GATE Geology and Geophysics – Geology

Sample Paper – 6

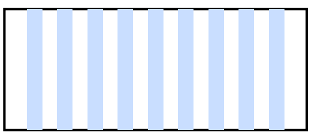
Duration: 128 Minutes — **Maximum Marks: 72**

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 plagioclase feldspar grain shown displays a set of fine, parallel light-and-dark bands (striations) on its cleavage face, produced by many small twin lamellae repeated across the crystal under the albite twin law. This kind of twinning is called: **[1 mark]**



repeated (lamellar) twin planes

(A) Simple contact twin

(B) Penetration twin

(C) Polysynthetic (lamellar) twinning

(D) Carlsbad twin

Q2. Olivine, with the general formula $(Mg,Fe)_2SiO_4$, is built of isolated SiO_4 tetrahedra that are not linked to one another directly but are bound together only through the intervening cations. On the basis of this linkage, olivine belongs to the: **[1 mark]**

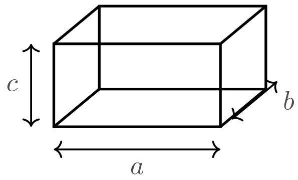
(A) Inosilicates (chain silicates)

(B) Phyllosilicates (sheet silicates)

(C) Tectosilicates (framework silicates)

(D) Nesosilicates (island silicates)

Q3. A crystal referred to three mutually perpendicular crystallographic axes that are all of different lengths ($a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$), as sketched, belongs to which crystal system? **[1 mark]**



(A) Orthorhombic

(B) Tetragonal

(C) Monoclinic

(D) Triclinic

Q4. In one important group of silicate minerals the SiO_4 tetrahedra each share two of their corner oxygen atoms with neighbours to build endless single chains, giving a silicon-to-oxygen ratio of $1 : 3$. This structural type characterises the: **[1 mark]**

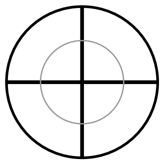
(A) Pyroxene group

(B) Amphibole group

(C) Mica group

(D) Feldspar group

Q5. Viewed conoscopically (with the Bertrand lens inserted) a mineral grain gives the centred interference figure shown: a single dark cross (isogyres) whose arms remain fixed and do not separate as the microscope stage is rotated. Optically the mineral is therefore: **[1 mark]**



fixed isogyre cross

(A) Biaxial positive

(B) Biaxial negative

(C) Isotropic

(D) Uniaxial

Q6. Among the following minerals, the one that effervesces briskly in cold dilute hydrochloric acid and breaks along three directions of cleavage to form rhombs is: **[1 mark]**

(A) Quartz

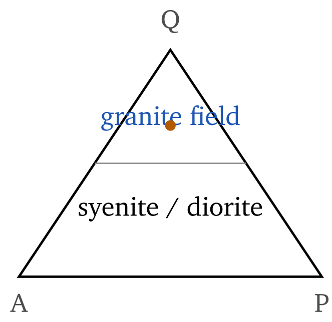
(B) Gypsum

(C) Fluorite

(D) Calcite

Igneous and Metamorphic Petrology

Q7. On the IUGS QAPF double triangle for plutonic rocks, part of which is sketched, a coarse-grained rock composed of quartz together with roughly equal amounts of alkali feldspar and plagioclase, and containing well over 20% quartz, plots in the field of: **[1 mark]**



(A) Granite

(B) Gabbro

(C) Peridotite

(D) Syenite

Q8. An igneous rock in which large, well-formed crystals (phenocrysts) are set within a distinctly finer-grained groundmass, recording two separate stages of cooling, is said to have a: **[1 mark]**

(A) Aphanitic texture

(B) Porphyritic texture

(C) Glassy texture

(D) Equigranular texture

Q9. A coarse-grained (phaneritic) plutonic rock composed chiefly of calcium-rich plagioclase and pyroxene, and forming the intrusive equivalent of basalt, is: **[1 mark]**

(A) Granite

(B) Gabbro

(C) Diorite

(D) Syenite

Q10. A high-grade metamorphic rock in which light quartzo-feldspathic layers alternate with dark mafic layers to give a coarse compositional banding (gneissose foliation), as shown, is: **[1 mark]**

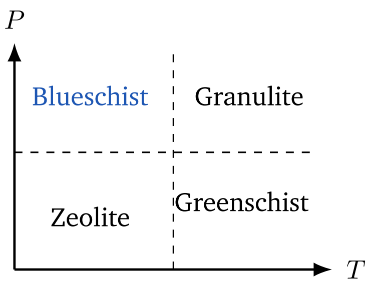
(A) Slate

(B) Phyllite

(C) Gneiss

(D) Schist

Q11. On the pressure–temperature grid of metamorphic facies shown, the field of high temperature and moderate-to-high pressure typical of the deep continental crust, in which pyroxene-bearing rocks (granulites) form, is the: **[1 mark]**



(A) Blueschist facies

(B) Granulite facies

(C) Zeolite facies

(D) Greenschist facies

Q12. The baking (thermal alteration) of country rock in a narrow aureole immediately around a hot igneous intrusion, producing a hard, fine-grained, non-foliated rock, is contact metamorphism. The rock so formed from a mudstone is: **[1 mark]**

(A) Mylonite

(B) Migmatite

(C) Hornfels

(D) Marble

Sedimentology and Stratigraphy

Q13. The set of post-depositional physical and chemical changes – chiefly compaction and cementation – by which loose, unconsolidated sediment is turned into a solid sedimentary rock is collectively called: **[1 mark]**

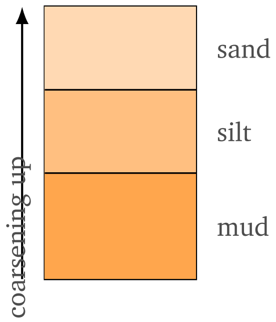
(A) Metamorphism

(B) Weathering

(C) Erosion

(D) Lithification (diagenesis)

Q14. The vertical sedimentary log shown coarsens upward, passing from offshore mud at the base, through silt, into clean shoreface sand at the top. Such a coarsening-upward succession most typically records a: **[1 mark]**



(A) A deepening (transgressive) event

(B) A deep-sea turbidite fan

(C) A prograding (regressive) shoreline

(D) An aeolian dune field

Q15. The most common cement that binds detrital quartz grains in many mature sandstones, precipitated during burial as syntaxial overgrowths on the grains, is: **[1 mark]**

(A) Silica (quartz)

(B) Halite

(C) Gypsum

(D) Organic matter

Q16. The bedding-plane surface shown preserves ripple marks whose crests are sharp and symmetrical and whose two flanks have equal slopes. Ripples of this form indicate deposition under: **[1 mark]**

symmetrical ripples

(A) Oscillatory wave action

(B) A strong one-way (unidirectional) current

(C) Moving glacial ice

(D) Wind on a dry desert floor only

Q17. In the stratigraphic succession of peninsular India, the vast pile of basaltic lava flows that erupted near the Cretaceous–Paleogene boundary and covers much of western India (the Deccan Traps) is best described as: **[1 mark]**

