GATE Geology and Geophysics – Geology

Sample Paper – 9

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. A crystal face makes intercepts of one unit length on the a-axis, one unit length on the b-axis, and is parallel to the c-axis (so its intercept on c is at infinity). The Miller indices (hkl) of this face are: **[1 mark]**

(A) (111)

(B) (110)

(C) (100)

(D) (010)

Q2. The chief ore mineral of uranium, a heavy, radioactive oxide with the ideal formula UO_2, is: **[1 mark]**

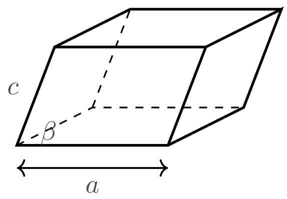
(A) Uraninite (pitchblende)

(B) Cassiterite

(C) Cinnabar

(D) Chalcopyrite

Q3. A crystal referred to three unequal crystallographic axes ($a \neq b \neq c$), two of which meet at an oblique angle while the third is perpendicular to both ($\alpha = \gamma = 90^\circ \neq \beta$), as sketched, belongs to which crystal system? **[1 mark]**



(A) Triclinic

(B) Orthorhombic

(C) Tetragonal

(D) Monoclinic

Q4. The phosphate mineral that is the principal ore of the light rare-earth elements (and an important source of thorium), typically occurring as a resistant heavy mineral in beach and river placers, is: **[1 mark]**

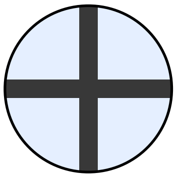
(A) Bauxite

(B) Beryl

(C) Fluorite

(D) Monazite

Q5. On the petrological microscope, a mineral grain is viewed under convergent light between crossed polarisers. It shows a centred interference figure consisting of a single black cross (isogyre) whose arms stay fixed and do NOT separate into hyperbolae as the stage is rotated, as sketched. Optically this mineral is: **[1 mark]**



fixed centred cross

(A) Uniaxial

(B) Biaxial

(C) Isotropic

(D) Opaque

Q6. In crystallography, when the possible combinations of symmetry elements passing through a point are worked out, the total number of distinct crystal classes (point groups) that results is: **[1 mark]**

(A) 7

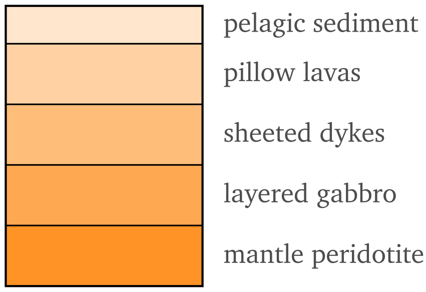
(B) 14

(C) 6

(D) 32

Igneous and Metamorphic Petrology

Q7. The idealized ophiolite sequence shown below represents a slice of oceanic lithosphere thrust onto a continent. Within this sequence the pillow basalts (submarine lavas) occur: **[1 mark]**



(A) At the very base, below the mantle peridotite

(B) Near the top, above the sheeted dyke complex

(C) Immediately below the layered gabbros

(D) Within the mantle harzburgite

Q8. In a large layered mafic–ultramafic intrusion (such as the Bushveld Complex), rhythmic layers built by the gravitational accumulation of early-formed crystals that settled and grew together on the magma-chamber floor display a texture described as: **[1 mark]**

(A) Cumulate texture

(B) Porphyritic texture

(C) Vesicular texture

(D) Graphic texture

Q9. An ultramafic plutonic rock composed almost entirely (more than about 90%) of the mineral olivine, and forming the lowest part of many ophiolite sequences, is: **[1 mark]**

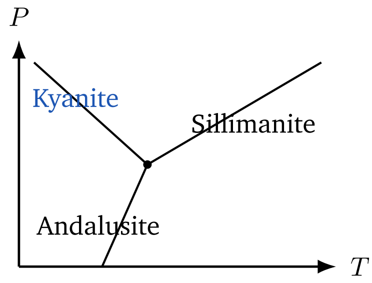
(A) Dunite

(B) Gabbro

(C) Granite

(D) Rhyolite

Q10. The three Al_2SiO_5 polymorphs share the phase diagram shown. The polymorph stable at high temperature and low-to-moderate pressure, and therefore an index mineral of the highest metamorphic grade in pelitic rocks, is: **[1 mark]**



(A) Kyanite

(B) Andalusite

(C) Chlorite

(D) Sillimanite

Q11. A hot granite pluton bakes the shale that surrounds it, producing a hard, fine-grained, non-foliated rock in a narrow aureole. This contact-metamorphic rock is: **[1 mark]**

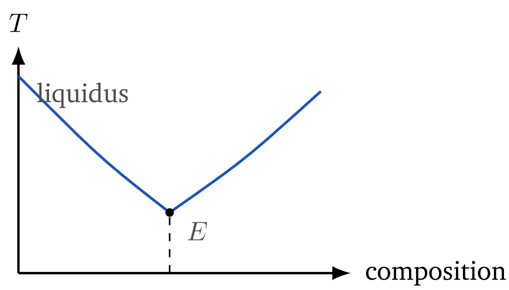
(A) Schist

(B) Phyllite

(C) Hornfels

(D) Mylonite

Q12. On the binary temperature–composition diagram shown for a two-component system with complete solid immiscibility, the point E at which the two liquidus curves meet, and at which liquid of fixed composition crystallises to two solids at the lowest temperature, is the: **[1 mark]**



(A) Liquidus maximum

(B) Solvus point

(C) Eutectic point

(D) Peritectic point

Sedimentology and Stratigraphy

Q13. Resistant heavy detrital minerals such as zircon, tourmaline, rutile and garnet are separated from a sandstone and studied chiefly in order to determine the: **[1 mark]**

(A) Provenance (nature of the source-rock area)

(B) Absolute radiometric age of deposition

(C) Depth of overburden during burial

(D) Present-day porosity of the rock

Q14. A sandstone shows a very high ZTR index (a large proportion of ultra-stable zircon, tourmaline and rutile among its transparent heavy minerals). This signature indicates a sediment that is: **[1 mark]**

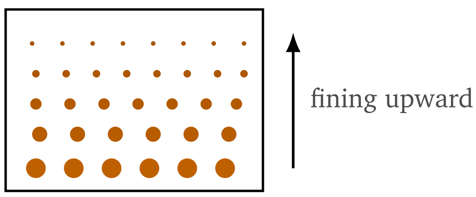
(A) First-cycle and mineralogically immature

(B) Rich in unstable feldspar and lithic grains

(C) Derived directly from a nearby fresh volcanic source

(D) Mineralogically mature and extensively recycled

Q15. The sandstone bed shown in profile grades upward from coarse grains at its base to fine grains at its top, the record of a single waning (decelerating) current such as a turbidity flow. This primary sedimentary structure is: **[1 mark]**



