GATE Geology and Geophysics – Geology

Sample Paper – 5

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. Pyrite (FeS_2), popularly called "fool's gold", shows a brassy metallic-yellow colour on a fresh surface. When it is drawn across an unglazed porcelain plate, the colour of the powder (streak) it leaves is: **[1 mark]**

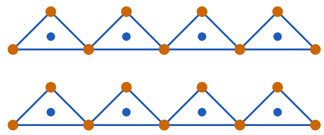
(A) Golden yellow

(B) Greenish-black

(C) White

(D) Reddish-brown

Q2. In the silicate structure sketched below, the SiO_4 tetrahedra share three of their four corner oxygens with neighbours to build continuous two-dimensional sheets, giving a Si:O ratio of $2 : 5$. Minerals with this structure (for example the micas) belong to which structural class? **[1 mark]**



sheet of linked tetrahedra

(A) Nesosilicate (isolated tetrahedra)

(B) Inosilicate (single chains)

(C) Tectosilicate (framework)

(D) Phyllosilicate (sheets)

Q3. All crystalline substances, when grouped by the complete set of symmetry operations that leave the crystal invariant, fall into a fixed number of crystal classes (point groups). That number is: **[1 mark]**

(A) 7

(B) 32

(C) 14

(D) 230

Q4. A very soft mineral that can be scratched even by a fingernail (hardness about 1 on the Mohs scale), feels distinctly soapy or greasy to the touch, and is ground up for use in talcum powder, is: **[1 mark]**

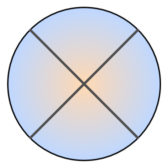
(A) Gypsum

(B) Calcite

(C) Fluorite

(D) Talc

Q5. When an anisotropic mineral grain is viewed between crossed polarisers, the bright interference colours it displays are produced by the difference between its greatest and least refractive indices. The optical property responsible for these colours is: **[1 mark]**



interference colours in cross of isogyres

(A) Pleochroism

(B) Relief

(C) Extinction angle

(D) Birefringence

Q6. Among the following minerals, the one that is strongly ferromagnetic, so that a fragment of it will visibly deflect a magnetic compass needle, is: **[1 mark]**

(A) Hematite

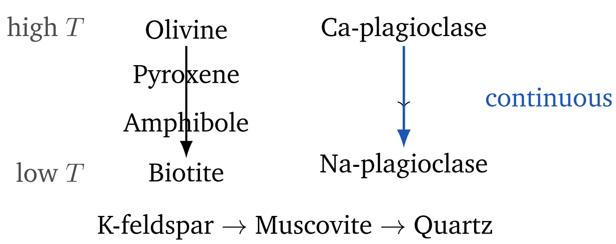
(B) Pyrite

(C) Magnetite

(D) Quartz

Igneous and Metamorphic Petrology

Q7. In Bowen's reaction series, shown below, the continuous branch is a single solid-solution series that changes composition steadily from calcium-rich at high temperature to sodium-rich at low temperature. This branch is made up of which mineral group? **[1 mark]**



(A) Plagioclase feldspars

(B) Pyroxenes

(C) Micas

(D) Olivines

Q8. A volcanic rock such as obsidian cools so rapidly from the melt that essentially no crystals have time to nucleate, so the solidified rock is a natural glass. The texture of such a rock is described as: **[1 mark]**

(A) Phaneritic

(B) Porphyritic

(C) Pegmatitic

(D) Glassy (hyaline)

Q9. Where a hot igneous intrusion bakes an adjoining shale, the heat (with little directed pressure) produces a hard, fine-grained, non-foliated metamorphic rock in the narrow contact aureole. This rock is: **[1 mark]**

(A) Schist

(B) Gneiss

(C) Hornfels

(D) Migmatite

Q10. Metamorphism driven almost entirely by the heat of a nearby magma body, acting on a narrow zone of country rock without any regional directed stress, is termed: **[1 mark]**

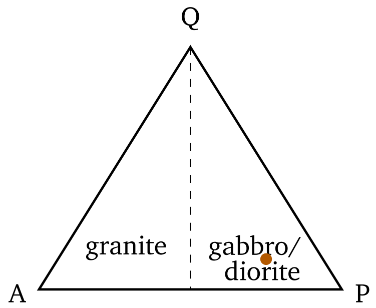
(A) Regional metamorphism

(B) Contact metamorphism

(C) Dynamic (cataclastic) metamorphism

(D) Burial metamorphism

Q11. On the QAPF classification triangle sketched below, a coarse-grained (phaneritic) plutonic rock composed chiefly of calcic plagioclase and pyroxene, plotting in the plagioclase-rich, quartz-poor field, is the intrusive equivalent of basalt. This rock is: **[1 mark]**



(A) Granite

(B) Rhyolite

(C) Diorite

(D) Gabbro

Q12. According to the weathering-stability order derived from Bowen's reaction series (Goldich's stability series), the common rock-forming silicate that is the last to crystallise and is by far the most resistant to chemical weathering at the Earth's surface is: **[1 mark]**

(A) Quartz

(B) Olivine

(C) Calcium-plagioclase

(D) Pyroxene

Sedimentology and Stratigraphy

Q13. A sedimentary rock composed dominantly of calcium carbonate ($CaCO_3$), which fizzes (effervesces) briskly when a drop of dilute hydrochloric acid is placed on it and commonly contains abundant marine shell fossils, is: **[1 mark]**

(A) Chert

(B) Limestone

(C) Rock salt

(D) Dolostone

Q14. The principle stating that sedimentary layers are deposited as originally nearly horizontal sheets, so that any strata now found steeply tilted must have been deformed after they were laid down, is the principle of: **[1 mark]**

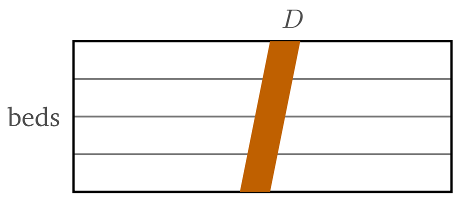
(A) Original horizontality

(B) Superposition

(C) Cross-cutting relationships

(D) Faunal succession

Q15. In the cross-section below, an igneous dyke D cuts sharply across a series of previously deposited sedimentary beds. The dyke must therefore be younger than the beds it intersects. The stratigraphic principle used to reach this conclusion is: **[1 mark]**



(A) Inclusions

(B) Cross-cutting relationships

(C) Superposition

(D) Uniformitarianism

Q16. A single sedimentary bed in which the grain size decreases progressively from coarse at the base to fine at the top, a structure typical of deposition from a waning turbidity current, is said to display: **[1 mark]**