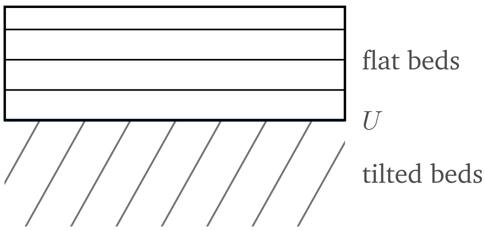
(A) A sequence of marine turbidites

(B) Continental flood basalts

(C) Glacial tillites

(D) Aeolian (desert) sandstones

Q18. Along the surface labelled U in the section shown, older strata that have been tilted and then planed off by erosion are overlain by younger, flat-lying beds. This type of unconformity is a: **[1 mark]**



(A) Nonconformity

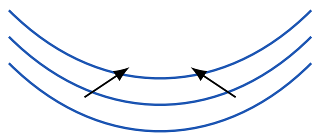
(B) Disconformity

(C) Paraconformity

(D) Angular unconformity

Structural Geology and Geotectonics

Q19. In the fold profile shown, the strata sag downward into a trough, the two limbs dip toward the central hinge, and the youngest beds occupy the core. This structure is a: **[1 mark]**



hinge

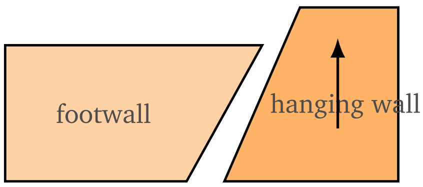
(A) Anticline

(B) Monocline

(C) Syncline

(D) Dome

Q20. In the fault block shown, the hanging wall has moved up relative to the footwall along a steeply dipping fault plane, in response to horizontal compression. This fault is a: **[1 mark]**



(A) Normal fault

(B) Reverse fault

(C) Strike-slip fault

(D) Growth fault

Q21. In the Wilson cycle of ocean-basin evolution, the stage in which a continental rift has just widened enough for a narrow strip of new oceanic crust and a young, growing sea to appear between the separating blocks – as seen in the Red Sea today – is the: **[2 marks]**

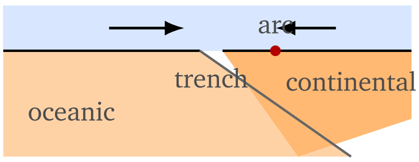
(A) Young (opening) ocean stage

(B) Terminal (closing) stage

(C) Suturing (continental collision) stage

(D) Mature, stable ocean stage

Q22. At the plate boundary shown, an oceanic plate bends down and descends beneath a continental plate along an inclined seismic (Benioff) zone, forming a deep trench and a volcanic arc. This is a: **[2 marks]**



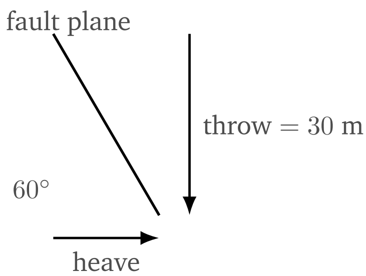
(A) Divergent boundary

(B) Transform boundary

(C) Passive continental margin

(D) Convergent (subduction) boundary

Q23. A normal fault dips at 60° and has a vertical throw of 30 m, as shown. The heave (horizontal component of the dip separation) is heave $=$ throw$/\tan($dip$)$. Taking $\tan 60^\circ = 1.732$, the heave is: **[2 marks]**



(A) 17.3 m

(B) 52.0 m

(C) 30.0 m

(D) 60.0 m

Q24. A mid-ocean ridge spreads symmetrically, adding new sea floor at a half-rate of 3 cm per year on each side, so the full spreading rate is 6 cm per year. Assuming a constant rate, the total width of new oceanic crust created across the ridge in 10 million years is: **[2 marks]**

(A) 60 km

(B) 300 km

(C) 30 km

(D) 600 km

Palaeontology and Historical Geology

Q25. The branch of palaeontology devoted to the study of trace fossils – the tracks, trails, burrows and borings left behind by the activity of organisms rather than their body parts – is called: **[2 marks]**

(A) Palynology

(B) Ichnology

(C) Micropalaeontology

(D) Taphonomy

Q26. On the standard geological time scale, the earliest eon of Earth history, extending from the planet's formation to about 4.0 billion years ago and predating the oldest known rocks, is the: **[2 marks]**

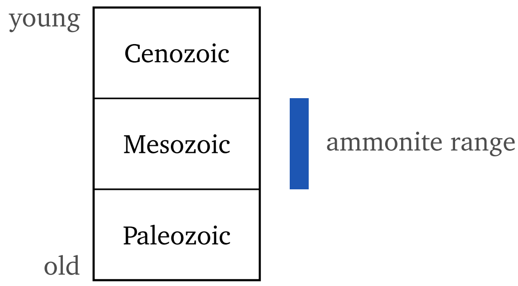
(A) Archean

(B) Proterozoic

(C) Phanerozoic

(D) Hadean

Q27. The stratigraphic range chart below shows the ammonoids (ammonites), coiled cephalopods that are classic index fossils of the Mesozoic. Reading the chart, the ammonites finally became extinct at the close of which era? **[2 marks]**



(A) Paleozoic

(B) Mesozoic

(C) Cenozoic

(D) Precambrian

Q28. The single largest mass extinction in the whole of Earth history, in which about 90% of marine species and many land groups were wiped out (the "Great Dying"), took place at the boundary between the: **[2 marks]**

(A) Permian and Triassic periods

(B) Cretaceous and Paleogene periods

(C) Ordovician and Silurian periods

(D) Devonian and Carboniferous periods

Q29. The principle stating that fossil organisms succeed one another through the rock record in a definite and recognisable order, so that any interval of geologic time can be identified by its fossil content, is the principle of: **[2 marks]**

(A) Faunal succession

(B) Original horizontality

(C) Cross-cutting relationships

(D) Uniformitarianism

Q30. The era of the Phanerozoic during which mammals diversified rapidly and came to dominate terrestrial faunas after the extinction of the non-avian dinosaurs – the so-called "Age of Mammals" – is the: [2 marks]

(A) Paleozoic

(B) Mesozoic

(C) Cenozoic

(D) Proterozoic

Economic Geology and Mineral Resources

Q31. The principal ore mineral of copper, a brass-yellow to golden sulphide with the chemical formula $CuFeS_2$ and a greenish-black streak, is: [2 marks]

(A) Bornite

(B) Chalcopyrite

(C) Malachite

(D) Galena

Q32. The strongly magnetic iron-oxide ore mineral, with the chemical formula Fe_3O_4, a black streak and the highest iron content of the common iron ores, is: [2 marks]

(A) Hematite

(B) Limonite

(C) Siderite

(D) Magnetite

Q33. In the reporting of mineral resources and reserves, the category applied to a deposit whose tonnage and grade are established with the highest degree of confidence, on the basis of closely spaced drilling and sampling, is: [2 marks]