(A) Cross-bedding

(B) Symmetrical ripple marks

(C) Desiccation (mud) cracks

(D) Graded bedding

Q16. A quartz arenite in which almost all the grains are well-rounded, very well sorted and consist of nearly pure quartz is best described as: **[1 mark]**

(A) Texturally immature

(B) Compositionally immature

(C) Mineralogically and texturally mature

(D) A poorly sorted greywacke

Q17. In the hierarchy of chronostratigraphic (time-rock) units, the unit that ranks immediately below a series and comprises the body of rock formed during a single age is a: **[1 mark]**

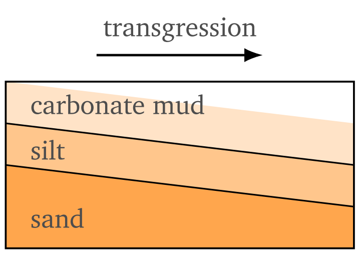
(A) System

(B) Series

(C) Stage

(D) Erathem

Q18. The section shows a shoreline where, during a marine transgression, sand, silt and carbonate mud were deposited side by side and then stacked one above another. Walther's Law of the correlation of facies states that, in a conformable succession, the facies seen in vertical order are the same as those that were originally deposited: **[1 mark]**



(A) At exactly the same instant everywhere

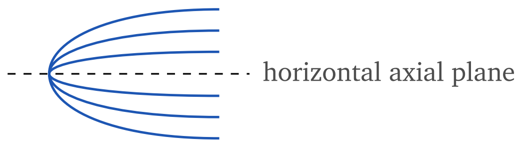
(B) Laterally adjacent to one another

(C) Only during a marine regression

(D) In a completely unrelated basin

Structural Geology and Geotectonics

Q19. In the fold profile shown, the layers have been rotated so far that the axial plane lies essentially horizontal and both limbs are nearly flat-lying. Such a fold is described as a: **[1 mark]**



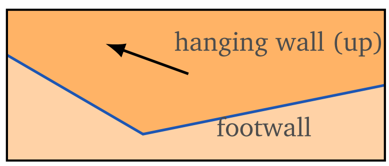
(A) Recumbent fold

(B) Symmetrical upright fold

(C) Open fold

(D) Gentle warp

Q20. In the fault shown, the fault plane dips at a low angle and the hanging wall (carrying older rocks) has been pushed up and over the footwall in response to horizontal compression. This structure is a: **[1 mark]**



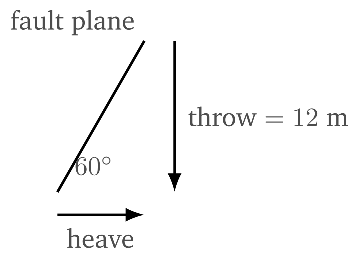
(A) Normal fault

(B) Thrust fault

(C) Dextral strike-slip fault

(D) Growth fault

Q21. A reverse fault dips at 60° and has a vertical throw of 12 m, as shown. The heave (horizontal component of the dip separation) is given by heave $=$ throw$/\tan(\text{dip})$. Taking $\tan 60^\circ = 1.732$, the heave is closest to: **[2 marks]**



(A) 6.9 m

(B) 12 m

(C) 20.8 m

(D) 24 m

Q22. The Richter scale of earthquake magnitude is logarithmic (base 10). An earthquake of magnitude 6.0 compared with one of magnitude 5.0 produces, at a given station, a ground-motion amplitude that is larger by a factor of: **[2 marks]**

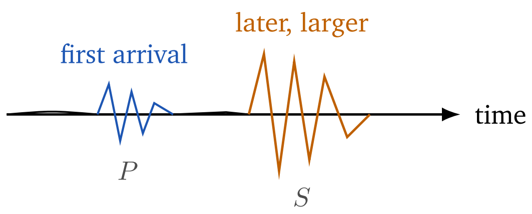
(A) 2 times

(B) 10 times

(C) 100 times

(D) 1000 times

Q23. On the earthquake seismogram sketched below, the first, fastest-travelling body waves to arrive at the station, which are compressional (push–pull) waves, are labelled: **[2 marks]**



(A) The S-waves (secondary, shear waves)

(B) The P-waves (primary, compressional waves)

(C) The Love surface waves

(D) The Rayleigh surface waves

Q24. A geologist measures that an active fault has accumulated a total displacement of 30 m over the last $15{,}000$ years. Assuming a steady rate, the long-term average slip rate on this fault is: **[2 marks]**

(A) 2 mm/yr

(B) 20 mm/yr

(C) 0.2 mm/yr

(D) 200 mm/yr

Palaeontology and Historical Geology

Q25. Which extinct group of free-swimming, coiled-shelled cephalopods evolved so rapidly that its successive species are the premier index fossils for zoning and correlating marine strata of the Mesozoic Era? **[2 marks]**

(A) Trilobites

(B) Graptolites

(C) Ammonites

(D) Nummulites

Q26. On the standard geological time scale, the oldest (earliest) period of the Palaeozoic Era, during which the first abundant shelly marine faunas appear, is the: **[2 marks]**

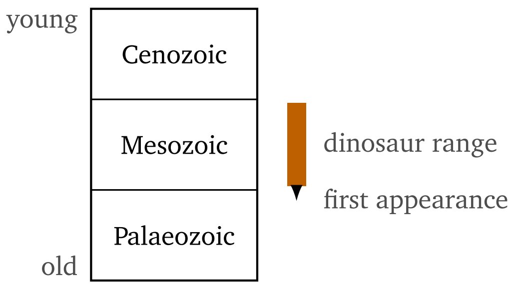
(A) Ordovician

(B) Cambrian

(C) Permian

(D) Devonian

Q27. The stratigraphic range chart below shows the total time span of the dinosaurs against the three Phanerozoic eras. Reading the chart, the dinosaurs first appeared during which period? **[2 marks]**



(A) Permian

(B) Jurassic

(C) Cretaceous

(D) Triassic

Q28. The largest mass extinction in the whole of Earth history, in which an estimated 90% of marine species (including the trilobites) were wiped out, took place at the boundary between the: **[2 marks]**

(A) Cretaceous and Paleogene periods

(B) Ordovician and Silurian periods

(C) Devonian and Carboniferous periods

(D) Permian and Triassic periods

Q29. Which group of single-celled marine protists, whose tiny calcareous tests are abundant in cores, is most widely used for the biostratigraphic zonation and correlation of petroleum-bearing marine successions? **[2 marks]**

(A) Corals

(B) Bivalves

(C) Foraminifera

(D) Crinoids

Q30. Laminated, dome-shaped sedimentary structures built by mats of photosynthesising cyanobacteria that trap and bind sediment, and which are the commonest fossils of Precambrian carbonate rocks, are called: **[2 marks]**