(A) Graded bedding

(B) Ripple marks

(C) Mud cracks

(D) Cross-bedding

Q17. The observation that fossil organisms follow one another through the rock record in a definite, repeatable and recognisable order, which allows widely separated strata to be correlated by their fossil content, is stated by the law of: **[1 mark]**

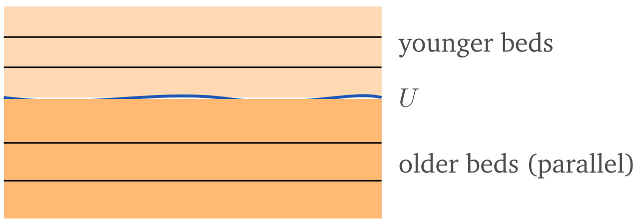
(A) Faunal succession

(B) Superposition

(C) Lateral continuity

(D) Inclusions

Q18. The buried erosion surface U in the column below separates parallel sedimentary strata above from parallel sedimentary strata below, yet it represents a long interval of erosion or non-deposition. This type of unconformity is a: **[1 mark]**



(A) Angular unconformity

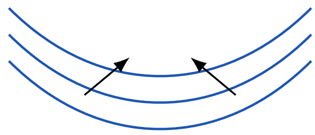
(B) Nonconformity

(C) Disconformity

(D) Paraconformity

Structural Geology and Geotectonics

Q19. In the fold profile drawn below, the strata are bent downward into a trough, the two limbs dip inward toward the hinge, and the youngest beds occupy the core. This structure is a: **[1 mark]**



hinge (trough)

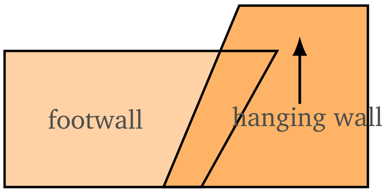
(A) Anticline

(B) Monocline

(C) Dome

(D) Syncline

Q20. In the fault block below, the hanging wall has moved up relative to the footwall along a fault plane of moderate dip, in response to horizontal compression that shortens the crust. This fault is a: **[1 mark]**



(A) Normal fault

(B) Reverse fault

(C) Strike-slip fault

(D) Graben

Q21. For any inclined planar bed, the strike line is drawn as the horizontal line of intersection of the bedding plane with a horizontal surface, and the true-dip direction is the line of steepest descent on the bed. The angle between the strike direction and the true-dip direction, measured in the horizontal plane, is always: **[2 marks]**

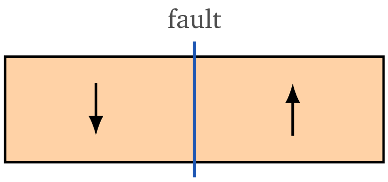
(A) 0°

(B) 45°

(C) 90°

(D) 180°

Q22. At the plate boundary shown, the two plates slide horizontally past one another and lithosphere is neither created nor destroyed; the San Andreas Fault of California is the classic example. This is a: [2 marks]



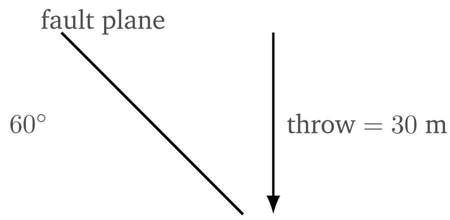
(A) Divergent boundary

(B) Transform boundary

(C) Convergent boundary

(D) Subduction zone

Q23. A normal fault dips at 60° and has a vertical throw of 30 m, as sketched. The net dip-slip along the fault plane is related to the throw by dip-slip $=$ throw/ $\sin$(dip). Its value is closest to: [2 marks]



(A) 34.6 m

(B) 26.0 m

(C) 30.0 m

(D) 60.0 m

Q24. Marine magnetic surveys reveal a pattern of alternating normal and reversed magnetic-anomaly stripes running parallel to, and symmetric about, a mid-ocean ridge axis. The accepted explanation for these matching stripes is: [2 marks]

(A) Sea-floor spreading recording periodic reversals of the geomagnetic field

(B) Deposition of banded iron ore in symmetric layers

(C) Two separate episodes of continental glaciation

(D) Repeated meteorite impacts along the ridge

Palaeontology and Historical Geology

Q25. A radioactive parent isotope used in geochronology has a half-life of 1.3 billion years. After exactly three half-lives have elapsed, the fraction of the original parent atoms still remaining (undecayed) is: **[2 marks]**

(A) $\frac{1}{2}$

(B) $\frac{1}{4}$

(C) $\frac{1}{8}$

(D) $\frac{1}{16}$

Q26. The eons of the geological time scale, arranged in correct order from the oldest to the youngest, are: **[2 marks]**

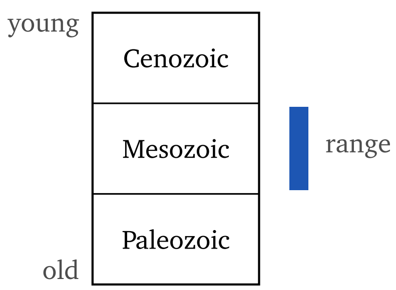
(A) Archean $\rightarrow$ Hadean $\rightarrow$ Proterozoic $\rightarrow$ Phanerozoic

(B) Hadean $\rightarrow$ Archean $\rightarrow$ Proterozoic $\rightarrow$ Phanerozoic

(C) Proterozoic $\rightarrow$ Archean $\rightarrow$ Hadean $\rightarrow$ Phanerozoic

(D) Hadean $\rightarrow$ Proterozoic $\rightarrow$ Archean $\rightarrow$ Phanerozoic

Q27. The stratigraphic range chart below shows a marine group whose total span is confined to the Mesozoic Era, making it the classic index fossil for correlating Mesozoic strata; it became extinct at the end of the Cretaceous. This coiled-shelled cephalopod group is: **[2 marks]**



(A) Ammonites

(B) Trilobites

(C) Graptolites

(D) Nummulites

Q28. The most severe mass extinction in Earth's history, which wiped out roughly 90% of all marine species and marks the close of the Palaeozoic Era, occurred 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. Radiocarbon (^{14}C) dating, based on an isotope with a half-life of about 5730 years, becomes unreliable once almost all the parent has decayed. Its practical upper limit for dating organic material is therefore of the order of: **[2 marks]**

(A) 5000 years

(B) 1 million years

(C) 4.5 billion years

(D) $50{,}000$ years

Q30. The most abundant and widespread record of life in Precambrian rocks is provided by finely laminated, dome- and column-shaped structures built by mats of photosynthesising cyanobacteria that trapped and bound sediment. These structures are: **[2 marks]**