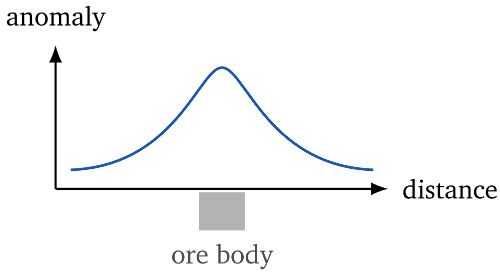
(A) Measured (proved) reserve

(B) Inferred resource

(C) Speculative resource

(D) Hypothetical resource

Q34. To locate a concealed body of magnetite iron ore at depth, the geophysical exploration method that responds most directly to the ore's contrasting physical property, as suggested by the anomaly profile shown, is the: **[2 marks]**



(A) Seismic refraction survey

(B) Gravity survey

(C) Magnetic survey

(D) Electrical resistivity sounding

Q35. Stratabound lead–zinc ores hosted in carbonate rocks, deposited at low temperature from dense basinal brines far from any igneous body (the Mississippi Valley Type deposits), are formed chiefly by: **[2 marks]**

(A) Magmatic segregation in a layered intrusion

(B) Low-temperature hydrothermal deposition from basinal brines

(C) Contact metasomatism (skarn formation)

(D) Placer concentration in river gravels

Q36. An ore body contains $5{,}000{,}000$ tonnes of ore at an average copper grade of 1.2%. The total mass of contained copper metal is: **[2 marks]**

(A) $6{,}000$ tonnes

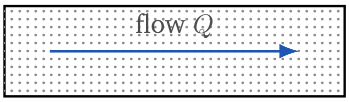
(B) 12,000 tonnes

(C) 60,000 tonnes

(D) 600,000 tonnes

Hydrogeology and Engineering Geology

Q37. Groundwater flows horizontally through the sand body shown. By Darcy's law $Q = K\,i\,A$, with hydraulic conductivity $K = 25$ m/day, hydraulic gradient $i = 0.01$ and cross-sectional area $A = 200$ m^2, the discharge Q is: **[2 marks]**



$K = 25$ m/day, $i = 0.01$, $A = 200$ m^2

(A) 5 m^3/day

(B) 500 m^3/day

(C) 25 m^3/day

(D) 50 m^3/day

Q38. When a site is being chosen for a large concrete gravity dam, the most favourable foundation condition among the following is: **[2 marks]**

(A) Highly jointed, permeable rock

(B) Soluble limestone riddled with karst cavities

(C) Thick, loose, unconsolidated alluvium

(D) Massive, fresh, impermeable bedrock

Q39. During the driving of a rock tunnel, a sudden and heavy inflow of groundwater into the excavation is most likely to occur where the tunnel line crosses a: **[2 marks]**

(A) Body of massive, unfractured granite

(B) Water-bearing fault or shear zone

(C) Thick, dry, impermeable shale

(D) Compact, unfractured basalt flow

Q40. In a drill run of total length 2.0 m, the individual pieces of intact, sound core that are each longer than 10 cm add up to 1.4 m. The Rock Quality Designation (RQD), defined as the summed length of such pieces divided by the total run length, expressed as a percentage, is: **[2 marks]**

intact pieces $>$ 10 cm shaded; total run $=$ 2.0 m

(A) 14%

(B) 20%

(C) 70%

(D) 100%

Q41. Water seeps through the rock foundation beneath a dam under a hydraulic gradient of $i = 0.25$. If the foundation rock has a hydraulic conductivity $K = 4$ m/day, the Darcy (seepage) velocity $v = K\,i$ through it is: **[2 marks]**

(A) 1 m/day

(B) 0.25 m/day

(C) 16 m/day

(D) 4 m/day

Geochemistry, Geomorphology and Remote Sensing

Q42. By weight percentage, the second most abundant chemical element in the Earth's continental crust, coming immediately after oxygen, is: **[2 marks]**

(A) Aluminium

(B) Silicon

(C) Iron

(D) Calcium

Q43. The chemical weathering process in which iron-bearing silicate minerals react with atmospheric oxygen to form reddish-brown ferric oxides and hydroxides (such as limonite and hematite), staining the rock, is: [2 marks]

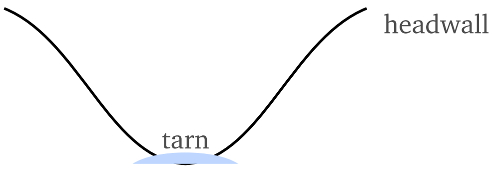
(A) Hydrolysis

(B) Oxidation

(C) Carbonation

(D) Hydration

Q44. The steep-sided, amphitheatre-shaped hollow shown in profile, carved by ice at the head of a glacial valley and often holding a small lake (tarn) after the glacier melts, is a: [2 marks]



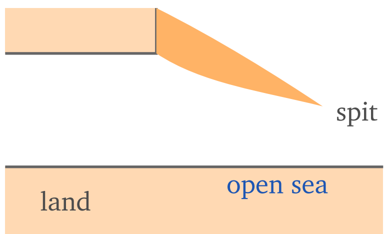
(A) Cirque

(B) Drumlin

(C) Esker

(D) Terminal moraine

Q45. The long, narrow ridge of sand or shingle shown in plan, built by long-shore drift and extending outward from the coast across the mouth of a bay with one end still joined to the land, is a: [2 marks]



(A) Tombolo

(B) Barrier island

(C) Spit

(D) Lagoon

Q46. In Goldschmidt's geochemical classification of the elements, those that have a strong affinity for metallic iron and are believed to be concentrated in the Earth's core (for example Ni, Co, Au and the platinum-group elements) are grouped as: **[2 marks]**

(A) Lithophile

(B) Chalcophile

(C) Siderophile

(D) Atmophile

Detailed Solutions

Q1.

Solution

Concept – kinds of crystal twinning: A twin is an intergrowth of two or more crystals of the same species related by a symmetry operation. Twins are simple (two individuals) or repeated (many individuals).

Step 1 – read the description: Many small twin lamellae are repeated across the crystal, giving fine parallel striations on the cleavage face.

Step 2 – match to the twin type: A large number of individuals twinned in the same way, stacked as thin lamellae, is repeated or polysynthetic (lamellar) twinning.

Step 3 – link to plagioclase: The albite twin law in plagioclase produces exactly this polysynthetic twinning, and the resulting striations are a standard way of telling plagioclase from alkali feldspar.

Why the other options are wrong:

- A, simple contact twin: only two individuals joined along one composition plane, not repeated.
- B, penetration twin: two individuals appearing to pass through one another.
- D, Carlsbad twin: a simple penetration twin of orthoclase, giving a single twin plane, not fine striations.

Final Answer: Polysynthetic (lamellar) twinning $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – classification of silicates by tetrahedral linkage: Silicate minerals are grouped by how their SiO_4 tetrahedra are joined: isolated, chains, sheets or frameworks.

Step 1 – read the linkage given: The tetrahedra in olivine are isolated (independent) and are held together only through the intervening Mg and Fe cations.