(A) Stromatolites

(B) Ammonites

(C) Trilobites

(D) Belemnites

Economic Geology and Mineral Resources

Q31. The only important ore mineral of chromium, an oxide of the spinel group with the ideal formula $FeCr_2O_4$ that is mined mainly from layered mafic–ultramafic intrusions, is: **[2 marks]**

(A) Pyrolusite

(B) Bauxite

(C) Ilmenite

(D) Chromite

Q32. The monazite-bearing beach-sand placers along the Kerala coast of India are worked chiefly to recover their content of: **[2 marks]**

(A) Copper and zinc

(B) Iron and manganese

(C) Thorium and rare-earth elements

(D) Gold and silver

Q33. The mines of the Singhbhum shear zone at Jaduguda in Jharkhand are India's most important primary source of which radioactive metal? **[2 marks]**

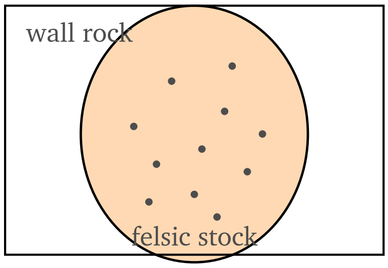
(A) Copper

(B) Gold

(C) Manganese

(D) Uranium

Q34. The section shows a large, low-grade, disseminated copper (and molybdenum) ore body in which fine sulphide grains are spread through a fractured felsic intrusive stock and its wall rock, as sketched. This class of deposit is called a: [2 marks]



(A) Porphyry copper deposit

(B) Marine evaporite deposit

(C) Banded iron formation

(D) Residual laterite deposit

Q35. Ore minerals precipitated from hot, mineral-charged aqueous solutions that rise through the crust and deposit their load in open fissures and fractures, forming discrete tabular veins, are said to constitute a: [2 marks]

(A) Placer deposit

(B) Hydrothermal vein deposit

(C) Sedimentary evaporite deposit

(D) Magmatic cumulate deposit

Q36. Primary diamonds are mined from a distinctive, deep-sourced ultramafic igneous rock that ascends explosively to form a carrot-shaped volcanic pipe. That host rock is: [2 marks]

(A) A basaltic lava flow

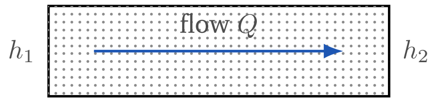
(B) A kimberlite pipe

(C) A granite pegmatite

(D) A quartz sandstone

Hydrogeology and Engineering Geology

Q37. Groundwater flows steadily through the horizontal sand column shown. By Darcy's law $Q = K\,i\,A$, with hydraulic conductivity $K = 15$ m/day, hydraulic gradient $i = 0.03$ and cross-sectional area $A = 40$ m^2, the discharge Q is: **[2 marks]**



$K = 15$ m/day, $i = 0.03$, $A = 40$ m^2

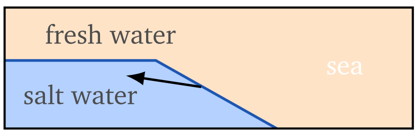
(A) 4.5 m^3/day

(B) 45 m^3/day

(C) 1.8 m^3/day

(D) 18 m^3/day

Q38. In the coastal aquifer shown, heavy pumping of fresh groundwater has lowered the water table so that the wedge of dense sea water beneath it advances inland below the wells. This landward migration of the salt-water body is called: **[2 marks]**



(A) Artesian overflow

(B) Natural groundwater recharge

(C) Saltwater (seawater) intrusion

(D) Capillary rise

Q39. Prolonged, excessive withdrawal of groundwater from a thick confined aquifer lowers the piezometric head, allows the clay interbeds to compact, and at the surface most commonly produces: **[2 marks]**

(A) Artesian overflow at the wellhead

(B) Land subsidence of the ground surface

(C) A permanent rise in the water table

(D) An increase in aquifer porosity

Q40. By the Ghyben–Herzberg relation for a coastal unconfined aquifer, taking fresh-water density $\rho_f = 1.000$ g/cm^3 and salt-water density $\rho_s = 1.025$ g/cm^3, the depth z of the fresh–salt interface below sea level per unit height h of the water table above sea level is $z = \dfrac{\rho_f}{\rho_s - \rho_f} h$. For $h = 1$ m the interface lies at a depth of about: **[2 marks]**

(A) 25 m

(B) 10 m

(C) 40 m

(D) 4 m

Q41. An aquifer has a hydraulic conductivity $K = 20$ m/day and a saturated thickness $b = 5$ m. Its transmissivity T, defined as $T = K\,b$, is: **[2 marks]**

(A) 100 m^2/day

(B) 4 m^2/day

(C) 25 m^2/day

(D) 15 m^2/day

Geochemistry, Geomorphology and Remote Sensing

Q42. By mass, taking the Earth as a whole (the bulk Earth, including its metallic core), the single most abundant chemical element is: **[2 marks]**

(A) Oxygen

(B) Iron

(C) Silicon

(D) Magnesium

Q43. The chemical weathering reaction in which iron-bearing silicate minerals combine with atmospheric oxygen so that ferrous iron is converted to ferric iron, staining the rock reddish-brown, is an example of: **[2 marks]**

(A) Hydrolysis

(B) Carbonation

(C) Oxidation

(D) Hydration

Q44. The gridded array of terrain-elevation values shown below, from which slope, aspect and drainage networks can be computed in a Geographic Information System, is known as a: **[2 marks]**

62	58	55	51
60	57	53	49
59	55	50	46

elevation (m) in each cell

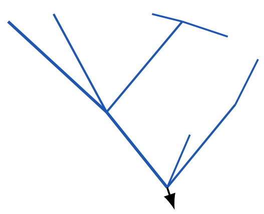
(A) Digital Elevation Model (DEM)

(B) False-colour composite image

(C) Geological cross-section

(D) Stereographic projection

Q45. The drainage network shown, in which tributaries branch and join at acute angles like the limbs of a tree and no strong structural control is evident, is a: **[2 marks]**



(A) Trellis pattern

(B) Radial pattern

(C) Dendritic pattern

(D) Rectangular pattern

Q46. When a Digital Elevation Model is processed in a GIS, the local rate of change of elevation between a cell and its neighbours (the steepness of the ground surface at that cell) is reported as the: **[2 marks]**

(A) Aspect

(B) Slope (gradient)

(C) Absolute elevation

(D) Profile curvature

Detailed Solutions

Q1.

Solution

Concept – Miller indices: Miller indices (hkl) describe the orientation of a crystal face by the reciprocals of its axial intercepts, cleared of fractions.

Step 1 – write the intercepts: The face cuts a at 1, cuts b at 1, and is parallel to c so its c intercept is at ∞.