(A) Trilobites

(B) Stromatolites

(C) Foraminifera

(D) Belemnites

Economic Geology and Mineral Resources

Q31. The progressive burial transformation of accumulated plant debris into coal, passing from peat through lignite and bituminous coal to anthracite with a steady increase in fixed-carbon content, is the process known as: **[2 marks]**

(A) Diagenesis of carbonate mud

(B) Katagenesis of crude oil

(C) Coalification

(D) Silicification of wood

Q32. In petroleum geology, the fine-grained, organic-rich rock in which hydrocarbons are actually generated from buried kerogen under rising temperature is called the: **[2 marks]**

(A) Reservoir rock

(B) Cap rock

(C) Source rock

(D) Basement rock

Q33. As a source rock is buried and heated, kerogen is converted mainly to liquid petroleum over a restricted temperature interval known as the "oil window". This interval lies approximately at: **[2 marks]**

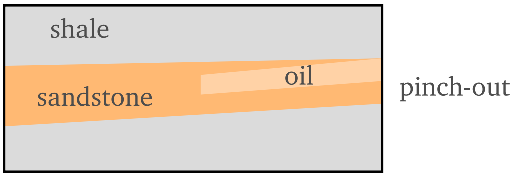
(A) 0–20 °C

(B) 200–300 °C

(C) 400–500 °C

(D) 60–120 °C

Q34. In the cross-section below, hydrocarbons are held not by folding or faulting but because the porous reservoir sandstone pinches out laterally into impermeable shale (a facies change). This kind of hydrocarbon trap is a: **[2 marks]**



(A) Anticlinal (structural) trap

(B) Fault trap

(C) Stratigraphic trap

(D) Salt-dome trap

Q35. In the proximate analysis of a coal sample, after the moisture, the volatile matter and the ash have each been measured and subtracted, the combustible solid residue that remains is reported as the: **[2 marks]**

(A) Total sulphur

(B) Fixed carbon

(C) Gross calorific value

(D) Ash-fusion temperature

Q36. Ore deposits formed when hot, aqueous, metal-bearing solutions rise along fractures and faults and precipitate ore minerals such as galena and sphalerite as fissure fillings, are classified as: **[2 marks]**

(A) Placer deposits

(B) Hydrothermal vein deposits

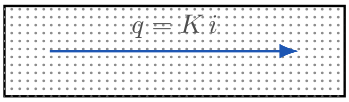
(C) Evaporite deposits

(D) Residual laterite deposits

Hydrogeology and Engineering Geology

Q37. Groundwater moves through the aquifer sketched below with a hydraulic conductivity $K = 15$ m/day under a hydraulic gradient $i = 0.01$. By

Darcy's law the Darcy velocity (specific discharge) is $q = K\,i$. Its value is: **[2 marks]**



$K = 15$ m/day, $i = 0.01$

(A) 0.15 m/day

(B) 1.5 m/day

(C) 15 m/day

(D) 150 m/day

Q38. The upper boundary of the zone of saturation, the surface below which all interconnected pore spaces in the ground are completely filled with water, is called the: **[2 marks]**

(A) Piezometric (potentiometric) surface

(B) Capillary fringe

(C) Water table

(D) Aquiclude

Q39. In the limit-equilibrium analysis of a slope, the factor of safety is defined as the ratio of the total resisting (shear-strength) forces to the total driving (shear) forces along the failure surface. For the slope to be regarded as stable, this factor of safety must be: **[2 marks]**

(A) Equal to 0

(B) Less than 1

(C) Exactly 1

(D) Greater than 1

Q40. In rock-mass characterisation for engineering projects, the Rock Quality Designation (RQD) obtained from a drill core is defined as the percentage given by: **[2 marks]**

(A) Total recovered core length divided by total core-run length, regardless of piece size

(B) Pore volume divided by bulk volume of the core

(C) Cumulative length of intact core pieces ≥ 10 cm divided by total core-run length

(D) Number of fractures counted per metre of core

Q41. A dry, cohesionless (clean sand) slope stands stable only up to its angle of repose, which for such a material equals its angle of internal friction ϕ. If $\phi = 34^\circ$, the steepest stable slope angle the dry sand can maintain is: **[2 marks]**

(A) 34°

(B) 17°

(C) 56°

(D) 68°

Geochemistry, Geomorphology and Remote Sensing

Q42. Isotopes of a given chemical element all share the same atomic number and hence the same chemical behaviour, but they differ from one another in the number of: **[2 marks]**

(A) Electrons

(B) Neutrons

(C) Protons

(D) Valence electrons

Q43. In the uranium–lead radiometric dating system, the parent isotope uranium-238 decays through a long series of intermediate steps to finally yield the stable daughter isotope: **[2 marks]**

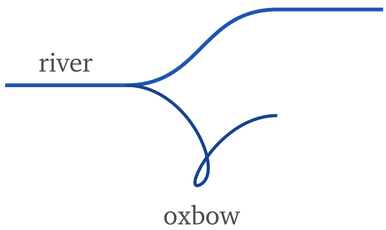
(A) Lead-206

(B) Lead-208

(C) Argon-40

(D) Strontium-87

Q44. The crescent-shaped standing body of water shown below forms where a river cuts through the narrow neck of a tight meander loop and later seals off the abandoned bend from the active channel. This landform is called an: **[2 marks]**



(A) Alluvial fan

(B) Yardang

(C) Esker

(D) Oxbow lake

Q45. A remote-sensing system that generates and transmits its own energy (for example microwave pulses), then records the return signal, so that it can image the surface both at night and through cloud cover, is described as a(n): **[2 marks]**

(A) Passive optical sensor

(B) Thermal-infrared sensor

(C) Multispectral passive scanner

(D) Active sensor (e.g. RADAR)

Q46. The radiogenic isotope pair most widely used to date old igneous and metamorphic rocks by the whole-rock isochron method, based on the very slow beta decay of a rubidium isotope to a strontium isotope, is: **[2 marks]**

(A) Potassium-40 to argon-40

(B) Carbon-14 to nitrogen-14

(C) Rubidium-87 to strontium-87

(D) Uranium-238 to lead-206

Detailed Solutions

Q1.

Solution

Concept – colour versus streak: The colour of a mineral in the hand specimen can be misleading, but its streak (the colour of its finely powdered form on a porcelain plate) is a far more reliable diagnostic property.

Step 1 – recall the property tested: Streak removes the effects of surface tarnish and shows the true colour of the powder.

Step 2 – apply it to pyrite: Although pyrite looks brassy-gold, its powder is dark.

Step 3 – state the streak: Pyrite gives a greenish-black (to brownish-black) streak.

Why the other options are wrong:

- A, golden yellow: is the surface colour, not the streak; this contrast is exactly why pyrite fools people.
- C, white: is typical of light silicates such as quartz or feldspar, not a metallic sulphide.
- D, reddish-brown: is the streak of hematite, not pyrite.

