movement may occur rapidly, in the form of an earthquake or may occur slowly, in the form of creep. Faults may range in length from a few millimeters to thousands of kilometers.
- Faults which move along the direction of the dip plane are dip-slip faults and described as either normal or reverse (thrust), depending on their motion.
- Faults which move horizontally are known as strike-slip faults and are classified as either right-lateral or left-lateral.
- Faults which show both dip-slip and strike-slip motion are known as oblique-slip faults.
- Normal Fault – It is a dip-slip fault in which the block above the fault has moved downward relative to the block below. This type of faulting occurs in response to extension and is often observed in the Western United States Basin and Range Province and along oceanic ridge systems.
- Reverse Fault – It is a dip-slip fault in which the upper block, above the fault plane, moves up and over the lower block. This type of faulting is common in areas of compression, such as regions where one plate is being subducted under another as in Japan. When the dip angle is shallow, a reverse fault is often described as a thrust fault.
- Strike-slip Fault – It is a fault on which the two blocks slide past one another. It is also known as Trans current Fault. The San Andreas Fault is an example of a right lateral fault.
- A left-lateral strike-slip fault is one on which the displacement of the far block is to the left when viewed from either side.
- A right-lateral strike-slip fault is one on which the displacement of the far block is to the right when viewed from either side.

L3: Real Challenge

47. Correct Option: (d)

Explanation:

- **Pair 1 is incorrect:** Soliflucation – It occurs during the summer thaw when the water in the soil is trapped there by frozen permafrost beneath it.
- **Pair 2 is incorrect:** Slump – It is a type of slide wherein downward rotation of rock or regolith occurs along a concave-upward curved surface (rotational slides).
- **Pair 3 is incorrect:** Mudflows – It is a highly fluid, high velocity mixture of sediment and water that has a consistency ranging between soup-like and wet concrete.

Supplementary notes:

Types of Mass Movement

- **Slope Failures:** A sudden failure of the slope resulting in transport of debris down the hill by sliding, rolling, falling, or slumping.
- Slumps (also called Rotational Slides) – It is a type of slide wherein downward rotation of rock or regolith occurs along a concave-upward curved surface (rotational slides). The upper surface of each slump block remains relatively undisturbed, as do the individual blocks. Slumps leave arcuate scarps or depressions on the hill slope.
    - Falls – Rock falls occur when a piece of rock on a steep slope becomes dislodged and falls down the slope. Debris falls are similar, except they involve a mixture of soil, regolith, vegetation, and rocks.
- Slides (also called Translational Slides) – Rock slides and debris slides result when rocks or debris slide down a pre-existing surface, such as a bedding plane, foliation surface, or joint surface
- **Sediment Flows:** They occur when sufficient force is applied to rocks and regolith that they begin to flow down slope. A sediment flow is a mixture of rock, and/or regolith with some water or air. They can be broken into two types depending on the amount of water present.
- Slurry Flows – They are sediment flows that contain between about 20 and 40% water. As the water content increases above about 40% slurry flows grade into streams. Slurry flows are considered water-saturated flows.
    - Granular Flows – They are sediment flows that contain between 0 and 20% water.

L3: Real Challenge

48. Correct Option: (d)

Explanation:

- **Statement 4 is incorrect:** Rivers with high sinuosity, or lots of bends, often create longer oxbow lakes than rivers that naturally flow in straighter lines.

Supplementary notes:

Ox-bow Lake

- An oxbow lake gets its name from the U-shaped collar placed around an ox's neck to which a plow is attached. It can also be called a horseshoe lake, a loop lake, or a cutoff lake.
- An oxbow lake starts out as a curve, or meander, in a river. A lake forms as the river finds a different, shorter, course. The meander becomes an oxbow lake along the side of the river.
- Oxbow lakes usually form in flat, low-lying plains close to where the river empties into another body of water. On these plains, rivers often have wide meanders.
- Meanders that form oxbow lakes have two sets of curves: one curving away from the straight path of the river and one curving back. The corners of the curves closest to each other are called concave banks. The concave banks erode over time. The force of the rivers flowing water wears away the land on the meanders concave banks.
- The banks opposite the concave banks are called convex banks. The opposite of erosion happens here. Silt and sediment build up on convex banks. This build-up is called deposition.
- Erosion and deposition eventually cause a new channel to be cut through the small piece of land at the narrow end of the meander. The river makes a shortcut. Oxbow lakes are the remains of the bend in the river.
- Oxbow lakes are Stillwater lakes. This means that water does not flow into or out of them. There is no stream or spring feeding the lake, and it does not have a natural outlet. Oxbow lakes often become swamps or bogs, and they often dry up as their water evaporates.

L4 : Incapacitated

49. Correct Option: (c)

Explanation:

- **Both statements are correct**

Supplementary notes:

Aeolian Landforms

- Aeolian landforms are features produced by either the erosive or constructive action of the wind.
- These features may be built up from sand or snow, or eroded into rock, snow, or ice.
- Aeolian landforms are commonly observed in sandy deserts and on frozen lakes or sea ice and have been observed and studied across Earth and on other planets, including Mars and Pluto.
- Aeolian landforms are formed when wind moves sediment (see aeolian processes).

- Sediment particles move when they are lifted by upwards Bernoulli forces that exceed their downwards weight or when they are dragged from their initial position.

L2: Approachable

50. Correct Option: (d)

Explanation:

- **Statement 1 is incorrect:** Mass wasting is not erosion; rather, it refers to the downslope movement of already weathered and fragmented materials under the influence of gravity. Erosion involves the transport of materials by external agents like water, wind, or ice.
- **Statement 2 is incorrect:** Mass wasting is not caused by the mechanical breakdown of materials. Instead, mass wasting is the movement of weathered materials due to gravity, after they have already undergone mechanical, chemical, or biological weathering processes.
- **Statement 3 is incorrect:** Mass wasting does involve the movement of weathered materials, but it primarily occurs due to the force of gravity, rather than the direct influence of water, ice, and air. Although the presence of water, ice, or air may influence and accelerate mass wasting, gravity is the main driving force behind it.

Supplementary notes:

Mass Wasting

- Disintegrated and fragmented material due to the mechanism of weathering processes (mechanical, chemical, or biological) is called debris or rock-wastes. Generally, movement of this waste material down the hill slope under the influence of gravity is called mass movement or mass wasting.
- The sliding or flowing of weathered materials ranging from very fine (soils) to very coarse and large sized rock materials (boulders) is due to their position and to gravitational forces, but mass movement is accelerated by presence of water, ice, and air.

L3: Real Challenge