Step 2 – take the reciprocals: $\frac{1}{1} = 1$ for a; $\frac{1}{1} = 1$ for b; $\frac{1}{\infty} = 0$ for c.

Step 3 – clear fractions and enclose: The reciprocals are already whole numbers $1, 1, 0$, giving the Miller index (110).

Why the other options are wrong:

- A, (111): would require finite equal intercepts on all three axes.
- C, (100): a face cutting only a and parallel to both b and c.
- D, (010): a face cutting only b and parallel to a and c.

Final Answer: $(110) \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – ore minerals of the radioactive metals: Each metal has a characteristic principal ore mineral defined by its chemistry.

Step 1 – read the clues: The mineral is heavy, radioactive and is an oxide of formula UO_2.

Step 2 – match the formula: UO_2 is the composition of uraninite; its massive, botryoidal variety is called pitchblende.

Step 3 – confirm the role: Uraninite is the world's chief ore of uranium, consistent with the radioactive, high-density description.

Why the other options are wrong:

- B, cassiterite: SnO_2, the ore of tin (not radioactive).
- C, cinnabar: HgS, the ore of mercury.
- D, chalcopyrite: $CuFeS_2$, a copper ore.

Final Answer: Uraninite (pitchblende) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – crystal systems from axes and angles: The seven crystal systems are separated by the relative lengths of the crystallographic axes and the inter-axial angles.

Step 1 – read the length condition: All three axes are of different length, $a \neq b \neq c$.

Step 2 – read the angle condition: Two angles are right angles and one is oblique: $\alpha = \gamma = 90^\circ$ but $\beta \neq 90^\circ$.

Step 3 – match to the table: Three unequal axes with exactly one oblique inter-axial angle define the monoclinic system.

Why the other options are wrong:

- A, triclinic: all three angles are oblique ($\alpha \neq \beta \neq \gamma \neq 90^\circ$).
- B, orthorhombic: three unequal axes but all angles $= 90^\circ$.
- C, tetragonal: two axes equal and all angles $= 90^\circ$.

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

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – ores of the rare-earth elements: The light rare earths and thorium are won mostly from a few resistant accessory minerals.

Step 1 – read the clues: The mineral is a phosphate, is the main ore of the light rare earths, also yields thorium, and survives as a heavy placer mineral.

Step 2 – identify it: These properties describe monazite, $(Ce,La,Th)PO_4$.

Step 3 – confirm the setting: Because monazite is dense and chemically durable it concentrates in beach and river placers, exactly as stated.

Why the other options are wrong:

- A, bauxite: the ore of aluminium.
- B, beryl: a beryllium silicate, a gem and Be ore, not an REE ore.

- C, fluorite: CaF_2, a source of fluorine.

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

Answer: (D) Go Back to Q4

Q5.

Solution

Concept – interference figures distinguish optical classes: Under convergent light between crossed polarisers, anisotropic minerals give interference figures whose behaviour on rotation reveals whether they are uniaxial or biaxial.

Step 1 – read the observation: A single black cross (isogyre) is centred in the field and its arms remain joined, not splitting, as the stage rotates.

Step 2 – interpret the fixed cross: A centred cross that stays intact throughout rotation is the optic-axis figure of a uniaxial mineral (one optic axis).

Step 3 – contrast with biaxial: In a biaxial mineral the cross would break up into two curved isogyres (hyperbolae) that swing apart on rotation.

Why the other options are wrong:

- B, biaxial: gives a cross that separates into two isogyres.
- C, isotropic: gives no interference figure at all (stays dark).
- D, opaque: transmits no light, so no figure can form.

Final Answer: Uniaxial mineral $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept – symmetry and the crystal classes: Combining the permitted rotation axes, mirror planes and inversion centres about a point yields a fixed number of symmetrically distinct arrangements.

Step 1 – recall the standard counts: There are 7 crystal systems and 14 Bravais lattices.

Step 2 – recall the point-group count: The distinct combinations of point-symmetry elements give 32 crystal classes (point groups).

Step 3 – select the value asked: The question asks for the number of crystal classes, which is 32.

Why the other options are wrong:

- A, 7: the number of crystal systems.
- B, 14: the number of Bravais lattices.
- C, 6: not a standard count here (there are 6 crystal families in one scheme, but 32 classes).

Final Answer: 32 crystal classes $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – structure of an ophiolite: An ophiolite preserves, from bottom to top, mantle peridotite, layered gabbro, sheeted dykes, pillow lavas and pelagic sediment.

Step 1 – locate the pillow lavas: Pillow basalts are the erupted sea-floor lavas, so they lie high in the sequence.

Step 2 – fix them relative to the dykes: They rest directly on top of the sheeted dyke complex that fed them, and are overlain only by deep-sea sediment.

Step 3 – read the figure: The column shows pillow lavas above the sheeted dykes, confirming their position near the top.

Why the other options are wrong:

- A, at the base: that position is occupied by mantle peridotite.
- C, below the gabbros: the gabbros are deeper (crystallised at depth), not above the pillows.
- D, within the harzburgite: harzburgite is residual mantle, well below the volcanic pile.

Final Answer: Near the top, above the sheeted dykes $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept – textures of layered intrusions: Slow cooling of a large magma chamber lets early crystals settle and accumulate on the floor.

Step 1 – read the process: Early-formed crystals settle gravitationally and pack together as rhythmic layers.

Step 2 – name the texture: A rock built of such accumulated (settled) crystals shows a cumulate texture; the settled grains are called cumulus crystals.

Step 3 – link to the example: The chromite and silicate layers of the Bushveld Complex are the classic cumulate rocks.

Why the other options are wrong:

- B, porphyritic: large crystals in a finer groundmass, from two cooling stages.
- C, vesicular: full of gas-bubble cavities, a volcanic texture.
- D, graphic: an intergrowth of quartz and feldspar resembling runic writing, seen in pegmatites.

Final Answer: Cumulate texture $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – ultramafic rock names: Ultramafic plutonic rocks are named by the proportions of olivine, pyroxene and other mafic minerals.

Step 1 – read the composition: More than 90% olivine, essentially a monomineralic olivine rock.

Step 2 – name it: An olivine-dominated ultramafic rock is a dunite.

Step 3 – confirm the setting: Dunite forms the deepest (mantle/lowest cumulate) part of ophiolite sequences, matching the clue.

Why the other options are wrong:

- B, gabbro: a coarse mafic rock of plagioclase plus pyroxene, not dominantly olivine.
- C, granite: a felsic, quartz-rich plutonic rock.
- D, rhyolite: a felsic volcanic rock.

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

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – the aluminosilicate (Al_2SiO_5) polymorphs: Kyanite, andalusite and sillimanite share the composition Al_2SiO_5 but occupy different P–T fields, so they are pressure–temperature index minerals.