Final Answer: Greenish-black streak $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – classification of silicates by tetrahedral linkage: Silicate minerals are grouped by how the SiO_4 tetrahedra are polymerised: isolated, in chains, in sheets or in a full framework.

Step 1 – read the linkage described: Each tetrahedron shares three corner oxygens, producing continuous two-dimensional sheets.

Step 2 – check the Si:O ratio: Sharing three of four oxygens gives the characteristic sheet ratio Si:O $= 2 : 5$.

Step 3 – name the class: Sheet silicates are the phyllosilicates, which include the micas, chlorite and clay minerals.

Why the other options are wrong:

- A, nesosilicate: has isolated tetrahedra (Si:O $= 1 : 4$), e.g. olivine.

- B, inosilicate: has single (or double) chains, e.g. pyroxene ($1:3$).
- C, tectosilicate: has a fully polymerised framework ($1:2$), e.g. quartz and feldspar.

Final Answer: Phyllosilicate (sheet silicate) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – the crystal classes (point groups): When crystals are classified by their external symmetry, every possible combination of symmetry elements reduces to a fixed number of point groups.

Step 1 – distinguish the hierarchy: There are 7 crystal systems, 14 Bravais lattices, 32 crystal classes and 230 space groups.

Step 2 – pick the level asked for: The question asks for crystal classes based on point-group symmetry.

Step 3 – state the number: There are exactly 32 crystal classes.

Why the other options are wrong:

- A, 7: is the number of crystal systems.
- C, 14: is the number of Bravais lattices.
- D, 230: is the number of space groups (point groups combined with translational symmetry).

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

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – diagnostic physical properties: Very low hardness combined with a distinctive soapy feel points to a specific soft mineral.

Step 1 – use the hardness clue: A mineral scratched by a fingernail has a hardness of about 1 to 2.

Step 2 – use the feel clue: A greasy or soapy touch is characteristic of talc.

Step 3 – confirm with the use: Talc, the softest mineral (Mohs 1), is ground to make talcum powder.

Why the other options are wrong:

- A, gypsum: is Mohs 2 but does not feel soapy.
- B, calcite: is Mohs 3 and effervesces with acid.
- C, fluorite: is Mohs 4, too hard to be scratched by a fingernail.

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

Answer: (D) Go Back to Q4

Q5.

Solution

Concept – optical anisotropy and interference colours: Anisotropic minerals split incident light into two rays that travel at different speeds, so they have more than one refractive index.

Step 1 – identify what produces the colours: The interference colours seen between crossed polars arise from the path difference between the fast and slow rays.

Step 2 – define the property: The numerical difference between the maximum and minimum refractive indices is the birefringence.

Step 3 – link cause and effect: The larger the birefringence, the higher the order of interference colours shown by the grain.

Why the other options are wrong:

- A, pleochroism: is the colour change in plane-polarised light, not the crossed-polar interference colour.
- B, relief: is the apparent standing-out of a grain due to its refractive-index contrast with the mounting medium.
- C, extinction angle: is the angle between a cleavage/edge and the extinction position, not the source of the colours.

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

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – magnetism as a diagnostic property: Only a few minerals are magnetic enough to move a compass needle without any special apparatus.

Step 1 – recall the strongly magnetic mineral: Magnetite (Fe_3O_4) is naturally, strongly (ferri)magnetic.

Step 2 – test the property: A small piece of magnetite will visibly deflect a compass needle; lodestone is a naturally magnetised variety.

Step 3 – select the answer: Of the four minerals, only magnetite shows this strong magnetism.

Why the other options are wrong:

- A, hematite: is only very weakly magnetic (antiferromagnetic) and does not deflect a compass.
- B, pyrite: is essentially non-magnetic.
- D, quartz: is diamagnetic and shows no compass deflection.

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

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – the two branches of Bowen's reaction series: Bowen's series has a discontinuous (ferromagnesian) branch and a continuous (feldspar) branch that crystallise together as the magma cools.

Step 1 – identify the continuous branch: The continuous branch is a single solid-solution series of plagioclase feldspar.

Step 2 – describe its variation: It changes smoothly from calcium-rich (anorthite) at high temperature to sodium-rich (albite) at lower temperature.

Step 3 – contrast with the other branch: The discontinuous branch changes by abrupt jumps: olivine $\rightarrow$ pyroxene $\rightarrow$ amphibole $\rightarrow$ biotite.

Why the other options are wrong:

- B, pyroxenes: belong to the discontinuous branch.
- C, micas: biotite is on the discontinuous branch; muscovite crystallises still later.

- D, olivines: sit at the top of the discontinuous branch, not the continuous one.

Final Answer: Plagioclase feldspars $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept – texture records cooling rate: The faster a melt cools, the smaller the crystals; extreme quenching prevents crystals from forming at all.

Step 1 – interpret "no crystals": If the melt solidifies before any ordered crystal lattice can grow, the result is an amorphous solid.

Step 2 – name the texture: A rock that is essentially natural glass has a glassy (hyaline) texture.

Step 3 – confirm with the example: Obsidian is the classic glassy volcanic rock, formed by very rapid quenching of felsic lava.

Why the other options are wrong:

- A, phaneritic: coarse crystals from slow, deep cooling.
- B, porphyritic: large crystals in a finer groundmass (two cooling stages), still crystalline.
- C, pegmatitic: exceptionally coarse crystals from volatile-rich residual melt.

Final Answer: Glassy (hyaline) texture $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept – contact-metamorphic products: Heating of country rock next to an intrusion, without strong directed stress, produces non-foliated metamorphic rocks.

Step 1 – read the setting: Shale baked in a narrow aureole by intrusion heat, little directed pressure.

Step 2 – deduce the fabric: Without differential stress there is no preferred mineral alignment, so the rock is non-foliated.

Step 3 – name the rock: A hard, fine-grained, non-foliated contact rock formed from shale is hornfels.

Why the other options are wrong:

- A, schist: is foliated and forms by regional (directed-stress) metamorphism.
- B, gneiss: is a high-grade, banded, foliated regional rock.
- D, migmatite: is a mixed rock showing partial melting at very high grade.

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

Answer: (C) Go Back to Q9

Q10.

Solution

Concept – types of metamorphism: Metamorphism is classified by the dominant agent and the setting in which it acts.

Step 1 – read the agent: The change is driven almost entirely by heat from a magma body.

Step 2 – read the setting: It affects only a narrow zone of country rock, with no regional directed stress.

Step 3 – name the type: Heat-dominated metamorphism confined to an aureole around an intrusion is contact (thermal) metamorphism.

