GATE Geology and Geophysics – Geology

Sample Paper – 7

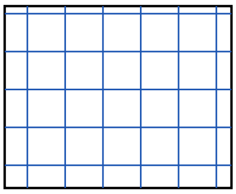
Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Geology** stream of the GATE Geology and Geophysics paper conducted by the IITs and IISc (General Aptitude and the common section are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Unless stated otherwise, take the acceleration due to gravity as $g = 9.81$ m/s^2 and the unit weight of water as 9.81 kN/m^3.

Mineralogy and Crystallography

Q1. The pyroxene group of minerals is recognised in thin section and hand specimen by two well-developed cleavage directions that intersect, as sketched, at an angle of approximately: **[1 mark]**



two cleavages meeting at nearly a right angle

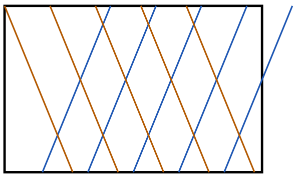
(A) 56°

(B) 120°

(C) 87°

(D) 30°

Q2. Amphiboles are distinguished optically from pyroxenes chiefly by their two prismatic cleavages, which meet, as shown, at angles of about: **[1 mark]**



two cleavages at ≈ 56° and 124°

(A) 90° and 90°

(B) 30° and 150°

(C) 45° and 135°

(D) 56° and 124°

Q3. The plagioclase feldspars form a complete solid-solution series at high temperature between the two end-members: **[1 mark]**

(A) Orthoclase ($KAlSi_3O_8$) and microcline

(B) Nepheline and leucite

(C) Albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$)

(D) Sanidine and quartz

Q4. The alkali (potassium) feldspar orthoclase, a common constituent of granite, has the chemical formula: **[1 mark]**

(A) $NaAlSi_3O_8$

(B) $KAlSi_3O_8$

(C) $CaAl_2Si_2O_8$

(D) $CaMgSi_2O_6$

Q5. Fine, closely spaced, parallel striations seen on a cleavage face under the microscope, produced by repeated (polysynthetic) albite twinning, are diagnostic of which feldspar? **[1 mark]**

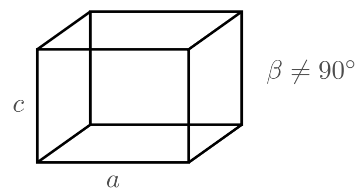
(A) Orthoclase

(B) Plagioclase

(C) Sanidine

(D) Adularia

Q6. The clinopyroxene diopside crystallises in a system whose three axes are of unequal length, with two axes inclined and the third perpendicular to their plane ($\alpha = \gamma = 90°$, $\beta \neq 90°$), as sketched. This is the: **[1 mark]**



(A) Triclinic system

(B) Orthorhombic system

(C) Hexagonal system

(D) Monoclinic system

Igneous and Metamorphic Petrology

Q7. The dark, calcium-magnesium-iron clinopyroxene that is the dominant ferromagnesian mineral in most basalts and gabbros is: **[1 mark]**

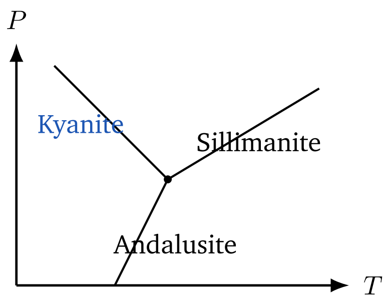
(A) Enstatite

(B) Hypersthene

(C) Fayalite

(D) Augite

Q8. In the pressure–temperature phase diagram of the aluminosilicate (Al_2SiO_5) polymorphs shown, the polymorph that is stable at the highest pressures, and is therefore an index mineral of high-pressure metamorphism, is: **[1 mark]**



(A) Andalusite

(B) Kyanite

(C) Sillimanite

(D) Mullite

Q9. The prograde dehydration reaction muscovite + quartz $\rightarrow$ K-feldspar + $Al_2SiO_5 + H_2O$ marks the entry into: **[1 mark]**

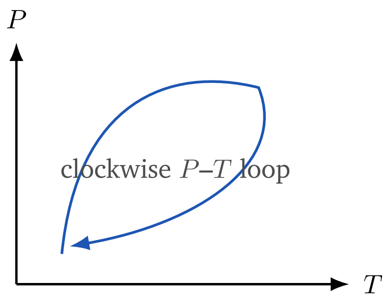
(A) The onset of low-grade greenschist facies

(B) Diagenesis, below metamorphic grade

(C) High-grade (upper amphibolite) metamorphism, the second sillimanite isograd

(D) The zeolite facies

Q10. The clockwise pressure–temperature path shown is characteristic of continental collision. A rock following this path is: **[1 mark]**



(A) Cooled continuously at constant depth

(B) First buried and heated, then exhumed by near-isothermal decompression during uplift

(C) Heated only at constant low pressure at the surface

(D) Cooled at constant pressure (isobaric cooling)

Q11. High-grade regional metamorphism of a basalt or gabbro produces a dark, foliated rock dominated by hornblende and plagioclase. This rock is: **[1 mark]**

(A) Marble

(B) Amphibolite

(C) Quartzite

(D) Slate

Q12. Baking of the country rock immediately around a hot igneous intrusion, without directed pressure, produces a hard, fine-grained, non-foliated contact-metamorphic rock called: **[1 mark]**

(A) Mylonite

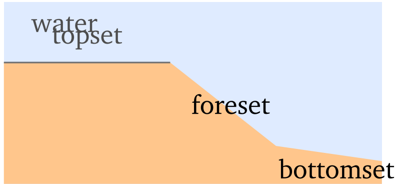
(B) Phyllite

(C) Migmatite

(D) Hornfels

Sedimentology and Stratigraphy

Q13. The landform built where a sediment-laden river enters a standing body of water and deposits its load in topset, foreset and bottomset beds, as shown, is a: **[1 mark]**



(A) Alluvial fan

(B) Point bar

(C) Delta

(D) Natural levee

Q14. In a prograding, river-dominated delta, the steeply inclined beds deposited on the advancing delta front, dipping basinward, are the: **[1 mark]**

(A) Topset beds

(B) Bottomset beds

(C) Backset beds

(D) Foreset beds

Q15. A coarsening-upward succession that passes from marine mudstone at the base up into clean sandstone at the top, recording shoreline advance into the basin, is most typical of a: **[1 mark]**