Step 1 – read the field requested: High temperature at low-to-moderate pressure.

Step 2 – match the polymorph: The high-T field belongs to sillimanite (kyanite occupies high-P/low-T; andalusite occupies low-P/low-T).

Step 3 – link to grade: Because it needs the highest temperature, sillimanite marks the highest grade reached in regionally metamorphosed pelites.

Why the other options are wrong:

- A, kyanite: high-pressure, lower-temperature polymorph.
- B, andalusite: low-pressure, low-temperature polymorph.
- C, chlorite: a hydrous sheet silicate of low grade, not an Al_2SiO_5 polymorph.

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

Answer: (D) Go Back to Q10

Q11.

Solution

Concept – contact metamorphism: Heat from an intrusion, with little added stress, recrystallises the country rock in a surrounding aureole.

Step 1 – read the setting: A granite pluton bakes the adjacent shale in a narrow aureole (heat-dominated, low differential stress).

Step 2 – read the product: The result is hard, fine-grained and non-foliated because directed pressure was minimal.

Step 3 – name the rock: A tough, non-foliated contact-metamorphic rock of this kind is a hornfels.

Why the other options are wrong:

- A, schist: strongly foliated, a regional-metamorphic rock.

- B, phyllite: foliated with a silky sheen, also regional.
- D, mylonite: a foliated rock formed by intense shearing in a fault zone.

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

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – binary phase diagrams: In a two-component system with complete solid immiscibility, two liquidus curves descend from the pure-component melting points and meet at a single low point.

Step 1 – read point E: It is where the two liquidus curves intersect, at the lowest temperature on the liquidus.

Step 2 – describe the reaction there: At this point a liquid of fixed composition crystallises simultaneously to both solid phases at constant temperature.

Step 3 – name it: Such a point is the eutectic point.

Why the other options are wrong:

- A, liquidus maximum: the liquidus reaches a minimum here, not a maximum.
- B, solvus: the limit of solid solution, not relevant to a simple eutectic melt.
- D, peritectic: where a solid reacts with liquid to form a new solid, giving an incongruent (reaction) point, not this simple minimum.

Final Answer: Eutectic point $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – heavy minerals and provenance: Ultra-stable heavy accessory minerals survive transport and record the rocks they came from.

Step 1 – read the purpose: Zircon, tourmaline, rutile and garnet are separated for study of what a sandstone was derived from.

Step 2 – link mineral to source: Each heavy mineral points to a particular source lithology (for example zircon and tourmaline from granites and pegmatites).

Step 3 – conclude: The assemblage is therefore used to determine the provenance, the nature of the source-rock terrain.

Why the other options are wrong:

- B, absolute age: needs isotopic dating, not a heavy-mineral count.
- C, burial depth: read from compaction and diagenesis, not heavy minerals.
- D, porosity: a physical property measured directly on the rock.

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

Answer: (A) Go Back to Q13

Q14.

Solution

Concept – the ZTR maturity index: The ZTR index is the percentage of zircon, tourmaline and rutile among the transparent, non-micaceous heavy minerals; these three are the most chemically and mechanically durable.

Step 1 – interpret a high ZTR: A high ZTR means the less stable heavy minerals have been destroyed, leaving only the toughest survivors.

Step 2 – relate to maturity: This loss of unstable grains happens through prolonged weathering, abrasion and repeated recycling.

Step 3 – conclude: Therefore a high ZTR index marks a mineralogically mature, extensively recycled sediment.

Why the other options are wrong:

- A, immature: an immature sand still retains many unstable heavy minerals (low ZTR).
- B, feldspar-rich: abundant feldspar signals immaturity, the opposite case.
- C, fresh volcanic source: would supply abundant unstable minerals, lowering the ZTR.

Final Answer: Mineralogically mature, recycled $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept – graded bedding: A current that loses energy drops its coarsest load first and its finest last.

Step 1 – read the profile: Grain size decreases upward, coarse at the base and fine at the top, within a single bed.

Step 2 – identify the process: This vertical fining records deposition from one waning (decelerating) current, typically a turbidity flow.

Step 3 – name the structure: An upward-fining bed of this kind is called graded bedding.

Why the other options are wrong:

- A, cross-bedding: inclined foreset laminae from migrating bedforms, not vertical size grading.
- B, ripple marks: small wave- or current-formed surface undulations.
- C, mud cracks: polygonal shrinkage cracks from subaerial drying.

Final Answer: Graded bedding $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept – textural and compositional maturity: Texture reflects rounding and sorting; composition reflects how much unstable material survives.

Step 1 – read the texture: Grains are well-rounded and very well sorted, so the rock is texturally mature.

Step 2 – read the composition: The grains are nearly pure quartz, the most stable framework mineral, so it is also compositionally (mineralogically) mature.

Step 3 – combine: A well-rounded, well-sorted, quartz-only sandstone is both mineralogically and texturally mature.

Why the other options are wrong:

- A, texturally immature: contradicts the good rounding and sorting.
- B, compositionally immature: contradicts the pure-quartz composition.
- D, greywacke: a poorly sorted, matrix-rich, immature sandstone, the opposite of this rock.

Final Answer: Mature quartz arenite $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept – the chronostratigraphic hierarchy: Time-rock units nest as eonothem > erathem > system > series > stage, each with a matching geochronologic unit.

Step 1 – locate "below a series": The rank immediately below a series is the stage.

Step 2 – link to time: A stage is the rock formed during a single age (its geochronologic equivalent).

Step 3 – conclude: The required unit is the stage.

Why the other options are wrong:

- A, system: ranks above a series (rock of a period).
- B, series: the unit above stage (rock of an epoch).
- D, erathem: a very high rank (rock of an era).

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

Answer: (C) Go Back to Q17

Q18.

Solution

Concept – Walther's Law of facies: Walther's Law links the vertical stacking of facies in a conformable succession to their original lateral arrangement.

Step 1 – state the law: Only environments that lie side by side in space can be superimposed in a conformable vertical section.

Step 2 – apply to the figure: As the shoreline transgresses, the sand, silt and carbonate-mud belts that were laterally adjacent migrate landward and become stacked one above another.

Step 3 – conclude: Hence the facies seen vertically were originally deposited laterally adjacent to one another.

Why the other options are wrong:

- A, same instant everywhere: facies are time-transgressive, not synchronous surfaces.

- C, only during regression: the law holds for any conformable shift, transgressive or regressive.
- D, unrelated basin: the law applies within one continuous, genetically linked succession.

Final Answer: Laterally adjacent $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept – fold classification by axial-plane attitude: Folds are named partly by the inclination of their axial plane, from upright through inclined and overturned to recumbent.