Why the other options are wrong:

- A, regional: affects large areas under combined heat and directed pressure.
- C, dynamic (cataclastic): is driven by shear along fault zones.
- D, burial: results from deep burial of sediments under lithostatic load, over broad areas.

Final Answer: Contact metamorphism $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept – plutonic rocks on the QAPF diagram: Coarse-grained igneous rocks are named from their modal quartz (Q), alkali feldspar (A) and plagioclase (P) proportions.

Step 1 – read the mineralogy: The rock is rich in calcic plagioclase and pyroxene and poor in quartz, plotting toward the P corner.

Step 2 – use the "intrusive equivalent" clue: The coarse-grained (plutonic) equivalent of basalt is required.

Step 3 – name the rock: A plagioclase-plus-pyroxene plutonic rock, the intrusive equivalent of basalt, is gabbro.

Why the other options are wrong:

- A, granite: is quartz- and alkali-feldspar-rich (felsic), plotting near the Q–A side.
- B, rhyolite: is the fine-grained (volcanic) equivalent of granite, not a mafic plutonic rock.
- C, diorite: is intermediate, dominated by sodic plagioclase and hornblende, with less pyroxene.

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

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – Goldich weathering-stability series: Minerals that crystallise last from a magma (at low temperature) are the most stable at the low temperatures of the Earth's surface, so they resist chemical weathering best.

Step 1 – invert Bowen's series: The order of crystallisation is essentially the reverse of the order of weathering resistance.

Step 2 – find the last-formed mineral: Quartz is the last common silicate to crystallise, at the bottom of Bowen's series.

Step 3 – conclude: Therefore quartz is the most resistant to chemical weathering, which is why it dominates mature sands.

Why the other options are wrong:

- B, olivine: crystallises first (highest T) and is the least stable, weathering very readily.
- C, calcium-plagioclase: is high on the continuous branch and weathers relatively easily.
- D, pyroxene: forms early and is far less resistant than quartz.

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

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – identifying carbonate rocks: Carbonate rocks are recognised in the field by their reaction with dilute acid.

Step 1 – read the acid test: Brisk effervescence with cold dilute HCl indicates calcium carbonate.

Step 2 – read the fossil clue: Abundant marine shell fossils are typical of a shallow-marine carbonate.

Step 3 – name the rock: A $CaCO_3$ rock that fizzes readily and is fossil-rich is limestone.

Why the other options are wrong:

- A, chert: is microcrystalline silica (SiO_2) and does not react with acid.
- C, rock salt: is halite (NaCl), an evaporite, and is salty, not effervescent.
- D, dolostone: is calcium–magnesium carbonate; it reacts only weakly with cold dilute acid (mainly when powdered).

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

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – the fundamental stratigraphic principles: Steno and later workers set out several guiding principles for reading sedimentary successions.

Step 1 – read the statement: Beds are deposited as originally near-horizontal layers.

Step 2 – draw the inference: Therefore strata now tilted or folded must have been disturbed after deposition.

Step 3 – name the principle: This is the principle of original horizontality.

Why the other options are wrong:

- B, superposition: concerns the age order (oldest at the bottom), not the initial attitude.
- C, cross-cutting relationships: dates features that cut across others.
- D, faunal succession: uses fossils to establish relative ages.

Final Answer: Original horizontality $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – relative dating of cross-cutting features: Any geological feature that cuts across another must be the younger of the two.

Step 1 – read the geometry: The dyke D transects several pre-existing sedimentary beds.

Step 2 – apply the rule: The beds had to exist first for the dyke to cut them, so the dyke is younger.

Step 3 – name the principle: This reasoning is the principle of cross-cutting relationships.

Why the other options are wrong:

- A, inclusions: dates fragments enclosed within a rock (the fragments are older than the host).
- C, superposition: gives the age order of undisturbed layers, not intrusions.
- D, uniformitarianism: is the general idea that present processes explain the past.

Final Answer: Cross-cutting relationships $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – primary sedimentary structures: The internal arrangement of grains in a bed records the flow conditions during deposition.

Step 1 – read the size trend: Grain size falls smoothly from coarse at the base to fine at the top within one bed.

Step 2 – link to the process: As a turbidity current loses energy, it drops the coarsest grains first and the finest last.

Step 3 – name the structure: This upward-fining pattern is graded bedding, the hallmark of a turbidite (Bouma sequence).

Why the other options are wrong:

- B, ripple marks: are small bedform undulations on a surface, not a vertical size gradation.
- C, mud cracks: are desiccation polygons indicating subaerial drying.
- D, cross-bedding: consists of inclined laminae recording migrating dunes, not a fining-upward trend.

Final Answer: Graded bedding $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept – fossils and correlation: Because life has evolved irreversibly, the fossil content of strata changes through time in a fixed order.

Step 1 – read the statement: Fossil species appear and disappear in a definite, recognisable and repeatable order.

Step 2 – state its use: This lets rocks in different places be correlated by matching their fossil assemblages.

Step 3 – name the law: This is the law (principle) of faunal (and floral) succession, established by William Smith.

Why the other options are wrong:

- B, superposition: orders layers by position, not by fossils.
- C, lateral continuity: states that beds extend outward until they thin or reach a barrier.

- D, inclusions: dates enclosed rock fragments.

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

Answer: (A) Go Back to Q17

Q18.

Solution

Concept – classifying unconformities: Unconformities are named from the relationship between the beds above and below the erosion surface.

Step 1 – read the geometry: Strata above and below the surface U are parallel (both are layered sediments).

Step 2 – read the time gap: The surface is an erosional break representing a significant interval of missing time.

Step 3 – name the unconformity: Parallel sediments separated by a recognisable erosion surface define a disconformity.

Why the other options are wrong:

- A, angular unconformity: requires the lower beds to be tilted at an angle to the upper beds.
- B, nonconformity: has sedimentary strata resting on eroded igneous or metamorphic rock.
- D, paraconformity: is a subtle break with beds parallel but with *no* obvious erosion surface.

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

Answer: (C) 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 core beds.

Step 1 – read the limb dips: Both limbs dip inward, toward the hinge, and the strata form a downward trough.

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

Step 3 – name the fold: A trough-shaped fold with limbs dipping toward the axis and the youngest beds in the core is 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: is a single step-like flexure, not a trough.
- C, dome: is a circular upwarp (the three-dimensional equivalent of an anticline).

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

Answer: (D) Go Back to Q19

Q20.

Solution

Concept – dip-slip fault types: Dip-slip faults are classified by the sense of movement of the hanging wall and by the driving stress.

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

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

Step 3 – name the fault: Hanging-wall-up movement under compression on a moderately dipping plane is a reverse fault.