(A) Prograding delta or shoreface (regressive) setting

(B) Deep abyssal plain

(C) Aeolian (desert dune) field

(D) Glacial till plain

Q16. Chalk, a soft, fine-grained, white marine limestone widespread in Cretaceous rocks, is composed chiefly of: **[1 mark]**

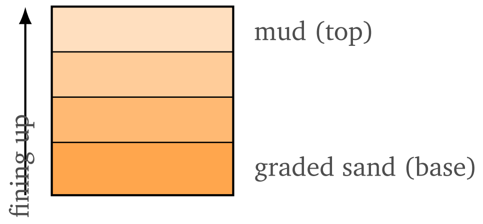
(A) Wind-blown quartz silt

(B) Calcareous microfossils (coccoliths and foraminifera)

(C) Fine volcanic ash

(D) Detrital clay minerals

Q17. The graded sand-to-mud beds shown, deposited by dilute, dense, sediment-laden currents that flow down the continental slope onto the deep-sea floor, are called: **[1 mark]**



(A) Varves

(B) Evaporites

(C) Tillites

(D) Turbidites

Q18. Walther's Law of the correlation of facies states that, in a conformable succession with no break in sedimentation, the vertical sequence of facies reflects: **[1 mark]**

(A) Only the single deepest environment ever reached

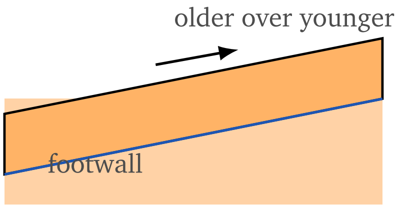
(B) The lateral succession of adjacent depositional environments

(C) The age of the underlying basement

(D) Purely random deposition

Structural Geology and Geotectonics

Q19. The low-angle reverse fault shown, along which older rocks of the hanging wall have been pushed up and over younger rocks of the footwall, is the fundamental structure of fold-thrust belts. It is a: **[1 mark]**



(A) Thrust fault

(B) Normal fault

(C) Dextral strike-slip fault

(D) Graben-bounding fault

Q20. In a fold-thrust belt, a set of sub-parallel thrust faults that branch upward from a common basal (floor) thrust, each carrying its slice up-section over the one ahead, forms an: **[1 mark]**

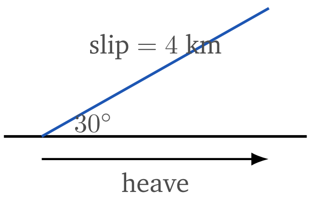
(A) Imbricate thrust stack

(B) Horst block

(C) Rift valley

(D) Oceanic transform

Q21. A thrust fault dips at 30° and has a net dip-slip displacement of 4 km along the fault plane, as shown. The horizontal shortening (heave) equals slip $\times$ $\cos(\text{dip})$. Its value is (take $\cos 30^\circ = 0.866$): **[2 marks]**



(A) 2.0 km

(B) 4.0 km

(C) 3.46 km

(D) 8.0 km

Q22. The Himalayan orogeny, which produced the world's highest mountains and the Tibetan Plateau, was caused by the collision of the northward-moving Indian Plate with the: **[2 marks]**

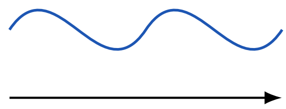
(A) Eurasian (Asian) Plate – a continent–continent collision

(B) Pacific Plate along a subduction zone

(C) African Plate across a transform boundary

(D) Mid-ocean ridge by sea-floor spreading only

Q23. A layer that was originally 12 km long horizontally now occupies only 9 km after folding and thrusting. The percentage of horizontal shortening, $\frac{L_0 - L_f}{L_0} \times 100$, is: **[2 marks]**



present width = 9 km (originally 12 km)

(A) 25%

(B) 33%

(C) 12.5%

(D) 75%

Q24. The major crustal-scale thrust that carries the high-grade rocks of the Higher (Greater) Himalaya over the rocks of the Lesser Himalaya is the: **[2 marks]**

(A) Main Frontal Thrust

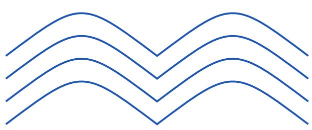
(B) Main Central Thrust (MCT)

(C) Indus–Tsangpo Suture Zone

(D) San Andreas Fault

Palaeontology and Historical Geology

Q25. The layered, dome- and column-shaped structures shown, built by cyanobacterial mats that trapped and bound carbonate sediment, and abundant in Precambrian rocks, are: **[2 marks]**



laminated microbial domes

(A) Stromatolites

(B) Ooids

(C) Ripple marks

(D) Trilobite trails

Q26. The distinctive soft-bodied, mostly frond- and disc-shaped organisms of the late Neoproterozoic seas, the oldest large multicellular fossils, are collectively known as the: **[2 marks]**

(A) Burgess Shale fauna

(B) Ediacaran fauna

(C) Gondwana (Glossopteris) flora

(D) Siwalik mammal fauna

Q27. The rise of free oxygen in the Earth's atmosphere at about 2.4 billion years ago, recorded by widespread banded iron formations and the first red beds, is called the: **[2 marks]**

(A) Snowball Earth glaciation

(B) Cambrian explosion

(C) Great Oxygenation Event

(D) Cretaceous–Paleogene extinction

Q28. The most severe mass extinction in the geological record, which wiped out roughly 90% of marine species, occurred at the end of the: **[2 marks]**

(A) Permian Period

(B) Cretaceous Period

(C) Ordovician Period

(D) Devonian Period

Q29. The single supercontinent that assembled by the end of the Palaeozoic and brought nearly all of the Earth's landmasses together is: **[2 marks]**

(A) Rodinia

(B) Gondwana

(C) Laurasia

(D) Pangaea

Q30. The coiled cephalopods with complex, frilled suture lines that are the standard index fossils for zoning and correlating Mesozoic marine strata are the: **[2 marks]**

(A) Ammonites

(B) Graptolites

(C) Trilobites

(D) Fusulinids

Economic Geology and Mineral Resources

Q31. The iron ore mineral that is strongly magnetic, black with a black streak, and has the chemical formula Fe_3O_4 is: **[2 marks]**