Step 2 – name the group with isolated tetrahedra: Silicates built of isolated SiO_4 tetrahedra are the nesosilicates (island silicates, from the Greek *nesos* = island).

Step 3 – confirm with the formula: The $2 : 1$ cation-to-silicon ratio in $(Mg,Fe)_2SiO_4$ is consistent with a discrete $(SiO_4)^{4-}$ unit balanced by two divalent cations.

Why the other options are wrong:

- A, inosilicates: tetrahedra linked into single or double chains (pyroxenes, amphiboles).
- B, phyllosilicates: tetrahedra linked into continuous sheets (micas, clays).
- C, tectosilicates: every oxygen shared to build a three-dimensional framework (quartz, feldspars).

Final Answer: Nesosilicates (island silicates) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – crystal systems from axial lengths and angles: The seven crystal systems are set apart by the relative lengths of the three (or four) crystallographic axes and the angles between them.

Step 1 – read the angle condition: All three axes are mutually perpendicular, $\alpha = \beta = \gamma = 90^\circ$.

Step 2 – read the length condition: The three axes are all of different lengths, $a \neq b \neq c$.

Step 3 – match to the system table: Three unequal axes meeting at right angles define the orthorhombic system.

Why the other options are wrong:

- B, tetragonal: two axes equal, one different ($a = b \neq c$), all at 90°.
- C, monoclinic: two of the inter-axial angles are 90° but one (β) is not.
- D, triclinic: no axes equal and no angle equal to 90°.

Final Answer: Orthorhombic system $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – chain silicates and the Si:O ratio: When each SiO_4 tetrahedron shares two of its four corner oxygens with neighbours, the tetrahedra link into an endless single chain.

Step 1 – work out the sharing: Two of the four oxygens are shared (counted half each) and two are unshared, giving effective oxygen $= 2(\frac{1}{2}) + 2 = 3$ per silicon.

Step 2 – state the ratio: The silicon-to-oxygen ratio is therefore $1 : 3$, matching the value given.

Step 3 – name the group: Single-chain inosilicates with $\mathrm{Si} : \mathrm{O} = 1 : 3$ are the pyroxene group (e.g. augite, diopside).

Why the other options are wrong:

- B, amphibole: a double-chain inosilicate with $\mathrm{Si} : \mathrm{O} = 4 : 11$ and essential (OH) groups.
- C, mica: a sheet silicate $(\mathrm{Si} : \mathrm{O} = 2 : 5)$.
- D, feldspar: a framework silicate in which all oxygens are shared.

Final Answer: Pyroxene group (single-chain) $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept – interference figures under conoscopic light: An interference figure reveals whether a mineral is uniaxial or biaxial from the shape and behaviour of its isogyres (dark brushes).

Step 1 – read the figure: A single dark cross whose arms stay together and do not break apart as the stage is turned.

Step 2 – interpret the fixed cross: In a uniaxial mineral the two isogyres form a cross that remains joined for a centred optic-axis figure and merely sweeps as the stage rotates.

Step 3 – contrast with biaxial: In a biaxial mineral the cross breaks up: the isogyres separate into two curved brushes on rotation.

Step 4 – conclude: Because the cross stays fixed and does not separate, the mineral is optically uniaxial.

Why the other options are wrong:

- A and B, biaxial positive/negative: the isogyres would split into two hyperbolic brushes.
- C, isotropic: gives no interference figure at all (stays dark).

Final Answer: Uniaxial mineral $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – diagnostic tests for carbonates: Carbonate minerals react with dilute acid, and calcite in particular has a distinctive threefold cleavage.

Step 1 – read the acid test: Brisk effervescence in cold dilute HCl signals a carbonate, because CO_2 gas is released.

Step 2 – read the cleavage: Three directions of cleavage, not at right angles, that yield rhombs are the perfect rhombohedral cleavage of calcite.

Step 3 – combine the clues: Brisk cold-acid reaction plus rhombohedral cleavage identifies the mineral as calcite ($CaCO_3$).

Why the other options are wrong:

- A, quartz: does not react with HCl and has no cleavage.
- B, gypsum: a sulphate; it does not effervesce.
- C, fluorite: has four octahedral cleavage directions and does not fizz in acid.

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

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – the IUGS QAPF classification: Plutonic rocks are classified on the QAPF double triangle, using the proportions of quartz (Q), alkali feldspar (A) and plagioclase (P).

Step 1 – read the mineralogy: The rock has abundant quartz (well over 20%) plus roughly equal alkali feldspar and plagioclase.

Step 2 – locate it on the diagram: High Q with sub-equal A and P plots in the central upper field of the QAPF triangle.

Step 3 – name that field: That field is granite (in the broad sense, granite–granodiorite).

Why the other options are wrong:

- B, gabbro: a quartz-poor mafic rock (calcic plagioclase + pyroxene), off the QAPF felsic fields.
- C, peridotite: an ultramafic rock of olivine and pyroxene, with essentially no feldspar or quartz.
- D, syenite: sits in the low-quartz, alkali-feldspar-rich field, not the high-quartz granite field.

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

Answer: (A) Go Back to Q7

Q8.

Solution

Concept – porphyritic texture records two cooling stages: The grain size of an igneous rock records its cooling history; a mixture of two very different grain sizes records two stages.

Step 1 – read the texture: Large crystals (phenocrysts) are set in a much finer groundmass.

Step 2 – interpret the two sizes: The large crystals grew slowly at depth; the fine groundmass froze quickly when the magma later rose and cooled fast.

Step 3 – name the texture: A rock with conspicuous phenocrysts in a finer matrix is porphyritic.

Why the other options are wrong:

- A, aphanitic: uniformly fine-grained, crystals not visible to the eye.
- C, glassy: no crystals at all, quenched to glass.
- D, equigranular: all crystals of roughly the same size.

Final Answer: Porphyritic texture $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – the intrusive equivalents of volcanic rocks: Each fine-grained volcanic rock has a coarse-grained plutonic equivalent of the same composition.

Step 1 – read the composition: Calcium-rich plagioclase together with pyroxene is a mafic (basic) mineralogy.

Step 2 – read the grain size: Coarse-grained (phaneritic) means the rock crystallised slowly at depth.

Step 3 – name the rock: A coarse-grained mafic plutonic rock of plagioclase and pyroxene is gabbro, the plutonic equivalent of basalt.

Why the other options are wrong:

- A, granite: a felsic (silica-rich) plutonic rock of quartz and feldspar.
- C, diorite: intermediate in composition, with sodic plagioclase and hornblende, less mafic than gabbro.
- D, syenite: an alkali-feldspar-rich rock poor in quartz and in mafic minerals.

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

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q9**

Q10.

Solution

Concept – foliation and grade in metamorphic rocks: As metamorphic grade rises, the foliation coarsens from slaty cleavage, through schistosity, to coarse gneissose banding.

Step 1 – read the fabric: Coarse compositional layering with light quartzo-feldspathic bands alternating with dark mafic bands.