Step 1 – read the geometry: The axial plane lies essentially horizontal and both limbs are nearly flat-lying.

Step 2 – match the class: A fold with a horizontal (or near-horizontal) axial plane is a recumbent fold.

Step 3 – link to setting: Recumbent folds form where intense horizontal compression has rotated the fold right over, as in nappes of collisional belts.

Why the other options are wrong:

- B, symmetrical upright: has a vertical axial plane.
- C, open fold: has gently dipping limbs and a steep axial plane, not laid over.
- D, gentle warp: a very low-amplitude flexure, not overturned.

Final Answer: Recumbent fold $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – fault classification: Faults are named by the sense of hanging-wall movement and the stress that drives it.

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

Step 2 – read the geometry and stress: The fault plane dips at a low angle and the driving stress is horizontal compression.

Step 3 – name it: A low-angle compressional fault with the hanging wall pushed up is a thrust fault (a low-angle reverse fault carrying older rocks over younger).

Why the other options are wrong:

- A, normal fault: hanging wall moves down under extension, the opposite sense.
- C, strike-slip: movement is horizontal along the strike, not up-dip.
- D, growth fault: a syn-sedimentary normal fault, again extensional.

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

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – throw and heave of a fault: Throw is the vertical component and heave the horizontal component of the dip separation, related through the dip angle.

Step 1 – write the relation: heave $= \dfrac{\text{throw}}{\tan(\text{dip})}$.

Step 2 – insert the values: heave $= \dfrac{12}{\tan 60^\circ} = \dfrac{12}{1.732}$.

Step 3 – evaluate: $\dfrac{12}{1.732} = 6.93$, so the heave is about 6.9 m.

Why the other options are wrong:

- B, 12 m: that is the throw, not the heave.
- C, 20.8 m: equals $12 \times \tan 60^\circ$, an incorrect multiplication instead of division.
- D, 24 m: simply twice the throw, with no basis.

Final Answer: Heave ≈ 6.9 m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept – the logarithmic Richter scale: The Richter magnitude is defined from the base-10 logarithm of the maximum ground-motion amplitude.

Step 1 – write the amplitude ratio: A magnitude difference ΔM corresponds to an amplitude ratio of $10^{\Delta M}$.

Step 2 – insert the difference: Here $\Delta M = 6.0 - 5.0 = 1.0$.

Step 3 – evaluate: $10^{1.0} = 10$, so the ground-motion amplitude is 10 times larger.

Why the other options are wrong:

- A, 2 times: would need $\Delta M = \log_{10} 2 \approx 0.3$, not 1.
- C, 100 times: corresponds to a two-unit jump (10^2).
- D, 1000 times: this is roughly the increase in released *energy* per unit magnitude ($\approx 31.6\times$ per unit, $\approx 1000\times$ over two units), not the amplitude per one unit.

Final Answer: Ten times larger amplitude $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – seismic body and surface waves: An earthquake radiates fast compressional body waves, slower shear body waves and still slower surface waves.

Step 1 – rank the speeds: P-waves (compressional) are the fastest, S-waves (shear) are slower, and surface waves are slowest.

Step 2 – read the seismogram: The very first, small wiggle to arrive is therefore the compressional wave.

Step 3 – name it: That first arrival is the P-wave (primary, push–pull, compressional wave).

Why the other options are wrong:

- A, S-waves: arrive after the P-waves and are shear, not compressional.
- C, Love waves: surface waves, arriving late with large amplitude.
- D, Rayleigh waves: also surface waves, the last to arrive.

Final Answer: The P-waves $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – average slip rate: The long-term slip rate is total displacement divided by the elapsed time.

Step 1 – write the relation: $\text{rate} = \dfrac{\text{displacement}}{\text{time}}$.

Step 2 – insert the values: $\text{rate} = \dfrac{30\ \text{m}}{15{,}000\ \text{yr}} = 0.002\ \text{m/yr}$.

Step 3 – convert to millimetres: $0.002\ \text{m/yr} \times 1000 = 2\ \text{mm/yr}$.

Why the other options are wrong:

- B, 20 mm/yr: ten times too large (a factor-of-ten slip error).
- C, 0.2 mm/yr: ten times too small.
- D, 200 mm/yr: a hundred times too large; unrealistically fast.

Final Answer: 2 mm/yr $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept – index fossils of the eras: Different eras are zoned by different rapidly evolving groups.

Step 1 – read the clues: Free-swimming cephalopods with coiled shells, evolving fast, used to correlate Mesozoic marine strata.

Step 2 – identify the group: These features describe the ammonites (ammonoids), the classic Mesozoic zone fossils.

Step 3 – confirm: Their short-lived, wide-ranging species make them ideal index fossils for the Triassic, Jurassic and Cretaceous.

Why the other options are wrong:

- A, trilobites: Palaeozoic index arthropods, extinct before the Mesozoic.
- B, graptolites: Lower Palaeozoic index fossils.
- D, nummulites: large Cenozoic (Tertiary) foraminifera.

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

Answer: (C) Go Back to Q25

Q26.

Solution

Concept – periods of the Palaeozoic Era: The Palaeozoic runs Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian.

Step 1 – locate the earliest: The first (oldest) period in that list is the Cambrian.

Step 2 – link the clue: The Cambrian opens with the first abundant shelly marine faunas (the Cambrian "explosion"), matching the description.

Step 3 – conclude: The oldest Palaeozoic period is therefore the Cambrian.

Why the other options are wrong:

- A, Ordovician: the second period, younger than the Cambrian.
- C, Permian: the youngest Palaeozoic period.
- D, Devonian: a middle Palaeozoic period.

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

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – reading a stratigraphic range chart: The lowest end of a range bar marks a group's first appearance in the rock record.

Step 1 – locate the base of the bar: The dinosaur range bar starts at the bottom of the Mesozoic block.

Step 2 – identify that period: The first (oldest) period of the Mesozoic is the Triassic.

Step 3 – conclude: Therefore the dinosaurs first appeared in the Triassic Period.

Why the other options are wrong:

- A, Permian: the last Palaeozoic period, before dinosaurs existed.
- B, Jurassic: dinosaurs flourished then but had already appeared earlier.
- C, Cretaceous: the last Mesozoic period, when the non-avian dinosaurs died out.

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

Answer: (D) Go Back to Q27

Q28.

Solution

Concept – the "Big Five" mass extinctions: The end-Permian event was the most severe biotic crisis in Earth history.

Step 1 – read the severity: About 90% of marine species were lost, including the last trilobites.

Step 2 – match the event: Losses of this magnitude identify the end-Permian mass extinction.

Step 3 – name the boundary: It occurred at the boundary between the Permian and Triassic periods (the Palaeozoic–Mesozoic transition).