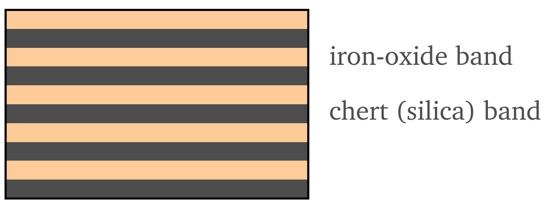
(A) Hematite

(B) Limonite

(C) Siderite

(D) Magnetite

Q32. The finely layered Precambrian chemical sedimentary iron ores shown, made of alternating iron-oxide-rich and silica (chert) laminae, are called: **[2 marks]**



(A) Laterite

(B) Placer deposit

(C) Banded Iron Formation (BIF)

(D) Skarn

Q33. The chief ore mineral of manganese, a soft black oxide with the composition MnO_2, is: [2 marks]

(A) Rhodochrosite

(B) Braunite

(C) Pyrolusite

(D) Bauxite

Q34. India's largest reserves of high-grade, banded-iron-formation-hosted hematite ore lie chiefly within the: [2 marks]

(A) Basalt flows of the Deccan Traps

(B) Neogene Siwalik molasse of the sub-Himalaya

(C) Aravalli granite plutons of Rajasthan

(D) Precambrian iron-ore (greenstone) belts of Odisha, Jharkhand and Chhattisgarh

Q35. A high-temperature ore body formed at the contact between a granitic intrusion and carbonate country rock by metasomatic replacement, hosting garnet, pyroxene and magnetite, is called a: [2 marks]

(A) Placer deposit

(B) Evaporite deposit

(C) Skarn (contact-metasomatic) deposit

(D) Residual (laterite) deposit

Q36. Deep, in-situ chemical weathering of manganese- and iron-rich rocks under a humid tropical climate leaves a residual, enriched ore cap known as: [2 marks]

(A) Laterite (residual enrichment)

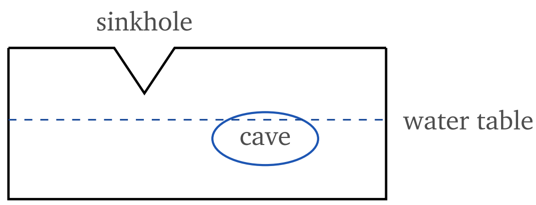
(B) Turbidite

(C) Evaporite

(D) Pegmatite

Hydrogeology and Engineering Geology

Q37. The terrain shown, formed where soluble carbonate rock has been dissolved by groundwater to give sinkholes, caves and largely underground drainage, is called: **[2 marks]**



(A) Badland topography

(B) Moraine topography

(C) Delta plain

(D) Karst topography

Q38. The closed, funnel- or bowl-shaped surface depression that forms in a karst area where soluble rock is dissolved or collapses at depth is a: **[2 marks]**

(A) Sinkhole (doline)

(B) Drumlin

(C) Esker

(D) Yardang

Q39. Groundwater in a karst aquifer flows through a cross-section following Darcy's law $Q = K\,i\,A$. With hydraulic conductivity $K = 25$ m/day, hydraulic gradient $i = 0.04$ and cross-sectional area $A = 20$ m^2, the discharge Q is: **[2 marks]**

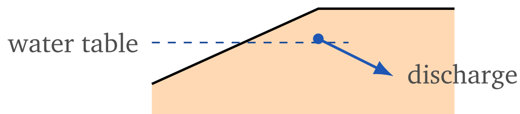
(A) $20\ m^3/day$

(B) $2\ m^3/day$

(C) $200\ m^3/day$

(D) $50\ m^3/day$

Q40. At the point shown, where the water table intersects the sloping ground surface at the foot of a limestone hill, groundwater emerges naturally at the surface. Such a natural discharge is a: **[2 marks]**



(A) An aquiclude

(B) A spring

(C) A sinkhole

(D) A cone of depression

Q41. A confined aquifer has a hydraulic conductivity $K = 15$ m/day and a saturated thickness $b = 20$ m. Its transmissivity, $T = K\,b$, is: **[2 marks]**

(A) $35\ m^2/day$

(B) $0.75\ m^2/day$

(C) $300\ m^2/day$

(D) $150\ m^2/day$

Geochemistry, Geomorphology and Remote Sensing

Q42. In the exogenic (surface) geochemical cycle, elements such as sodium and chlorine that stay in solution and are readily carried away by surface and ground waters are described as geochemically: **[2 marks]**

(A) Mobile

(B) Immobile

(C) Siderophile

(D) Refractory

Q43. During the chemical weathering of a granite, which of the following elements is the most mobile, being leached and removed in solution most readily? **[2 marks]**

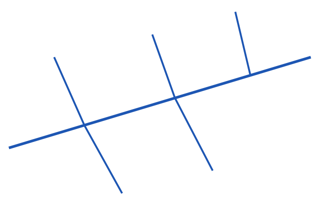
(A) Aluminium

(B) Iron

(C) Sodium

(D) Titanium

Q44. The tree-like, randomly branching drainage pattern shown, which develops on flat-lying or uniformly resistant rocks with no structural control, is described as: **[2 marks]**



tree-like branching

(A) Radial

(B) Dendritic

(C) Trellis

(D) Rectangular

Q45. The normalised band ratio $\frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$, computed from satellite imagery to map the vigour and density of green vegetation, is the: **[2 marks]**

(A) Digital Elevation Model (DEM)

(B) Surface albedo

(C) Leaf Area Index (LAI)

(D) Normalised Difference Vegetation Index (NDVI)

Q46. Trace elements that are too large or too highly charged to substitute readily into the common rock-forming minerals, and which therefore concentrate in the residual silicate melt as crystallisation proceeds, are termed: **[2 marks]**

(A) Compatible elements

(B) Incompatible elements

(C) Siderophile elements

(D) Native elements

Detailed Solutions

Q1.

Solution

Concept – pyroxene cleavage: Pyroxenes are single-chain (ino-) silicates; the weak bonds run parallel to two prism faces, giving two cleavage directions.

Step 1 – recall the chain geometry: The single silica chains are bonded side by side, and the cleavage planes lie parallel to the chains.

Step 2 – read the intersection angle: The two prismatic cleavages in pyroxenes intersect at nearly a right angle, about 87° (and 93°).

Step 3 – use it diagnostically: This near-90° cleavage is the standard way to tell a pyroxene from an amphibole under the microscope.

Why the other options are wrong:

- A, 56°: this is the amphibole angle, not the pyroxene one.
- B, 120°: not a cleavage angle of pyroxene.
- D, 30°: far too acute.