Step 2 – link fabric to grade: This coarse banding (gneissosity) forms at high metamorphic grade, where minerals segregate into layers.

Step 3 – name the rock: A high-grade rock with such coarse light-and-dark banding is a gneiss.

Why the other options are wrong:

- A, slate: low grade, very fine, splits along slaty cleavage.
- B, phyllite: low–medium grade with a silky sheen, finer than schist.
- D, schist: medium grade, strongly foliated by aligned platy minerals but

without the coarse banding of gneiss.

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

Answer: (C) Go Back to Q10

Q11.

Solution

Concept – metamorphic facies on a P–T grid: Each metamorphic facies occupies a characteristic field of pressure and temperature.

Step 1 – read the requested field: High temperature combined with moderate-to-high pressure, in the deep crust.

Step 2 – link to a rock type: Under these conditions anhydrous, pyroxene-bearing rocks (granulites) crystallise.

Step 3 – name the facies: The corresponding facies is the granulite facies.

Why the other options are wrong:

- A, blueschist: high pressure but low temperature (subduction zones).
- C, zeolite: very low temperature and pressure, the lowest grade.
- D, greenschist: low-to-moderate temperature and pressure, well below granulite grade.

Final Answer: Granulite facies $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – contact (thermal) metamorphism: Heat from an intrusion alters the surrounding rock in a narrow aureole, usually without directed pressure, so the product is non-foliated.

Step 1 – read the process: Baking of country rock in a narrow zone around a hot intrusion, driven by heat alone.

Step 2 – read the product: A hard, fine-grained, non-foliated rock formed from a mudstone.

Step 3 – name the rock: The tough, non-foliated contact-metamorphic rock formed from pelitic country rock is hornfels.

Why the other options are wrong:

- A, mylonite: a fine-grained rock formed by intense shearing in a fault zone (dynamic metamorphism), not by baking.
- B, migmatite: a mixed rock showing partial melting at very high grade.
- D, marble: a contact/regional product of limestone, not of mudstone.

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

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – from sediment to sedimentary rock: Loose sediment becomes solid rock through the physical and chemical changes grouped under diagenesis.

Step 1 – read the changes: Compaction (grains squeezed together as pore water is expelled) and cementation (minerals precipitated in the pores).

Step 2 – name the overall process: The turning of loose sediment into solid rock by these changes is lithification (part of diagenesis).

Step 3 – confirm: After lithification the once-loose sand or mud becomes sandstone or shale.

Why the other options are wrong:

- A, metamorphism: changes existing rock at high temperature and pressure, not loose sediment into rock.
- B, weathering: breaks rock down at the surface.
- C, erosion: removes and transports weathered material.

Final Answer: Lithification (diagenesis) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – vertical grain-size trends and sedimentary environments: The way grain size changes up a sedimentary log records how the depositional environment shifted through time.

Step 1 – read the trend: The log coarsens upward, from mud at the base to clean sand at the top.

Step 2 – interpret coarsening-upward: Progressively coarser sediment upward means the energy increased and the shoreline moved seaward over the site (shallowing).

Step 3 – name the setting: A shoreline building out (seaward) over deeper deposits is a prograding, regressive shoreline (for example a delta or beach–shoreface).

Why the other options are wrong:

- A, transgression: would deepen upward and generally fine upward, the opposite trend.
- B, turbidite: a single event bed typically fines upward (graded).
- D, aeolian dune field: dominated by well-sorted cross-bedded sand, not a mud-to-sand marine trend.

Final Answer: Prograding (regressive) shoreline $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept – cements in sandstones: During diagenesis, minerals precipitate in the pore spaces of a sandstone and bind the grains into rock.

Step 1 – read the setting: Detrital quartz grains in a mature sandstone are bound by a cement precipitated during burial.

Step 2 – identify the common cement: The most widespread such cement is silica, deposited as quartz overgrowths that grow in optical continuity on the detrital grains.

Step 3 – conclude: Therefore the common binding cement is silica (quartz).

Why the other options are wrong:

- B, halite: an evaporite salt, only a local cement in arid settings.
- C, gypsum: also an evaporite mineral, not a common quartz-sandstone cement.
- D, organic matter: binds some sediments but is not the usual grain cement of a quartz sandstone.

Final Answer: Silica (quartz) cement $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept – ripple form records the flow that made it: The symmetry of a ripple tells whether the water moved back and forth or in one direction.

Step 1 – read the ripple shape: Sharp, symmetrical crests with equal slopes on both flanks.

Step 2 – interpret the symmetry: Equal, symmetrical flanks form under a to-and-fro (oscillatory) flow that moves sediment equally in both directions.

Step 3 – name the process: Such symmetrical (wave) ripples are produced by oscillatory wave action, as in shallow water stirred by waves.

Why the other options are wrong:

- B, unidirectional current: makes asymmetrical (current) ripples with a gentle upstream and steep downstream face.
- C, glacial ice: produces striations and till, not delicate ripple marks.
- D, wind only: makes asymmetrical wind ripples, again not symmetrical wave ripples.

Final Answer: Oscillatory wave action ⇒ $\boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept – the Deccan Traps in Indian stratigraphy: The Deccan Traps are one of the world's great volcanic provinces, forming a thick pile of successive lava flows.

Step 1 – read the description: A vast pile of basaltic lava flows erupted near the Cretaceous–Paleogene boundary and spread across western India.

Step 2 – classify the setting: Enormous outpourings of fluid basalt onto a continent, flow upon flow, are continental flood basalts (a large igneous province).

Step 3 – conclude: The Deccan Traps are therefore continental flood basalts.

Why the other options are wrong:

- A, marine turbidites: deep-sea sedimentary deposits, not lavas.
- C, glacial tillites: lithified glacial debris (as in the older Gondwana sequence), not basalt.
- D, aeolian sandstones: wind-blown sands, unrelated to volcanism.

Final Answer: Continental flood basalts $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept – types of unconformity: The type of an unconformity depends on the attitude and nature of the rocks below the erosion surface.

Step 1 – read what lies below: Older strata that have been tilted and then truncated (planed off) by erosion.

Step 2 – read what lies above: Younger, flat-lying beds deposited across the eroded, tilted strata.

Step 3 – match to the definition: An erosion surface separating tilted older beds below from flat-lying younger beds above is an angular unconformity.

Why the other options are wrong:

- A, nonconformity: sediment resting on eroded igneous or metamorphic (non-stratified) rock.
- B, disconformity: an erosion surface between two parallel sedimentary sequences.
- C, paraconformity: a subtle, near-parallel break with no visible erosion or angular discordance.

Final Answer: Angular unconformity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – anticlines versus synclines: Folds are told apart by the way the limbs dip and by the relative age of the beds in the core.

Step 1 – read the fold shape: The strata sag downward into a trough and both limbs dip inward toward the central hinge.

Step 2 – read the age pattern: The youngest beds lie in the core of the fold.

Step 3 – match to the fold type: Limbs dipping toward the hinge with the youngest beds in the core define a syncline.