Why the other options are wrong:

- A, normal fault: hanging wall moves *down* under extension.
- C, strike-slip fault: has horizontal (lateral) slip, not vertical.
- D, graben: is a down-dropped block between two normal faults, not a single fault type.

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

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – geometry of strike and dip: The attitude of a planar bed is given by its strike (a horizontal line on the plane) and its true dip (the steepest line down the plane).

Step 1 – recall the definition of true dip: The true dip is measured in the vertical plane that is perpendicular to the strike.

Step 2 – relate the two directions in map view: In the horizontal plane, the direction of steepest descent lies at right angles to the strike line.

Step 3 – state the angle: Therefore the strike direction and the true-dip direction are always $90°$ apart.

Why the other options are wrong:

- A, $0°$: would mean strike and dip point the same way, which is impossible.
- B, $45°$: has no geometric basis; the relationship is fixed at a right angle.
- D, $180°$: would place them along the same line but opposed, again not the true-dip geometry.

Final Answer: $90° \Rightarrow \boxed{\text{C}}$

Answer: (C) 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: The two plates slide horizontally past one another.

Step 2 – read the crust budget: Lithosphere is neither created nor destroyed at the boundary.

Step 3 – name the boundary: Horizontal shearing with no gain or loss of crust defines a transform boundary; the San Andreas Fault is the type example.

Why the other options are wrong:

- A, divergent boundary: creates new crust at a ridge as plates separate.
- C, convergent boundary: destroys or thickens crust as plates collide.
- D, subduction zone: is a specific convergent setting where one plate de-

scends beneath another.

Final Answer: Transform boundary $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – fault-slip components: The net dip-slip along a fault plane, its vertical throw and its horizontal heave form a right-angled triangle set by the dip.

Step 1 – write the relation: Throw = (dip-slip) $\times \sin(\text{dip})$, so dip-slip = throw$/\sin(\text{dip})$.

Step 2 – insert the values: Dip-slip $= 30/\sin 60°$.

Step 3 – evaluate $\sin 60°$: $\sin 60° = 0.866$.

Step 4 – compute: Dip-slip $= 30/0.866 = 34.6$ m.

Why the other options are wrong:

- B, 26.0 m: this is $30 \times \cos 30°$ or $30 \sin 60°$, i.e. multiplying instead of dividing.
- C, 30.0 m: this just repeats the throw, ignoring the dip.
- D, 60.0 m: this doubles the throw with no valid basis.

Final Answer: 34.6 m $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – marine magnetic anomalies (Vine–Matthews): New oceanic crust records the polarity of the Earth's magnetic field at the time it solidifies.

Step 1 – read the observation: Alternating normal and reversed stripes lie parallel to and symmetric about the ridge.

Step 2 – link to the process: As lava erupts and spreads outward on both sides, it freezes in the ambient field direction.

Step 3 – add the reversals: Because the geomagnetic field reverses polarity from time to time, successive strips of new crust record opposite polarities.

Step 4 – explain the symmetry: Since crust is added symmetrically to both flanks, the stripe pattern is a mirror image about the ridge axis.

Why the other options are wrong:

- B: banded iron formations are chemical sediments unrelated to symmetric ridge stripes.
- C: glaciation leaves no such magnetic-polarity pattern in ocean crust.
- D: meteorite impacts cannot produce ordered, symmetric magnetic stripes.

Final Answer: Sea-floor spreading recording geomagnetic reversals $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept – radioactive decay and half-life: After each half-life the number of remaining parent atoms is halved.

Step 1 – write the decay fraction: Fraction of parent remaining after n half-lives $= \left(\frac{1}{2}\right)^n$.

Step 2 – insert $n = 3$: Fraction $= \left(\frac{1}{2}\right)^3$.

Step 3 – evaluate: $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$.

Step 4 – interpret: So $\frac{1}{8}$ (that is 12.5%) of the original parent survives; the value of the 1.3-billion-year half-life is not needed for this fraction.

Why the other options are wrong:

- A, $\frac{1}{2}$: is the amount left after only one half-life.
- B, $\frac{1}{4}$: is left after two half-lives.
- D, $\frac{1}{16}$: is left after four half-lives.

Final Answer: $\frac{1}{8}$ remaining $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept – the eons of geological time: The largest divisions of geological time are the eons, in order Hadean, Archean, Proterozoic and Phanerozoic.

Step 1 – recall the oldest eon: The Hadean is the earliest, beginning at the formation of the Earth about 4.6 billion years ago.

Step 2 – order the next two: It is followed by the Archean, then the Proterozoic (together the Precambrian).

Step 3 – place the youngest: The Phanerozoic, the eon of abundant visible life, is the youngest and continues today.

Why the other options are wrong:

- A: places Archean before Hadean, which is out of order.
- C: reverses the Precambrian eons entirely.
- D: places Proterozoic before Archean, which is wrong.

Final Answer: Hadean $\rightarrow$ Archean $\rightarrow$ Proterozoic $\rightarrow$ Phanerozoic $\Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q26

Q27.

Solution

Concept – index fossils of the Mesozoic: A good index fossil is widespread, abundant and confined to a short interval of time.

Step 1 – read the range chart: The group's total span is restricted to the Mesozoic Era.

Step 2 – read the description: It is a coiled-shelled marine cephalopod that died out at the end of the Cretaceous.

Step 3 – name the group: Coiled cephalopods that flourished in the Mesozoic and vanished at the K–Pg boundary are the ammonites (ammonoids).

Why the other options are wrong:

- B, trilobites: are Palaeozoic index fossils, extinct by the end of the Permian.
- C, graptolites: are Early Palaeozoic (Ordovician–Silurian) index fossils.
- D, nummulites: are large Cenozoic (Paleogene) foraminifera.

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

$\boxed{\text{Answer: (A)}}$ Go Back to Q27

Q28.

Solution

Concept – the "Great Dying": The largest of the five major Phanerozoic mass extinctions closed the Palaeozoic Era.

Step 1 – read the severity: About 90% of marine species were eliminated, the most severe extinction known.

Step 2 – place it in time: This event marks the end of the Palaeozoic and the start of the Mesozoic.

Step 3 – name the boundary: It occurred at the Permian–Triassic (P–T) boundary, about 252 million years ago.

Why the other options are wrong:

- B, Cretaceous–Paleogene: is the (later, smaller) dinosaur extinction with the iridium anomaly.
- C, Ordovician–Silurian: was a large extinction but not the most severe, and lies earlier.
- D, Devonian–Carboniferous: the Late Devonian crisis was significant but again not the greatest.

Final Answer: Permian and Triassic periods $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept – the useful range of radiocarbon dating: A radiometric clock is useful for only a limited number of half-lives before too little parent remains to measure.