Final Answer: About $87^\circ \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – amphibole cleavage: Amphiboles are double-chain silicates; the wider double chains set the orientation of the two cleavage planes.

Step 1 – compare with pyroxene: Because the chain is double, the cleavage planes are inclined more steeply than in pyroxene.

Step 2 – read the angle: The two amphibole cleavages meet at about 56° and its supplement 124°.

Step 3 – apply the test: Seeing cleavage traces at roughly $60^\circ/120^\circ$ (rather than 90°) identifies the mineral as an amphibole such as hornblende.

Why the other options are wrong:

- A, $90^\circ/90^\circ$: this is the pyroxene pattern.
- B and C: are not the observed amphibole angles.

Final Answer: About 56° and $124^\circ \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – the plagioclase solid-solution series: Plagioclase feldspar is a continuous solid solution in which Na and Ca (with coupled Si–Al substitution) vary between two end-members.

Step 1 – name the sodic end-member: The Na end-member is albite, $NaAlSi_3O_8$.

Step 2 – name the calcic end-member: The Ca end-member is anorthite, $CaAl_2Si_2O_8$.

Step 3 – describe the substitution: Along the series $Na^+ + Si^{4+}$ is replaced by $Ca^{2+} + Al^{3+}$, keeping the charge balanced.

Why the other options are wrong:

- A, orthoclase–microcline: these are alkali (K) feldspars, a different series.
- B, nepheline–leucite: these are feldspathoids, not feldspars.
- D, sanidine–quartz: sanidine is a K-feldspar and quartz is not a feldspar.

Final Answer: Albite and anorthite $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept – composition of alkali feldspar: Orthoclase belongs to the alkali (potassium) feldspar group.

Step 1 – identify the cation: The dominant large cation is potassium, K^+.

Step 2 – write the framework: Feldspars are framework silicates; orthoclase has one Al replacing one Si in an Si_3Al framework.

Step 3 – assemble the formula: This gives $KAlSi_3O_8$.

Why the other options are wrong:

- A, $NaAlSi_3O_8$: this is albite (Na-plagioclase end-member).
- C, $CaAl_2Si_2O_8$: this is anorthite.
- D, $CaMgSi_2O_6$: this is diopside, a pyroxene.

Final Answer: $KAlSi_3O_8 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – polysynthetic (albite) twinning: Some feldspars grow with many thin twin lamellae stacked together, producing fine parallel lines on a cleavage surface.

Step 1 – link the striations to a structure: Repeated albite-law twinning on the triclinic lattice produces these closely spaced striations.

Step 2 – match the mineral: Only the triclinic plagioclase feldspars show this polysynthetic (multiple) twinning; the striations are their hallmark.

Step 3 – contrast with K-feldspar: Monoclinic orthoclase and sanidine do not show these fine repeated striations (microcline shows a cross-hatched grid instead).

Why the other options are wrong:

- A, orthoclase and C, sanidine: monoclinic K-feldspars, no polysynthetic striations.
- D, adularia: a low-temperature K-feldspar, also lacks the striations.

Final Answer: Plagioclase $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – crystal systems from axes and angles: Each crystal system is fixed by the relative lengths of the axes and the inter-axial angles.

Step 1 – read the given angles: Two angles are 90° and one, β, is not 90°.

Step 2 – read the lengths: All three axes are of unequal length.

Step 3 – match to the system: Three unequal axes with only one oblique angle define the monoclinic system, to which clinopyroxenes like diopside belong.

Why the other options are wrong:

- A, triclinic: has all three angles different from 90°.
- B, orthorhombic: has all three angles $= 90^\circ$.
- C, hexagonal: has four axes and 120° inter-axial angles.

Final Answer: Monoclinic system $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – ferromagnesian minerals of basalt: Basalts and gabbros carry olivine and pyroxene as their main dark minerals.

Step 1 – identify the pyroxene type: The common pyroxene in basalt is a monoclinic clinopyroxene rich in Ca, Mg and Fe.

Step 2 – name it: That clinopyroxene is augite, $(Ca,Mg,Fe)_2Si_2O_6$ with some Al.

Step 3 – confirm the role: Augite typically makes up a large part of a basalt's groundmass and phenocrysts.

Why the other options are wrong:

- A, enstatite and B, hypersthene: these are orthopyroxenes, less typical as the dominant basalt pyroxene.
- C, fayalite: this is the iron olivine end-member, not a pyroxene.

Final Answer: Augite $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – the Al_2SiO_5 polymorphs: Kyanite, andalusite and sillimanite have the same composition but are stable in different pressure–temperature fields, meeting at a triple point.

Step 1 – locate the high-pressure field: Reading up the pressure axis on the diagram, the uppermost field belongs to kyanite.

Step 2 – link to setting: Kyanite (bladed, blue) forms at high pressure and low-to-moderate temperature, typical of deep, high-P metamorphism.

Step 3 – order the others: Andalusite occupies the low-pressure field and sillimanite the high-temperature field.

Why the other options are wrong:

- A, andalusite: low-pressure, contact-metamorphic polymorph.

- C, sillimanite: high-temperature polymorph.
- D, mullite: an artificial/ceramic phase, not a metamorphic index mineral.

Final Answer: Kyanite $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – a dehydration (index) reaction: Metamorphic grade is marked by mineral reactions that release water as temperature rises.

Step 1 – read the reactants: Muscovite plus quartz break down together.

Step 2 – read the products: They yield K-feldspar, an aluminosilicate (sillimanite) and water vapour.

Step 3 – fix the grade: The disappearance of muscovite+quartz and the appearance of K-feldspar+sillimanite defines the high-grade, upper-amphibolite "second sillimanite" isograd, close to the start of partial melting.

Why the other options are wrong:

- A, greenschist onset: far lower grade than this reaction.
- B, diagenesis: below metamorphism entirely.
- D, zeolite facies: the lowest metamorphic grade.

Final Answer: Upper amphibolite (high) grade $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept – clockwise P–T paths: The way pressure and temperature change through time traces a loop on a P–T diagram that records the tectonic history.

Step 1 – read the up-going limb: Pressure rises first as the rock is buried (thickened crust), with temperature lagging behind.

Step 2 – read the top of the loop: Temperature keeps rising to a peak while pressure begins to fall.