Why the other options are wrong:

- A, anticline: arches upward, limbs dip away from the hinge, oldest beds in the core.
- B, monocline: a single step-like flexure with one limb.
- D, dome: a circular upwarp with beds dipping away in all directions.

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

Answer: (C) Go Back to Q19

Q20.

Solution

Concept – classifying dip-slip faults: Dip-slip faults are named from the movement of the hanging wall relative to the footwall and from the driving stress.

Step 1 – read the movement sense: The hanging wall has moved up relative to the footwall.

Step 2 – read the stress regime: The motion is driven by horizontal compression, which shortens and thickens the crust.

Step 3 – match to the fault type: Hanging wall up under compression, on a steeply dipping plane, defines a reverse fault.

Why the other options are wrong:

- A, normal fault: hanging wall moves down under extension.
- C, strike-slip fault: mainly horizontal movement parallel to strike.
- D, growth fault: a syn-sedimentary normal fault, still an extensional (hanging-wall-down) structure.

Final Answer: Reverse fault $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – the Wilson cycle: The Wilson cycle describes the life of an ocean basin, from the rifting of a continent, through ocean opening and widening, to closure and continental collision.

Step 1 – read the stage described: A continental rift has just widened enough for a narrow strip of new oceanic crust and a young sea to appear.

Step 2 – identify the modern example: The Red Sea is the classic present-day example of exactly this early opening stage.

Step 3 – name the stage: This is the young (opening or embryonic) ocean stage of the Wilson cycle.

Why the other options are wrong:

- B, terminal (closing) stage: the ocean is shrinking as subduction consumes it (e.g. the Mediterranean).
- C, suturing stage: two continents collide after the ocean has closed (e.g. the Himalaya).
- D, mature, stable ocean: a wide ocean with passive margins (e.g. the present Atlantic), well past the opening stage.

Final Answer: Young (opening) ocean stage $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept – the three types of plate boundary: Plate boundaries are divergent (plates move apart), convergent (plates move together) or transform (plates slide past).

Step 1 – read the motion: An oceanic plate bends down and descends beneath a continental plate.

Step 2 – read the associated features: The descent occurs along an inclined seismic (Benioff) zone and produces a deep trench and a volcanic arc.

Step 3 – match to the boundary type: One plate sinking beneath another, with a trench and arc, is a convergent boundary of the subduction type.

Why the other options are wrong:

- A, divergent: plates move apart and new crust is created, not consumed.
- B, transform: plates slide horizontally past each other with no subduction.
- C, passive margin: a tectonically quiet continent–ocean transition with no plate boundary at all.

Final Answer: Convergent (subduction) boundary $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept – throw and heave of a fault: For a fault of dip δ, the vertical component of the dip separation is the throw and the horizontal component is the heave, with heave $= \dfrac{\text{throw}}{\tan\delta}$.

Step 1 – list the data: Dip $\delta = 60^\circ$, throw $= 30$ m.

Step 2 – evaluate the tangent: $\tan 60^\circ = 1.732$

Step 3 – substitute into the formula: heave $= \dfrac{30}{1.732}$

Step 4 – evaluate: heave $= 17.3$ m

Step 5 – sanity check: Because the dip is steeper than 45°, the horizontal heave should be smaller than the vertical throw; 17.3 m < 30 m confirms this.

Final Answer: Heave ≈ 17.3 m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – distance from a constant spreading rate: Width equals rate multiplied by time, $d = v \times t$, using the full spreading rate for the total new crust across the ridge.

Step 1 – list the data: Full spreading rate $v = 6$ cm/year, time $t = 10 \times 10^6$ years.

Step 2 – multiply rate by time: $d = 6 \times (10 \times 10^6)$

Step 3 – evaluate in centimetres: $d = 60 \times 10^6 = 6 \times 10^7$ cm

Step 4 – convert to metres (1 m $= 100$ cm): $d = \dfrac{6 \times 10^7}{100} = 6 \times 10^5$ m

Step 5 – convert to kilometres (1 km $= 1000$ m): $d = \dfrac{6 \times 10^5}{1000} = 600$ km

Final Answer: $d = 600$ km $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – trace fossils and their study: Fossils are of two broad kinds: body fossils (actual remains) and trace fossils (records of behaviour).

Step 1 – read what is studied: Tracks, trails, burrows and borings – the signs of an organism's activity, not its body.

Step 2 – name the discipline: The study of such trace fossils is ichnology.

Step 3 – note its use: Trace fossils reveal how animals lived and moved and help interpret ancient sea-floor conditions.

Why the other options are wrong:

- A, palynology: the study of pollen, spores and other acid-resistant microfossils.
- C, micropalaeontology: the study of microscopic body fossils (foraminifera, ostracods, etc.).
- D, taphonomy: the study of how organisms decay and become fossilised.

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

Answer: (B) Go Back to Q25

Q26.

Solution

Concept – the eons of the geological time scale: Earth history is divided into four eons: Hadean, Archean, Proterozoic and Phanerozoic, from oldest to youngest.

Step 1 – read the requested interval: The earliest eon, from the planet's formation to about 4.0 Ga, before the oldest known rocks.

Step 2 – name that eon: The first eon is the Hadean, named for the hellish conditions of the very early Earth.

Step 3 – confirm: The Hadean has almost no rock record, consistent with predating the oldest preserved rocks.

Why the other options are wrong:

- A, Archean: follows the Hadean, roughly 4.0–2.5 Ga.
- B, Proterozoic: 2.5 Ga to about 541 Ma.
- C, Phanerozoic: the eon of abundant visible life, from about 541 Ma to today.

Final Answer: Hadean Eon $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept – the range of ammonites: Ammonoids (ammonites) are extinct coiled cephalopods and are among the best index fossils of the Mesozoic Era.

Step 1 – read the range chart: The shaded bar spans the Mesozoic box and ends at its top.

Step 2 – recall their extinction: Ammonites were wiped out in the end-Cretaceous (K–Pg) mass extinction, which closes the Mesozoic Era.

Step 3 – conclude: Therefore the ammonites became extinct at the close of the Mesozoic.

Why the other options are wrong:

- A, Paleozoic: ammonoids had appeared by the Devonian but survived well beyond the Paleozoic.
- C, Cenozoic: ammonites were already gone before the Cenozoic began.
- D, Precambrian: long before ammonites existed.

Final Answer: End of the Mesozoic Era $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – the end-Permian mass extinction: The greatest extinction in Earth history occurred at the very end of the Palaeozoic Era.

Step 1 – read the clues: About 90% of marine species and many land groups were destroyed – the "Great Dying".

Step 2 – identify the boundary: This event marks the boundary between the Permian (last period of the Palaeozoic) and the Triassic (first period of the Mesozoic).

Step 3 – conclude: The extinction took place at the Permian–Triassic boundary.

Why the other options are wrong:

- B, Cretaceous–Paleogene: the extinction that killed the dinosaurs, large but smaller than the end-Permian.
- C, Ordovician–Silurian: an earlier, less severe mass extinction.
- D, Devonian–Carboniferous: not the site of the largest extinction (the Late Devonian event lies within the Devonian).