Step 1 – recall the half-life: The half-life of ^{14}C is about 5730 years.

Step 2 – count usable half-lives: After roughly 8–10 half-lives the ^{14}C left is too small to measure reliably.

Step 3 – estimate the limit: Some 8–9 half-lives corresponds to about $50{,}000$ years, the practical upper limit.

Why the other options are wrong:

- A, 5000 years: is only about one half-life, far short of the true limit.
- B, 1 million years: is far beyond the range; almost no ^{14}C would remain.
- C, 4.5 billion years: is the scale of U–Pb dating of the Earth, not radiocarbon.

Final Answer: About 50,000 years $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept – the earliest evidence of life: Precambrian rocks preserve few body fossils, but microbial structures are abundant.

Step 1 – read the description: Finely laminated dome- and column-shaped structures built by mats of cyanobacteria that trapped sediment.

Step 2 – identify the structure: These layered microbial build-ups are stromatolites.

Step 3 – note their significance: Stromatolites are the most widespread record of life in the Precambrian and released early free oxygen.

Why the other options are wrong:

- A, trilobites: are Palaeozoic arthropods, not Precambrian microbial structures.
- C, foraminifera: are single-celled shelled protists, abundant much later.
- D, belemnites: are Mesozoic cephalopods.

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

Answer: (B) Go Back to Q30

Q31.

Solution

Concept – how coal forms: Coal forms by the burial and progressive alteration of accumulated plant matter, which increases its carbon content step by step.

Step 1 – read the sequence: Peat $\rightarrow$ lignite $\rightarrow$ bituminous coal $\rightarrow$ anthracite, with rising fixed carbon.

Step 2 – identify the driving conditions: Increasing burial depth, heat and pressure drive off moisture and volatiles.

Step 3 – name the process: This maturation of plant debris into higher-rank coal is called coalification.

Why the other options are wrong:

- A: diagenesis of carbonate mud forms limestone, not coal.
- B: katagenesis refers to the thermal maturation of oil-prone kerogen, a petroleum term.
- D: silicification replaces wood with silica (petrified wood), a different process.

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

Answer: (C) Go Back to Q31

Q32.

Solution

Concept – the petroleum system: A working petroleum system needs a source rock, a reservoir rock, a seal (cap) rock and a trap.

Step 1 – read the function described: The rock in which hydrocarbons are *generated* from kerogen is required.

Step 2 – match the rock: Fine-grained, organic-rich rocks (such as black shales) that generate oil and gas are source rocks.

Step 3 – distinguish from the reservoir: Once generated, the hydrocarbons migrate out of the source into a porous reservoir rock.

Why the other options are wrong:

- A, reservoir rock: *stores* hydrocarbons in its pore space; it does not generate them.
- B, cap rock: seals the trap and prevents upward escape.
- D, basement rock: is the underlying crystalline rock, generally barren of hydrocarbons.

Final Answer: Source rock $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – thermal maturation and the oil window: The kind of hydrocarbon generated from kerogen depends on temperature, which rises with burial depth.

Step 1 – recall the maturation stages: Too cool and kerogen is immature; too hot and only gas (then graphite) survives.

Step 2 – locate liquid generation: Liquid petroleum is generated over a moderate temperature band, the "oil window".

Step 3 – give the range: That window is roughly $60–120\ °C$ (about $2–4$ km depth).

Why the other options are wrong:

- A, $0–20\ °C$: too cool; kerogen is immature and generates no oil.
- B, $200–300\ °C$: too hot; oil is cracked to gas (the gas window and beyond).
- C, $400–500\ °C$: this is metamorphic-grade heat, well past hydrocarbon survival.

Final Answer: About $60–120\ °C \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept – classification of hydrocarbon traps: Traps are structural (folds, faults) or stratigraphic (depositional or diagenetic changes in the rock).

Step 1 – read the trapping mechanism: The reservoir sandstone loses porosity laterally by pinching out into impermeable shale.

Step 2 – classify the cause: This is a facies change in the rock body, not folding or faulting.

Step 3 – name the trap: A trap produced by lateral change or pinch-out of the reservoir is a stratigraphic trap.

Why the other options are wrong:

- A, anticlinal trap: relies on upward folding of the beds.
- B, fault trap: relies on a fault juxtaposing reservoir against a seal.
- D, salt-dome trap: is formed by the upward piercement of a salt diapir.

Final Answer: Stratigraphic trap $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept – proximate analysis of coal: Proximate analysis reports four quantities: moisture, volatile matter, ash and fixed carbon.

Step 1 – list what is measured directly: Moisture, volatile matter and ash are each determined by standard heating tests.

Step 2 – identify the residue: Fixed carbon is obtained by difference: 100% minus (moisture $+$ volatile matter $+$ ash).

Step 3 – interpret it: Fixed carbon is the solid combustible residue and rises with coal rank.

Why the other options are wrong:

- A, total sulphur: is measured in the *ultimate* (elemental) analysis, not obtained as this residue.
- C, gross calorific value: is the heat of combustion, a separate measurement.
- D, ash-fusion temperature: describes the melting behaviour of the ash, not the carbon residue.

Final Answer: Fixed carbon $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – classifying ore deposits by process: Ore deposits are grouped by the geological process that concentrated the metals.

Step 1 – read the process: Hot, aqueous, metal-bearing fluids ascend along fractures and faults.

Step 2 – read the product: They precipitate ore minerals such as galena and sphalerite as fissure (vein) fillings.

Step 3 – name the deposit: Ore emplaced from hot circulating solutions in fractures forms hydrothermal vein deposits.

Why the other options are wrong:

- A, placer deposits: concentrate heavy detrital grains mechanically in sediments, not from hot fluids.
- C, evaporite deposits: form by evaporation of saline water (e.g. halite, gyp-

sum).
- D, residual laterite deposits: form by intense surface weathering (e.g. bauxite), not vein filling.

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

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – Darcy velocity (specific discharge): The Darcy velocity is the volumetric flow per unit total cross-sectional area and equals the product of hydraulic conductivity and hydraulic gradient.

Step 1 – write the formula: $q = K\,i$.

Step 2 – insert the values: $q = 15$ m/day $\times\, 0.01$.

Step 3 – multiply: $q = 0.15$ m/day.

Step 4 – note the meaning: This is the specific discharge; the true seepage velocity would be q divided by the effective porosity, and is larger.

Why the other options are wrong:

- B, 1.5 m/day: results from using $i = 0.1$ instead of 0.01.
- C, 15 m/day: is just K, forgetting to multiply by the gradient.
- D, 150 m/day: multiplies K by 10, an incorrect gradient.

Final Answer: 0.15 m/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept – the subsurface water zones: Below the ground surface lies an unsaturated (vadose) zone above a saturated (phreatic) zone.