Step 3 – read the down-going limb: The rock is exhumed by near-isothermal decompression, so pressure drops while temperature stays high, then it cools.

Step 4 – interpret: This clockwise loop is the signature of continental-collision (Barrovian) metamorphism.

Why the other options are wrong:

- A, C and D: describe simple single-direction paths, not the burial-then-decompression loop shown.

Final Answer: Burial and heating, then near-isothermal decompression $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept – metamorphism of mafic rocks: A basalt or gabbro metamorphosed at medium to high grade recrystallises to a distinctive dark rock.

Step 1 – read the mineralogy: The rock is dominated by hornblende (an amphibole) plus plagioclase.

Step 2 – read the fabric: It is foliated because the hornblende grains align.

Step 3 – name the rock: A foliated hornblende+plagioclase metabasite is an amphibolite.

Why the other options are wrong:

- A, marble: from limestone (calcite/dolomite).
- C, quartzite: from quartz sandstone.
- D, slate: low-grade metapelite, not a metabasite.

Final Answer: Amphibolite $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – contact metamorphism: Heat from an intrusion, without directed stress, alters the surrounding rock in a contact aureole.

Step 1 – read the conditions: High temperature but negligible directed pressure.

Step 2 – infer the fabric: Without differential stress the new minerals grow with no preferred orientation, so the rock is non-foliated.

Step 3 – name the rock: A hard, fine-grained, non-foliated contact-metamorphic rock is a hornfels.

Why the other options are wrong:

- A, mylonite: a strongly sheared fault rock (high strain).
- B, phyllite: a foliated regional-metamorphic rock.
- C, migmatite: a partly melted, high-grade rock.

Final Answer: Hornfels $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept – delta architecture: Where a river meets standing water it drops its sediment in a predictable three-part geometry.

Step 1 – read the bed geometry: Nearly flat topset beds, steep foreset beds and thin, gently dipping bottomset beds.

Step 2 – match the landform: This topset–foreset–bottomset (Gilbert-type) geometry defines a delta.

Step 3 – confirm the setting: Deltas build out (prograde) into the standing water body as the river keeps supplying sediment.

Why the other options are wrong:

- A, alluvial fan: builds on land where a stream leaves a mountain front.
- B, point bar: a bar on the inside of a river meander.
- D, natural levee: a low ridge along a river bank.

Final Answer: Delta $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept – the three delta bed-sets: A delta has topset, foreset and bottomset beds, each formed in a different position.

Step 1 – identify the steep beds: The steeply inclined beds are deposited on the sloping delta front.

Step 2 – name them: These basinward-dipping, inclined beds are the foreset beds.

Step 3 – note their meaning: Their dip direction records the direction in which the delta was advancing.

Why the other options are wrong:

- A, topset: nearly horizontal beds on top of the delta plain.
- B, bottomset: thin, gently dipping beds in front of the foresets.
- C, backset: not a standard delta bed term.

Final Answer: Foreset beds $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept – coarsening-upward successions: The vertical grain-size trend records whether the shoreline advanced or retreated.

Step 1 – read the trend: Mud at the base passing up to clean sand means grain size increases upward (coarsening up).

Step 2 – interpret the energy change: Coarser sediment upward means shallower, higher-energy water upward, i.e. the shoreline is building out into the basin.

Step 3 – name the setting: A prograding delta front or shoreface produces exactly this regressive, coarsening-upward package.

Why the other options are wrong:

- B, abyssal plain: dominated by fine mud, no such upward-coarsening shoreline signal.
- C, aeolian dune field: continental sand, not a marine mud-to-sand shoreline sequence.
- D, glacial till plain: poorly sorted, unstratified till, not coarsening-upward marine sand.

Final Answer: Prograding delta / shoreface $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept – the make-up of chalk: Chalk is a very pure, fine-grained limestone formed in open marine settings.

Step 1 – recall its origin: It accumulated as a deep-shelf ooze from the calcareous skeletons of floating micro-organisms.

Step 2 – name the components: The chief components are coccoliths (plates of calcareous nannoplankton) together with foraminifera.

Step 3 – confirm the composition: These are all calcium carbonate, so chalk is essentially biogenic $CaCO_3$.

Why the other options are wrong:

- A, quartz silt: chalk is carbonate, not siliceous clastic.
- C, volcanic ash: an igneous fragmental material, unrelated.
- D, detrital clay: chalk is notably clay-poor.

Final Answer: Calcareous microfossils (coccoliths and foraminifera) $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – deep-marine gravity-flow deposits: Dense, sediment-laden currents can flow down the continental slope and spread across the deep-sea floor.

Step 1 – read the bed character: Each bed grades from sand at the base up to mud at the top (a graded, fining-upward couplet).

Step 2 – link to the process: Such graded beds form as a turbidity current slows and drops its coarsest load first, then progressively finer material.

Step 3 – name the deposit: The resulting graded beds (the Bouma sequence) are turbidites.

Why the other options are wrong:

- A, varves: annual lake laminae, not graded gravity-flow beds.
- B, evaporites: chemical salts from evaporation.
- C, tillites: lithified glacial till, poorly sorted and unstratified.

Final Answer: Turbidites $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept – Walther's Law of facies: Walther's Law connects the vertical stacking of facies to their lateral arrangement.

Step 1 – state the rule: Only facies that occur side by side in adjacent environments can be found superimposed in a conformable vertical succession.

Step 2 – give the reason: As environments migrate laterally through time, the deposits of neighbouring environments come to lie one above another.

Step 3 – apply the condition: This holds only where the succession is conformable (no significant break in deposition).

Why the other options are wrong:

- A: a single environment cannot explain a vertical facies change.
- C: the basement age is unrelated to facies stacking.
- D: facies patterns are systematic, not random.

Final Answer: The lateral succession of adjacent environments $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept – thrust faults: A thrust is a low-angle reverse fault produced by compression.

Step 1 – read the sense of motion: The hanging wall has moved up and over the footwall.

Step 2 – read the geometry: Older rocks now rest on younger rocks along a gently dipping plane.

Step 3 – name the structure: Up-and-over movement on a low-angle plane, carrying older over younger, is a thrust fault, the building block of fold-thrust belts.

Why the other options are wrong:

- B, normal fault: hanging wall moves down, from extension.

- C, strike-slip fault: horizontal, side-by-side motion.
- D, graben-bounding fault: a normal (extensional) fault.