Why the other options are wrong:

- A, Cretaceous–Paleogene: the dinosaur-killing event, large but less severe than end-Permian.
- B, Ordovician–Silurian: an earlier major extinction, but smaller.
- C, Devonian–Carboniferous: the Late Devonian crisis, again less severe.

Final Answer: Permian–Triassic boundary $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – microfossils in petroleum biostratigraphy: Tiny, abundant, fast-evolving microfossils recovered from cuttings and cores are ideal for correlating subsurface strata.

Step 1 – read the clues: Single-celled marine protists with calcareous tests, abundant, used to zone petroleum-bearing marine successions.

Step 2 – identify the group: These are the foraminifera, whose planktonic and benthic species are standard zone fossils.

Step 3 – confirm the use: Their small size and abundance in drill samples make them the workhorse of petroleum micropalaeontology.

Why the other options are wrong:

- A, corals: large colonial fossils, not recovered whole from cuttings.
- B, bivalves: macrofossils, less useful in small subsurface samples.
- D, crinoids: echinoderms preserved mostly as fragments, not primary zone fossils here.

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

Answer: (C) Go Back to Q29

Q30.

Solution

Concept – Precambrian life: The dominant fossil record of the Precambrian is microbial rather than shelly.

Step 1 – read the clues: Laminated, dome-shaped structures built by cyanobacterial mats that trap and bind sediment.

Step 2 – name them: Such structures are stromatolites, the commonest Precambrian fossils.

Step 3 – confirm: They record photosynthesising cyanobacteria that helped oxygenate the early atmosphere.

Why the other options are wrong:

- B, ammonites: Mesozoic cephalopods, far younger.
- C, trilobites: Palaeozoic arthropods.
- D, belemnites: Mesozoic cephalopods.

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

Answer: (A) Go Back to Q30

Q31.

Solution

Concept – ore mineral of chromium: Chromium is won from essentially one mineral, a member of the spinel group.

Step 1 – match the formula: $FeCr_2O_4$ is the composition of chromite.

Step 2 – confirm the setting: Chromite is concentrated as cumulate layers (chromitite) in layered mafic–ultramafic intrusions, exactly as stated.

Step 3 – conclude: The chief (essentially only) ore of chromium is chromite.

Why the other options are wrong:

- A, pyrolusite: MnO_2, the ore of manganese.
- B, bauxite: the ore of aluminium.
- C, ilmenite: $FeTiO_3$, the ore of titanium.

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

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – economic minerals in beach placers: Coastal placers concentrate dense, durable heavy minerals, each carrying particular valuable elements.

Step 1 – read the mineral: The placers are worked for monazite.

Step 2 – recall monazite chemistry: Monazite is a rare-earth–thorium phosphate, $(Ce,La,Th)PO_4$.

Step 3 – name the products: Therefore the Kerala monazite sands are mined chiefly for thorium and the rare-earth elements.

Why the other options are wrong:

- A, copper and zinc: won from sulphide ores, not monazite.
- B, iron and manganese: from oxide ores such as haematite and pyrolusite.
- D, gold and silver: gold does occur in some placers, but not as the monazite product.

Final Answer: Thorium and rare-earth elements $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – India's radioactive-metal resources: Certain shear zones host India's primary radioactive-metal ores.

Step 1 – read the locality: Jaduguda in the Singhbhum shear zone, Jharkhand.

Step 2 – recall its product: Jaduguda is India's oldest and most important underground mine for uranium.

Step 3 – conclude: The radioactive metal produced there is uranium.

Why the other options are wrong:

- A, copper: the Singhbhum belt does host copper, but Jaduguda is worked specifically for uranium.
- B, gold: mined elsewhere (for example Kolar), not the Jaduguda product.
- C, manganese: not a radioactive metal and not the Jaduguda ore.

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

Answer: (D) Go Back to Q33

Q34.

Solution

Concept – classifying ore deposits by form and setting: The geometry and host of an ore body identify its genetic class.

Step 1 – read the description: A large, low-grade body of finely disseminated copper (and molybdenum) sulphides spread through a fractured felsic intrusive stock.

Step 2 – match the class: Disseminated Cu–Mo mineralisation in and around a porphyritic felsic stock is the defining picture of a porphyry copper deposit.

Step 3 – confirm: Such deposits are the world's main source of copper and are mined by bulk, open-pit methods because of their low grade and huge tonnage.

Why the other options are wrong:

- B, evaporite: formed by precipitation from evaporating brine (salt, gypsum), not sulphides in a stock.
- C, banded iron formation: a chemical sedimentary iron ore, unrelated to an intrusion.
- D, laterite: a residual weathering deposit (for example bauxite/nickel laterite).

Final Answer: Porphyry copper deposit $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept – hydrothermal ore deposits: Hot aqueous fluids transport metals and precipitate them where conditions change.

Step 1 – read the process: Hot mineral-charged solutions rise and deposit ore minerals in open fissures and fractures.

Step 2 – read the form: Filling of fractures produces discrete tabular veins.

Step 3 – name the class: Ore emplaced in this way constitutes a hydrothermal vein deposit.

Why the other options are wrong:

- A, placer: mechanical concentration of heavy grains in sediment, not fracture-filling.
- C, evaporite: chemical precipitation from evaporating surface brine.
- D, magmatic cumulate: crystal settling within a cooling magma, not fluid-filled veins.

Final Answer: Hydrothermal vein deposit $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – primary source rock of diamond: Diamonds crystallise deep in the mantle and are carried up by a special ultramafic magma.

Step 1 – read the clues: A deep-sourced ultramafic rock that rises explosively to form a carrot-shaped volcanic pipe.

Step 2 – identify it: This description is of kimberlite, the classic primary host of diamond.

Step 3 – confirm: Kimberlite pipes (for example at Panna in India and at Kimberley in South Africa) are the chief primary diamond sources.

Why the other options are wrong:

- A, basalt flow: a surface mafic lava, too shallow a source for diamond.
- C, granite pegmatite: a felsic rock; a source of gems such as beryl, not diamond.
- D, sandstone: a sedimentary rock; it may host secondary placer diamonds

but is not the primary source.

Final Answer: Kimberlite pipe $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – Darcy's law: The steady groundwater discharge is $Q = K\,i\,A$, the product of hydraulic conductivity, hydraulic gradient and cross-sectional area.

Step 1 – list the data: $K = 15$ m/day, $i = 0.03$, $A = 40$ m^2.

Step 2 – multiply K and i: $K\,i = 15 \times 0.03 = 0.45$ m/day.

Step 3 – multiply by the area: $Q = 0.45 \times 40 = 18$ m^3/day.

Why the other options are wrong:

- A, 4.5 m^3/day: uses $A = 10$ or drops a factor of ten.
- B, 45 m^3/day: ignores the gradient beyond one decimal (off by ten).
- C, 1.8 m^3/day: ten times too small.