Step 1 – read the definition: The surface below which all interconnected pores are completely water-filled is required.

Step 2 – name that surface: This upper limit of the saturated zone is the water table.

Step 3 – note its behaviour: In an unconfined aquifer the water table is at atmospheric pressure and rises and falls with recharge.

Why the other options are wrong:

- A, piezometric (potentiometric) surface: is the level to which water rises in wells tapping a *confined* aquifer, not the top of the saturated zone in the ground.
- B, capillary fringe: is the thin zone just above the water table where water is held by capillarity.
- D, aquiclude: is an impermeable unit, not a water surface.

Final Answer: Water table $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept – factor of safety in slope stability: The factor of safety (FoS) compares the forces that resist sliding with those that drive it.

Step 1 – write the definition: $\text{FoS} = \dfrac{\text{resisting (shear-strength) forces}}{\text{driving (shear) forces}}.$

Step 2 – interpret the critical value: $\text{FoS} = 1$ means resisting and driving forces are exactly balanced, so the slope is on the point of failure.

Step 3 – state the stable condition: For a stable slope the resisting forces must exceed the driving forces, so $\text{FoS} > 1$.

Why the other options are wrong:

- A, 0: would mean no resistance at all, guaranteed failure.
- B, less than 1: driving forces exceed resistance, so the slope fails.
- C, exactly 1: is the limiting (marginally stable) case, not a safe design.

Final Answer: Greater than $1 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept – Rock Quality Designation (RQD): RQD is a simple, widely used index of the degree of fracturing of a rock mass, obtained from drill core.

Step 1 – recall the counting rule: Only intact, sound core pieces ≥ 10 cm (4 inches) long are counted.

Step 2 – write the ratio: $\text{RQD} = \dfrac{\sum(\text{lengths of intact pieces} \geq 10 \text{ cm})}{\text{total length of core run}} \times 100\%$.

Step 3 – interpret it: A higher RQD means fewer fractures and better rock-mass quality.

Why the other options are wrong:

- A: total recovery (core recovery) counts *all* recovered core regardless of piece length, which is a different index.
- B: pore volume over bulk volume is porosity, not RQD.
- D: fractures per metre is the fracture frequency, a related but distinct measure.

Final Answer: Cumulative length of intact pieces ≥ 10 cm over total core-run length $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept – angle of repose of cohesionless material: For a dry, cohesionless granular material the maximum stable slope angle equals the angle of internal friction.

Step 1 – recall the stability condition: At the point of sliding, the driving component of gravity just balances the frictional resistance, giving $\tan\beta = \tan\phi$.

Step 2 – solve for the slope angle: Therefore the maximum stable slope angle $\beta = \phi$.

Step 3 – insert the value: With $\phi = 34°$, the steepest stable dry-sand slope is $34°$.

Why the other options are wrong:

- B, $17°$: is half of ϕ, with no physical basis.
- C, $56°$: is the complement $(90° - 34°)$, the wrong angle.
- D, $68°$: is 2ϕ, again unfounded; the slope would have failed long before this.

Final Answer: $34^\circ \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept – what defines an isotope: An element is fixed by its atomic number (number of protons); isotopes vary in mass.

Step 1 – fix the element: All isotopes of an element have the same number of protons, hence the same chemistry.

Step 2 – identify what changes: Their mass numbers differ because the number of neutrons differs.

Step 3 – state the answer: Isotopes differ from one another only in their number of neutrons.

Why the other options are wrong:

- A, electrons: a neutral atom has electrons equal to protons; changing electrons makes an ion, not an isotope.
- C, protons: changing the proton number changes the element itself.
- D, valence electrons: these govern bonding and are the same for isotopes of one element.

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

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – the uranium–lead decay chains: Each long-lived uranium isotope decays through a chain of steps to a specific stable lead isotope.

Step 1 – identify the parent: The parent here is uranium-238.

Step 2 – follow the chain: ^{238}U decays by a series of alpha and beta emissions to a stable end product.

Step 3 – name the daughter: The stable end of the ^{238}U series is lead-206.

Why the other options are wrong:

- B, lead-208: is the end of the thorium-232 series, not ^{238}U.

- C, argon-40: is the daughter in the potassium–argon system.
- D, strontium-87: is the daughter of rubidium-87, not of uranium.

(Note: the separate ^{235}U chain ends in lead-207.)

Final Answer: Lead-206 $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – fluvial (meandering-river) landforms: Meandering rivers create characteristic erosional and depositional features on their floodplains.

Step 1 – read the process: The river cuts through the narrow neck of a tight meander loop, shortening its course.

Step 2 – read the result: The abandoned bend is left as an isolated, crescent-shaped body of standing water.

Step 3 – name the landform: A cut-off meander loop forms an oxbow lake.

Why the other options are wrong:

- A, alluvial fan: is a fan-shaped deposit where a stream leaves a mountain front.
- B, yardang: is a wind-eroded ridge in arid regions.
- C, esker: is a sinuous ridge of glaciofluvial gravel.

Final Answer: Oxbow lake $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q44

Q45.

Solution

Concept – active versus passive remote sensing: Remote-sensing systems are passive (they record natural energy, mainly reflected sunlight or emitted heat) or active (they supply their own energy).

Step 1 – read the key clue: The system generates and transmits its own energy (microwave pulses) and records the return.

Step 2 – read the capability: Because it does not rely on sunlight, it can image at night and, using microwaves, through cloud.

Step 3 – name the system: A self-illuminating sensor of this kind is an active sensor, the classic example being RADAR.

Why the other options are wrong:

- A, passive optical sensor: depends on reflected sunlight, so it cannot work at night.
- B, thermal-infrared sensor: passively records emitted heat and does not supply its own energy.
- C, multispectral passive scanner: is also passive, relying on external illumination.

Final Answer: Active sensor (RADAR) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – radiometric dating systems: Different parent–daughter pairs suit different age ranges and materials.

Step 1 – read the decay described: Very slow beta decay of a rubidium isotope to a strontium isotope.

Step 2 – identify the pair: This is the rubidium-87 to strontium-87 system.

Step 3 – note its use: With its very long half-life (about 49 billion years), ^{87}Rb–^{87}Sr is used with the whole-rock isochron method to date old igneous and metamorphic rocks.

Why the other options are wrong:

- A, ^{40}K–^{40}Ar: involves potassium and argon, not rubidium and strontium.
- B, ^{14}C–^{14}N: is radiocarbon dating of young organic material.
- D, ^{238}U–^{206}Pb: is the uranium–lead system, a different parent–daughter pair.

Final Answer: Rubidium-87 to strontium-87 $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q46

Answer Key

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