Final Answer: Thrust fault $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – stacking of thrust sheets: In a compressional belt, several thrusts commonly branch from one basal thrust.

Step 1 – read the arrangement: Sub-parallel thrusts all root into a common floor thrust and climb up-section.

Step 2 – describe the result: Each thrust slice is stacked over the one in front, thickening the crust.

Step 3 – name the structure: This shingled arrangement is an imbricate thrust stack (imbricate fan).

Why the other options are wrong:

- B, horst: an up-thrown block between two normal faults (extension).
- C, rift valley: an extensional down-dropped basin.
- D, oceanic transform: a strike-slip plate boundary.

Final Answer: Imbricate thrust stack $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – resolving slip into heave and throw: The net dip-slip on a fault resolves into a horizontal part (heave) and a vertical part (throw).

Step 1 – write the relation: For dip θ and net slip s, the horizontal component is heave $= s\cos\theta$.

Step 2 – insert the values: $s = 4$ km and $\theta = 30°$, so heave $= 4 \times \cos 30°$.

Step 3 – substitute the cosine: $\cos 30° = 0.866$, so heave $= 4 \times 0.866$.

Step 4 – compute: $4 \times 0.866 = 3.46$ km.

Why the other options are wrong:

- A, 2.0 km: this is $4 \sin 30°$, the throw, not the heave.
- B, 4.0 km: the full slip, not its horizontal part.
- D, 8.0 km: twice the slip, dimensionally wrong.

Final Answer: 3.46 km $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – collisional orogeny: Mountain belts form where plates converge; the type of belt depends on what collides.

Step 1 – identify the moving plate: The Indian Plate has drifted northward for tens of millions of years.

Step 2 – identify what it met: It collided with the southern margin of the Eurasian (Asian) Plate.

Step 3 – classify the collision: Both are continental, so this is a continent–continent collision, which crumpled the crust into the Himalaya and raised the Tibetan Plateau.

Why the other options are wrong:

- B, Pacific subduction: that produces ocean-margin arcs, not the Himalaya.
- C, African Plate: not the plate India collided with.
- D, sea-floor spreading: a divergent process, opposite to collision.

Final Answer: Eurasian Plate, continent–continent collision $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept – percentage shortening: Shortening measures how much an original length has been reduced by deformation.

Step 1 – write the formula: shortening $(\%) = \dfrac{L_0 - L_f}{L_0} \times 100.$

Step 2 – insert the lengths: $L_0 = 12$ km and $L_f = 9$ km.

Step 3 – find the change: $L_0 - L_f = 12 - 9 = 3$ km.

Step 4 – form the ratio: $\frac{3}{12} = 0.25$.

Step 5 – convert to percent: $0.25 \times 100 = 25\%$.

Why the other options are wrong:

- B, 33%: uses $3/9$, dividing by the final length instead of the original.
- C, 12.5%: halves the correct value.
- D, 75%: the ratio of final to original length, not the shortening.

Final Answer: $25\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – the main thrusts of the Himalaya: The Himalaya is divided by a set of north-dipping, crustal-scale thrusts.

Step 1 – recall the thrust stack: From north to south they are the MCT, then the MBT (Main Boundary Thrust), then the MFT.

Step 2 – match to the required boundary: The thrust that carries the high-grade Higher Himalayan crystallines over the Lesser Himalaya is the Main Central Thrust (MCT).

Step 3 – confirm: The MCT places older, metamorphosed rocks over younger, lower-grade rocks, as expected of a major thrust.

Why the other options are wrong:

- A, Main Frontal Thrust: the southernmost thrust, at the Himalayan front.
- C, Indus–Tsangpo Suture: the join between India and Asia, farther north.
- D, San Andreas Fault: a transform fault in California, unrelated.

Final Answer: Main Central Thrust (MCT) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept – microbial sedimentary structures: Some layered structures are built biologically rather than by currents.

Step 1 – read the description: Domed and columnar bodies with fine internal lamination.

Step 2 – link to the builder: Cyanobacterial (microbial) mats trapped and bound successive layers of carbonate sediment, growing upward into domes.

Step 3 – name them: These structures are stromatolites, the most abundant fossils of the Precambrian.

Why the other options are wrong:

- B, ooids: small concentric carbonate grains, not domal structures.
- C, ripple marks: current-formed bedforms, inorganic.
- D, trilobite trails: trace fossils of animal movement.

Final Answer: Stromatolites $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – the earliest large fossils: Just before the Cambrian, the seas held an unusual soft-bodied biota.

Step 1 – read the age: Late Neoproterozoic, immediately preceding the Cambrian.

Step 2 – read the form: Soft-bodied, frond-, disc- and quilt-shaped organisms without hard skeletons.

Step 3 – name the assemblage: This is the Ediacaran fauna, named after the Ediacara Hills of Australia.

Why the other options are wrong:

- A, Burgess Shale fauna: a Middle Cambrian, skeletonised assemblage.
- C, Glossopteris flora: a Permian Gondwana land-plant flora.
- D, Siwalik fauna: Neogene mammals of the sub-Himalaya.

Final Answer: Ediacaran fauna $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – the oxygenation of the atmosphere: Earth's early atmosphere had almost no free oxygen; this changed in the Palaeoproterozoic.

Step 1 – read the timing: About 2.4 billion years ago.

Step 2 – read the evidence: Deposition of banded iron formations and the first red beds records the arrival of free oxygen.

Step 3 – name the event: This first major build-up of atmospheric oxygen is the Great Oxygenation Event.

Why the other options are wrong:

- A, Snowball Earth: global glaciation episodes, a different phenomenon.
- B, Cambrian explosion: the rapid diversification of animals, much later.
- D, K–Pg extinction: the end-Cretaceous mass extinction.

Final Answer: Great Oxygenation Event $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept – the great mass extinctions: Several extinction events punctuate the Phanerozoic, but one is by far the largest.

Step 1 – recall the severity: About 90% of marine species disappeared in the biggest event.

Step 2 – place it in time: That greatest extinction closed the Palaeozoic Era, at the end of the Permian (≈ 252 Ma).

Step 3 – confirm: It is often called "the Great Dying" because of its scale.

Why the other options are wrong:

- B, end-Cretaceous: killed the dinosaurs but was less severe overall.
- C, end-Ordovician and D, Late Devonian: major, but smaller than the end-Permian event.