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

Answer: (A) Go Back to Q28

Q29.

Solution

Concept – the principles of stratigraphy: Several guiding principles let geologists order and correlate strata; each rests on a different observation.

Step 1 – read the statement: Fossil organisms succeed one another through the rock record in a definite, recognisable order.

Step 2 – name the principle: This is the principle of faunal (and floral) succession, established by William Smith.

Step 3 – note its use: Because each interval of time has its own fossil assemblage, strata far apart can be correlated by their fossils.

Why the other options are wrong:

- B, original horizontality: states that sediments are laid down in nearly horizontal layers.
- C, cross-cutting relationships: a feature that cuts another is the younger of the two.
- D, uniformitarianism: present-day processes are the key to interpreting the past.

Final Answer: Faunal succession $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – the eras of the Phanerozoic Eon: The Phanerozoic is divided, from oldest to youngest, into the Palaeozoic, Mesozoic and Cenozoic eras.

Step 1 – read the clue: Mammals diversified and came to dominate the land after the dinosaurs died out – the "Age of Mammals".

Step 2 – place the event in time: The dinosaurs vanished at the end of the Mesozoic, so the rise of mammals belongs to the era that followed.

Step 3 – name the era: The era after the Mesozoic, in which mammals flourished, is the Cenozoic.

Why the other options are wrong:

- A, Palaeozoic: the era of early marine life and the first land plants and animals, long before mammals.
- B, Mesozoic: the "Age of Reptiles", dominated by dinosaurs.
- D, Proterozoic: an eon of the Precambrian, not a Phanerozoic era.

Final Answer: Cenozoic Era $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – the ore minerals of copper: Copper is mined mainly from sulphide minerals, of which one is by far the most important.

Step 1 – read the formula: $CuFeS_2$ is a copper–iron sulphide.

Step 2 – match the formula and colour: $CuFeS_2$ is chalcopyrite, brass-yellow with a greenish-black streak.

Step 3 – conclude: Chalcopyrite is the principal ore mineral of copper.

Why the other options are wrong:

- A, bornite: Cu_5FeS_4, a copper ore too, but with a purple "peacock" tarnish, not the described brass-yellow.
- C, malachite: a green copper carbonate, $Cu_2CO_3(OH)_2$, a secondary ore.
- D, galena: PbS, the ore of lead, not copper.

Final Answer: Chalcopyrite ($CuFeS_2$) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – the iron-oxide ore minerals: The two chief iron oxides are hematite and magnetite, distinguished by formula, streak and magnetism.

Step 1 – read the clues: Strongly magnetic, formula Fe_3O_4, black streak, highest iron content.

Step 2 – match the formula: Fe_3O_4 is magnetite (hematite is Fe_2O_3).

Step 3 – confirm with the magnetism: Only magnetite among common iron ores is strongly magnetic, and it carries the highest iron content, exactly as stated.

Why the other options are wrong:

- A, hematite: Fe_2O_3, weakly magnetic at most, with a red streak.
- B, limonite: hydrated iron oxide, yellow-brown streak.
- C, siderite: iron carbonate, $FeCO_3$, not an oxide.

Final Answer: Magnetite (Fe_3O_4) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept – confidence categories in resource estimation: Mineral inventories are classified by how well the tonnage and grade are known, from the best-established to the most speculative.

Step 1 – read the confidence level: Highest confidence, established from closely spaced drilling and sampling.

Step 2 – name the category: The highest-confidence, economically mineable category is the measured (proved) reserve.

Step 3 – order the rest: Confidence decreases through indicated/probable, then inferred, then merely speculative or hypothetical.

Why the other options are wrong:

- B, inferred resource: estimated from limited, widely spaced data with low confidence.

- C, speculative resource: undiscovered material inferred only on general geological grounds.
- D, hypothetical resource: expected in known districts but not yet demonstrated.

Final Answer: Measured (proved) reserve $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept – matching geophysical method to ore property: Each geophysical exploration method senses a particular physical property, so the method is chosen to match the ore.

Step 1 – identify the ore's key property: Magnetite is strongly magnetic, so a buried magnetite body produces a local magnetic anomaly, as shown in the profile.

Step 2 – select the matching method: The method that maps such magnetic contrasts is the magnetic survey (magnetometer).

Step 3 – conclude: A magnetic survey is the most direct way to locate concealed magnetite ore.

Why the other options are wrong:

- A, seismic refraction: maps layer velocities and depths, used mainly for structure, not magnetic ore.
- B, gravity survey: detects density contrasts; useful for dense ores generally but less specific than magnetics for magnetite.
- D, resistivity sounding: senses electrical resistivity, aimed at conductive bodies and groundwater, not the magnetism of magnetite.

Final Answer: Magnetic survey $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept – Mississippi Valley Type (MVT) deposits: Some ore deposits form from ordinary sedimentary-basin fluids rather than from magmas.

Step 1 – read the setting: Stratabound lead–zinc ores in carbonate rocks, formed at low temperature far from any igneous body.

Step 2 – identify the fluid: The ore metals are carried and deposited by dense, warm basinal brines that migrate through the carbonate host.

Step 3 – name the process: Precipitation from these low-temperature basinal brines is the MVT ore-forming process, a form of low-temperature hydrothermal deposition.

Why the other options are wrong:

- A, magmatic segregation: needs a cooling magma; MVT deposits form with no igneous source.
- C, contact metasomatism (skarn): forms at the contact of an intrusion with carbonate rock, again requiring magma.
- D, placer concentration: a surface, gravity-sorting process in rivers, unrelated to these brine-deposited sulphides.

Final Answer: Low-temperature basinal-brine hydrothermal deposition $\Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q35

Q36.

Solution

Concept – contained metal from tonnage and grade: The mass of metal in an ore body equals its tonnage multiplied by the average grade (as a fraction).

Step 1 – list the data: Ore tonnage $= 5{,}000{,}000$ t, grade $= 1.2\%$.

Step 2 – convert the grade to a fraction: $1.2\% = \dfrac{1.2}{100} = 0.012$

Step 3 – multiply tonnage by grade: Cu $= 5{,}000{,}000 \times 0.012$

Step 4 – evaluate: Cu $= 60{,}000$ tonnes

Step 5 – sanity check: 1.2% of five million is a little over one per cent of five million, and $60{,}000$ is 1.2% of $5{,}000{,}000$, which checks out.

Final Answer: $60{,}000$ tonnes of copper $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q36

Q37.

Solution

Concept – Darcy's law: For laminar groundwater flow, the discharge is $Q = K\,i\,A$, where K is hydraulic conductivity, i is the hydraulic gradient and A is the cross-sectional area.

Step 1 – list the data: $K = 25$ m/day, $i = 0.01$, $A = 200$ m^2.

Step 2 – multiply K by i: $K\,i = 25 \times 0.01 = 0.25$ m/day

Step 3 – multiply by the area: $Q = 0.25 \times 200$

Step 4 – evaluate: $Q = 50$ m^3/day

Step 5 – check the units: (m/day) $\times$ (m^2) $=$ m^3/day, a volume flow rate, as required.