Final Answer: $Q = 18$ m^3/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept – fresh–salt water balance in coastal aquifers: A floating lens of fresh water normally holds the denser sea water back; disturbing that balance moves the interface.

Step 1 – read the cause: Heavy pumping lowers the fresh-water table and reduces the seaward flow that holds the salt water offshore.

Step 2 – read the effect: The wedge of dense sea water then advances landward beneath the wells.

Step 3 – name it: This landward migration of the salt-water body is saltwater (seawater) intrusion.

Why the other options are wrong:

- A, artesian overflow: upward flow of confined water at the surface, unrelated to the salt wedge.

- B, natural recharge: replenishment of the aquifer by rainfall, the opposite trend.
- D, capillary rise: upward movement of water in fine pores above the water table, a different process.

Final Answer: Saltwater intrusion $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept – consequences of over-pumping a confined aquifer: Lowering the pressure in a confined aquifer transfers load to the solid grains and compacts fine layers.

Step 1 – read the cause: Excessive withdrawal lowers the piezometric head.

Step 2 – follow the mechanics: The reduced pore-water pressure increases the effective stress, so the clay interbeds compact irreversibly.

Step 3 – read the surface result: This compaction shows at the surface as land subsidence.

Why the other options are wrong:

- A, artesian overflow: needs a rising head, the opposite of over-pumping.
- C, rise in water table: pumping lowers, not raises, the head.
- D, increase in porosity: compaction reduces porosity, it does not increase it.

Final Answer: Land subsidence $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – the Ghyben–Herzberg relation: In a coastal unconfined aquifer the depth of the fresh–salt interface below sea level is a fixed multiple of the water-table height above sea level.

Step 1 – write the relation: $z = \dfrac{\rho_f}{\rho_s - \rho_f} h.$

Step 2 – form the density factor: $\dfrac{\rho_f}{\rho_s - \rho_f} = \dfrac{1.000}{1.025 - 1.000} = \dfrac{1.000}{0.025} = 40.$

Step 3 – multiply by h: $z = 40 \times 1 = 40$ m.

Why the other options are wrong:

- A, 25 m: uses the reciprocal-like value $1/0.04$, an arithmetic slip.
- B, 10 m: too small; ignores the small density contrast.
- D, 4 m: off by a factor of ten from the correct 40.

Final Answer: $z \approx 40$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept – transmissivity of an aquifer: Transmissivity measures how much water an aquifer's full saturated thickness can transmit, and equals conductivity times thickness.

Step 1 – write the relation: $T = K\,b$.

Step 2 – insert the values: $T = 20$ m/day $\times$ 5 m.

Step 3 – evaluate: $T = 100$ m^2/day.

Why the other options are wrong:

- B, 4 m^2/day: divides instead of multiplying $(20/5)$.
- C, 25 m^2/day: adds the values incorrectly $(20 + 5)$.
- D, 15 m^2/day: subtracts the values $(20 - 5)$.

Final Answer: $T = 100$ m^2/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept – bulk-Earth versus crustal composition: The abundance ranking of elements differs between the crust and the whole Earth, because the metallic core is iron-rich.

Step 1 – recall the crust versus the whole Earth: In the crust oxygen dominates, but the bulk Earth includes the huge iron core.

Step 2 – rank the bulk Earth: By mass the bulk Earth is about 32% iron, 30% oxygen, 15% silicon and 14% magnesium.

Step 3 – select the largest: Iron, at roughly 32%, is the most abundant element in the Earth as a whole.

Why the other options are wrong:

- A, oxygen: the most abundant element in the crust, but second in the bulk Earth.
- C, silicon: third by mass in the bulk Earth.
- D, magnesium: fourth by mass in the bulk Earth.

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

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – chemical weathering reactions: Each chemical weathering process is defined by the reagent and the change it produces.

Step 1 – read the reaction: Iron-bearing silicates combine with atmospheric oxygen, and ferrous iron (Fe^{2+}) is converted to ferric iron (Fe^{3+}).

Step 2 – identify the process: A reaction that adds oxygen and raises the oxidation state is oxidation.

Step 3 – link the field evidence: The ferric iron forms reddish-brown haematite and limonite that stain the weathered rock, confirming oxidation.

Why the other options are wrong:

- A, hydrolysis: reaction of silicates with slightly acidic water to make clays, no change in oxidation state.
- B, carbonation: dissolution of carbonates by carbonic acid.
- D, hydration: the addition of water molecules into a mineral structure (for example anhydrite to gypsum), not oxygen uptake.

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

Answer: (C) Go Back to Q43

Q44.

Solution

Concept – digital terrain data: Terrain elevation stored as a regular grid of numbers is the basic input for quantitative geomorphic mapping.

Step 1 – read the data structure: A gridded array in which each cell holds an elevation value.

Step 2 – name it: Such a raster of elevations is a Digital Elevation Model (DEM).

Step 3 – link to its use: Slope, aspect and drainage networks are all derived from the DEM in a GIS, as the question states.

Why the other options are wrong:

- B, false-colour composite: an image made from spectral bands, storing reflectance, not elevation.
- C, geological cross-section: a vertical slice showing rock units, not a grid of heights.
- D, stereographic projection: a plot of orientation data on a net, unrelated to a terrain grid.

Final Answer: Digital Elevation Model (DEM) $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q44**

Q45.

Solution

Concept – drainage patterns reflect bedrock control: The plan geometry of a river network records the underlying rock structure.

Step 1 – read the pattern: Tributaries branch and join at acute angles like the limbs of a tree, with no strong structural alignment.

Step 2 – match the type: A tree-like, randomly branching network is the dendritic pattern.

Step 3 – link to substrate: Dendritic drainage develops on horizontal or uniformly resistant rocks where no structure steers the streams.

Why the other options are wrong:

- A, trellis: rectangular network of parallel main streams and right-angle tributaries, controlled by folded strata.
- B, radial: streams flowing outward from a central high such as a volcano.

- D, rectangular: streams meeting at right angles along joints and faults.

Final Answer: Dendritic pattern $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept – terrain derivatives from a DEM: A DEM can be processed to yield several derivative surfaces, each describing a different aspect of the terrain.

Step 1 – read the quantity: The local rate of change of elevation between a cell and its neighbours, that is, the steepness of the ground.

Step 2 – name it: The steepness derived from elevation differences is the slope (gradient).

Step 3 – confirm: Slope is computed as the maximum rate of elevation change per unit distance across the cell.

Why the other options are wrong:

- A, aspect: the compass direction that the slope faces, not its steepness.
- C, absolute elevation: the raw height itself, not its rate of change.
- D, profile curvature: the rate of change of the slope (second derivative), not the slope.

Final Answer: Slope (gradient) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q46

Answer Key

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