Final Answer: End of the Permian $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept – supercontinents through time: The continents have repeatedly gathered and dispersed.

Step 1 – read the timing: Assembly completed by the end of the Palaeozoic (late Permian).

Step 2 – read the extent: Nearly all continental crust was joined into one landmass.

Step 3 – name it: That single late-Palaeozoic supercontinent is Pangaea.

Why the other options are wrong:

- A, Rodinia: an earlier (Neoproterozoic) supercontinent.
- B, Gondwana: the southern part of Pangaea only.
- C, Laurasia: the northern part of Pangaea only.

Final Answer: Pangaea $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept – index fossils for the Mesozoic: Different fossil groups zone different parts of the column.

Step 1 – read the description: Coiled, chambered cephalopods with complex, frilled suture lines.

Step 2 – match the group: These are the ammonites (ammonoids), which evolved rapidly and spread widely.

Step 3 – confirm their use: Their fast evolution and wide distribution make them the standard index fossils of Mesozoic marine strata.

Why the other options are wrong:

- B, graptolites: index fossils of the Ordovician–Silurian.
- C, trilobites: index fossils of the Palaeozoic (especially Cambrian).
- D, fusulinids: large foraminifera that zone the late Palaeozoic.

Final Answer: Ammonites ⇒ $\boxed{A}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept – iron ore minerals: The main iron ores are oxides, distinguished by formula, colour and magnetism.

Step 1 – read the magnetism: Strongly magnetic points to only one common ore mineral.

Step 2 – read the formula: Fe_3O_4 is the spinel-structured iron oxide.

Step 3 – name it: Strongly magnetic Fe_3O_4 with a black streak is magnetite.

Why the other options are wrong:

- A, hematite: Fe_2O_3, weakly magnetic, cherry-red streak.
- B, limonite: hydrated iron oxide, yellow-brown, not strongly magnetic.
- C, siderite: iron carbonate ($FeCO_3$), not an oxide.

Final Answer: Magnetite ⇒ $\boxed{D}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – Precambrian chemical iron ores: The world's greatest iron reserves are ancient chemical sediments.

Step 1 – read the layering: Alternating iron-oxide-rich and chert (silica) laminae.

Step 2 – read the age: Overwhelmingly Precambrian, deposited when the oceans began to take up oxygen.

Step 3 – name the deposit: Such rhythmically banded chemical sediments are Banded Iron Formations (BIFs).

Why the other options are wrong:

- A, laterite: a residual weathering product, not banded chemical sediment.
- B, placer: a mechanical heavy-mineral concentrate.
- D, skarn: a contact-metasomatic replacement body.

Final Answer: Banded Iron Formation (BIF) $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – manganese ore minerals: Manganese is won mainly from its oxides.

Step 1 – read the formula: MnO_2 is the fully oxidised manganese oxide.

Step 2 – name the mineral: MnO_2 is pyrolusite, the chief ore of manganese.

Step 3 – confirm: Pyrolusite is soft, black and sooty, and is the most important source of the metal.

Why the other options are wrong:

- A, rhodochrosite: manganese carbonate ($MnCO_3$), a minor ore.
- B, braunite: a mixed Mn silicate-oxide, secondary in importance.
- D, bauxite: the ore of aluminium, not manganese.

Final Answer: Pyrolusite $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept – India's iron ore provinces: India's best iron ore is tied to Precambrian rocks of the eastern shield.

Step 1 – recall the ore type: High-grade hematite ore derived from banded iron formations.

Step 2 – locate the belts: These BIF-hosted ores form the iron-ore (greenstone) belts of Odisha, Jharkhand and Chhattisgarh (for example Noamundi, Bailadila, Barbil).

Step 3 – confirm: These Precambrian belts hold the bulk of the country's reserves.

Why the other options are wrong:

- A, Deccan Traps: basalt lava flows, not iron ore hosts.
- B, Siwaliks: young clastic sediments of the sub-Himalaya.
- C, Aravalli granites: not the main iron ore hosts.

Final Answer: Precambrian iron-ore belts of Odisha–Jharkhand–Chhattisgarh ⇒ $\boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – contact-metasomatic (skarn) deposits: Where a hot intrusion meets reactive carbonate rock, fluids drive chemical replacement.

Step 1 – read the setting: Contact between a granitic intrusion and carbonate country rock.

Step 2 – read the mineralogy: Growth of calc-silicates such as garnet and pyroxene, with ore minerals like magnetite.

Step 3 – name the deposit: This high-temperature replacement body is a skarn (contact-metasomatic) deposit.

Why the other options are wrong:

- A, placer: a surface mechanical concentrate of heavy grains.
- B, evaporite: precipitated from evaporating water.
- D, residual (laterite): a weathering residue, low temperature.

Final Answer: Skarn (contact-metasomatic) deposit ⇒ $\boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept – residual enrichment by weathering: Intense tropical weathering can leave behind an ore by removing everything soluble.

Step 1 – read the process: Deep, in-situ chemical weathering in a hot, humid climate.

Step 2 – read what remains: Soluble elements are leached away, leaving a residue enriched in iron and manganese (and aluminium).

Step 3 – name the product: This residual, enriched weathering cap is a laterite.

Why the other options are wrong:

- B, turbidite: a deep-marine gravity-flow sediment.

- C, evaporite: a chemical precipitate from evaporation.
- D, pegmatite: a very coarse late-magmatic igneous rock.

Final Answer: Laterite (residual enrichment) $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept – dissolution landscapes: Soluble rocks develop a distinctive landscape when groundwater dissolves them.

Step 1 – read the rock and process: Carbonate rock dissolved by slightly acidic groundwater.

Step 2 – read the landforms: Sinkholes at the surface, caves at depth and largely underground drainage.

Step 3 – name the terrain: This dissolution landscape is karst topography.

Why the other options are wrong:

- A, badland: fine-grained clastic terrain dissected by gullies.
- B, moraine: a depositional glacial landform.
- C, delta plain: a river-mouth depositional surface.

Final Answer: Karst topography $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept – karst surface depressions: Dissolution and collapse of soluble rock create closed hollows.

Step 1 – read the shape: A closed, funnel- or bowl-shaped depression.

Step 2 – read the cause: Dissolution of the rock at depth, or collapse of a cavity roof.

Step 3 – name the feature: Such a closed karst depression is a sinkhole (doline).