Final Answer: $Q = 50$ m^3/day $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q37

Q38.

Solution

Concept – foundation requirements for a large dam: A concrete gravity dam transmits huge loads to its foundation and must not leak beneath it, so the ideal foundation is strong and watertight.

Step 1 – state the two needs: The foundation must (i) carry the load without failing and (ii) resist seepage of water underneath.

Step 2 – test each option against those needs: Massive, fresh, impermeable bedrock is both strong and watertight.

Step 3 – conclude: Therefore the most favourable foundation is massive, fresh, impermeable bedrock.

Why the other options are wrong:

- A, highly jointed permeable rock: leaks and is mechanically weak along the joints.
- B, soluble karstic limestone: cavities cause leakage and the risk of collapse.
- C, thick loose alluvium: compressible and permeable, poor for a heavy dam.

Final Answer: Massive, fresh, impermeable bedrock $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – water inflow in tunnelling: Groundwater enters a tunnel where the rock it crosses is permeable and water-bearing.

Step 1 – identify where water is stored and moves: Fault and shear zones are crushed and fractured, so they hold and transmit large volumes of groundwater.

Step 2 – relate to the tunnel: When the excavation cuts such a zone, the stored water can flood in suddenly.

Step 3 – conclude: Heavy inflow is most likely where the tunnel crosses a water-bearing fault or shear zone.

Why the other options are wrong:

- A, massive unfractured granite: nearly impermeable, so little water.
- C, dry impermeable shale: holds little transmissible water.
- D, compact unfractured basalt: low permeability, minimal inflow.

Final Answer: Water-bearing fault or shear zone $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – Rock Quality Designation (RQD): RQD rates the soundness of a rock mass as the percentage of a core run made up of intact pieces longer than 10 cm.

Step 1 – write the definition: $\text{RQD} = \dfrac{\sum(\text{lengths of intact pieces} > 10 \text{ cm})}{\text{total length of core run}} \times 100\%$

Step 2 – list the data: Summed sound pieces $= 1.4$ m, total run $= 2.0$ m.

Step 3 – form the ratio: $\dfrac{1.4}{2.0} = 0.70$

Step 4 – convert to a percentage: $\text{RQD} = 0.70 \times 100\% = 70\%$

Step 5 – interpret: An RQD of 70% falls in the "fair to good" rock-quality class.

Final Answer: $\text{RQD} = 70\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept – Darcy velocity of seepage: The Darcy (specific-discharge) velocity of seepage is $v = K\,i$, the product of hydraulic conductivity and hydraulic gradient.

Step 1 – list the data: $K = 4$ m/day, $i = 0.25$.

Step 2 – multiply conductivity by gradient: $v = 4 \times 0.25$

Step 3 – evaluate: $v = 1$ m/day

Step 4 – check the units: K has units of velocity (m/day) and i is dimensionless, so v is a velocity in m/day, as required.

Final Answer: $v = 1$ m/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept – elemental abundance in the crust: The Earth's crust is built mostly of silicate minerals, so oxygen and silicon dominate its composition by weight.

Step 1 – recall the abundance order by weight: Oxygen $\approx 46\%$, silicon $\approx 28\%$, aluminium $\approx 8\%$, iron $\approx 5\%$, calcium $\approx 4\%$.

Step 2 – identify the second most abundant: After oxygen, the next most abundant element is silicon at about 28%.

Step 3 – reason why: Silicon is the small central cation of the silica tetrahedron that forms the framework of almost all rock-forming minerals.

Why the other options are wrong:

- A, aluminium: third at about 8%.
- C, iron: about 5%.
- D, calcium: about 4%.

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

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – chemical weathering reactions: Chemical weathering alters minerals through distinct reactions such as hydrolysis, oxidation and carbonation.

Step 1 – read the reaction: Iron-bearing minerals combine with atmospheric oxygen to form reddish-brown ferric oxides and hydroxides.

Step 2 – identify the reaction type: A reaction of a mineral with oxygen, converting ferrous iron to ferric iron, is oxidation.

Step 3 – conclude: The reddening ("rusting") of iron-rich rocks is therefore weathering by oxidation.

Why the other options are wrong:

- A, hydrolysis: reaction of silicates with water to form clays, not the oxygen reaction described.
- C, carbonation: dissolution of carbonates by carbonic acid.
- D, hydration: the taking up of water into a mineral's structure (e.g. anhydrite to gypsum), without the oxygen reaction.

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

Answer: (B) Go Back to Q43

Q44.

Solution

Concept – erosional landforms of glaciated mountains: Alpine glaciers carve a distinctive set of erosional landforms in the mountains they occupy.

Step 1 – read the shape: A steep-sided, amphitheatre-shaped hollow at the head of a glacial valley.

Step 2 – read the extra clue: It often holds a small lake (tarn) after the ice melts.

Step 3 – name the landform: This bowl-shaped, ice-carved hollow at a valley head is a cirque (corrie).

Why the other options are wrong:

- B, drumlin: a smooth, elongated hill of glacial till (a depositional, not erosional, form).
- C, esker: a winding ridge of sand and gravel deposited by a meltwater stream under the ice.

- D, terminal moraine: a ridge of debris dumped at the snout of a glacier.

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

Answer: (A) Go Back to Q44

Q45.

Solution

Concept – depositional landforms of coasts: Longshore drift moves sediment along a shore and builds a family of depositional coastal landforms.

Step 1 – read the shape: A long, narrow ridge of sand or shingle, one end joined to the land and the other projecting out across a bay.

Step 2 – read the process: It is built by longshore drift carrying sediment along the coast.

Step 3 – name the landform: A ridge attached to the shore at one end and free at the other is a spit.

Why the other options are wrong:

- A, tombolo: a bar that joins an island to the mainland (attached at both ends).
- B, barrier island: a long offshore island separated from the coast by a lagoon, not attached to the land.
- D, lagoon: the sheltered body of water behind such a bar, not the sand ridge itself.

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

Answer: (C) Go Back to Q45

Q46.

Solution

Concept – Goldschmidt's geochemical classification: Goldschmidt grouped the elements by the phases they prefer: lithophile (silicate/oxide), siderophile (metallic iron), chalcophile (sulphide) and atmophile (gaseous).

Step 1 – read the affinity described: Strong affinity for metallic iron, concentrating with native iron in the Earth's core.

Step 2 – match to the group: Iron-loving, metal-phase elements are the siderophile elements.

Step 3 – confirm with the examples: Ni, Co, Au and the platinum-group elements alloy readily with iron and are depleted in the crust, consistent with siderophile behaviour.

Why the other options are wrong:

- A, lithophile: bond with oxygen and concentrate in silicates (e.g. Si, Al, Ca).
- B, chalcophile: bond with sulphur and form sulphides (e.g. Cu, Zn, Pb).
- D, atmophile: occur as gases in the atmosphere (e.g. N, noble gases).

Final Answer: Siderophile elements $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q46

Answer Key

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