Why the other options are wrong:

- B, drumlin: a streamlined glacial deposit.

- C, esker: a sinuous ridge of glaciofluvial sand and gravel.
- D, yardang: a wind-eroded ridge.

Final Answer: Sinkhole (doline) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept – Darcy's law: Groundwater discharge is the product of conductivity, gradient and area.

Step 1 – write the law: $Q = K\,i\,A$.

Step 2 – list the values: $K = 25$ m/day, $i = 0.04$, $A = 20$ m^2.

Step 3 – multiply the first two: $K\,i = 25 \times 0.04 = 1.0$ m/day.

Step 4 – multiply by area: $Q = 1.0 \times 20 = 20$ m^3/day.

Why the other options are wrong:

- B, 2 m^3/day: off by a factor of ten in the arithmetic.
- C, 200 m^3/day: forgets the gradient factor 0.04 correctly.
- D, 50 m^3/day: not consistent with the given numbers.

Final Answer: 20 m^3/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – natural groundwater discharge: Groundwater emerges where the water table meets the land surface.

Step 1 – read the geometry: The water table intersects the sloping ground at the foot of the hill.

Step 2 – read the process: Groundwater flows out at that intersection under gravity.

Step 3 – name the feature: A natural point of groundwater discharge at the surface is a spring.

Why the other options are wrong:

- A, aquiclude: an impermeable unit that stops flow, not a discharge point.
- C, sinkhole: a closed dissolution depression, an input rather than an output.
- D, cone of depression: the drawdown around a pumped well.

Final Answer: A spring $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – transmissivity of an aquifer: Transmissivity measures how much water an aquifer can transmit through its full thickness.

Step 1 – write the relation: $T = K\,b$, where K is hydraulic conductivity and b is saturated thickness.

Step 2 – list the values: $K = 15$ m/day and $b = 20$ m.

Step 3 – multiply: $T = 15 \times 20 = 300$.

Step 4 – attach the units: $T = 300\ \text{m}^2/\text{day}$.

Why the other options are wrong:

- A, $35\ \text{m}^2/\text{day}$: this is $K + b$, an addition, not the product.
- B, $0.75\ \text{m}^2/\text{day}$: this is $K/b \cdot 1$, a wrong operation.
- D, $150\ \text{m}^2/\text{day}$: half of the correct product.

Final Answer: $300\ \text{m}^2/\text{day} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – geochemical mobility in the surface cycle: Elements differ in how easily surface waters carry them away.

Step 1 – read the behaviour: Sodium and chlorine stay dissolved and travel readily with water.

Step 2 – classify: Elements that are easily dissolved and transported are said to be geochemically mobile.

Step 3 – confirm: Na and Cl are among the most mobile elements, which is why sea water is rich in them.

Why the other options are wrong:

- B, immobile: describes elements like Al and Ti that stay behind in the residue.
- C, siderophile: a Goldschmidt (core-preference) term, not a surface-mobility term.
- D, refractory: describes elements resistant to melting/volatilisation, a different idea.

Final Answer: Mobile $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q42

Q43.

Solution

Concept – relative mobility during weathering: During chemical weathering, elements are removed in a definite order of mobility.

Step 1 – recall the mobility series: Roughly Ca $>$ Na $>$ Mg $>$ K $>$ Si $>$ Fe $>$ Al, Ti, from most to least mobile.

Step 2 – compare the options: Among Al, Fe, Na and Ti, sodium sits highest in the mobility series.

Step 3 – conclude: Sodium is therefore leached and carried away most readily.

Why the other options are wrong:

- A, aluminium and D, titanium: among the least mobile; they stay behind in clays and residues.
- B, iron: fairly immobile, precipitating as oxides/hydroxides.

Final Answer: Sodium $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q43

Q44.

Solution

Concept – drainage patterns and geology: The map pattern of a stream network reflects the underlying rock and structure.

Step 1 – read the pattern: Irregular, tree-like branching with tributaries joining at a range of angles.

Step 2 – link to the substrate: Such a pattern forms where the rock is uniform and flat-lying, offering no structural control.

Step 3 – name it: This tree-like network is a dendritic drainage pattern.

Why the other options are wrong:

- A, radial: streams flow outward from a central high (e.g. a volcano).
- C, trellis: rectangular pattern controlled by parallel folded ridges.
- D, rectangular: right-angle bends controlled by joints and faults.

Final Answer: Dendritic $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept – vegetation indices in remote sensing: Green vegetation reflects strongly in the near-infrared and absorbs in the red, and a band ratio exploits this.

Step 1 – read the formula: $\dfrac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$ contrasts the high NIR reflectance with the low red reflectance of leaves.

Step 2 – identify the index: This normalised ratio is the Normalised Difference Vegetation Index (NDVI).

Step 3 – note its use: NDVI is high for dense, healthy vegetation and low for bare soil or water, so it maps vegetation vigour.

Why the other options are wrong:

- A, DEM: a model of surface elevation, not a spectral ratio.
- B, albedo: total reflectance, not this specific ratio.
- C, LAI: leaf area index, a related but distinct quantity, not defined by this formula.

Final Answer: NDVI $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – compatible versus incompatible elements: Trace elements partition between crystals and melt according to how well they fit the mineral lattices.

Step 1 – read the behaviour: The elements described do not fit the common rock-forming minerals (wrong size or charge).

Step 2 – infer the partitioning: Because they are excluded from the early crystals, they stay in the shrinking residual melt and become concentrated there.

Step 3 – name the group: Elements that stay in the melt in this way are the incompatible elements (for example K, Rb, the large-ion lithophiles and high-field-strength elements).

Why the other options are wrong:

- A, compatible elements: fit the lattices well and enter early crystals (e.g. Ni, Cr), the opposite behaviour.
- C, siderophile: a Goldschmidt (metal-preference) category, not about melt partitioning.
- D, native elements: elements occurring uncombined in nature, unrelated to this concept.

Final Answer: Incompatible elements $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	C	4	B	5	B
6	D	7	D	8	B	9	C	10	B
11	B	12	D	13	C	14	D	15	A
16	B	17	D	18	B	19	A	20	A
21	C	22	A	23	A	24	B	25	A
26	B	27	C	28	A	29	D	30	A
31	D	32	C	33	C	34	D	35	C
36	A	37	D	38	A	39	A	40	B
41	C	42	A	43	C	44	B	45	D
46	B								