

Conventional Map

A map is a proportionate representation of an area/structure. The study of maps is known as cartography and the experts are known as cartographers. The maps were first prepared by people of Sumerian civilization by using clay lens. The characteristic elements of a map are scale (ratio of map distance to field distance and can be represented in three ways—statement method, e.g., 1 cm = 0.5 km, representative fraction method, e.g., 1:50,000 and graphical method in the form of a figure), direction, symbol and colour. On the basis of scale, maps are of two types: large-scale map (map gives more information pertaining to a smaller area, e.g., village map: 1:3956) and small: scale map (map gives less information pertaining to a larger area, e.g., world atlas: 1:100 km).

Topographic Maps/Toposheet

A toposheet is a map representing topography of an area. It is prepared by the Survey of India, Dehradun. Here, a three-dimensional feature is represented on a two-dimensional map and the information is mainly represented by contours. The contours/isohypses are lines connecting points of same elevation with respect to mean sea level (msl). The index contours are the contours representing 100's/multiples of 100's drawn with thick lines. The contour interval is usually 20 m. The contours never intersect each other and are not parallel. The characteristic elements of a toposheet are scale, colour, symbol and direction. The various layers which can be prepared from a toposheet are structural elements like fault and lineaments, cropping pattern, land use/land cover, groundwater abstraction structures, drainage density, drainage divide, elongation ratio, circularity ratio, drainage frequency, natural vegetation, rock types, landform units, infrastructural facilities, drainage and waterbodies, drainage number, drainage pattern, drainage length, relief/slope, stream order, sinuosity index and infiltration number.

Strike and Dip

Strike is the direction of a line formed by intersection of horizontal plane with an inclined plane and dip is the angle formed when a horizontal plane meets an inclined plane. The true dip is the angle between the horizontal and inclined planes measured along a vertical plane at right angles to the strike and apparent dip is the dip measured in any direction other than the true dip direction. The strike and dip can be represented by either full circle or quadrant bearing and can be measured by using clinometer or Brunton compass.

cleavage, bedding cleavage occur due to isoclinal folding, flow parallel to bedding, load metamorphism, mimetic (in situ) crystallization and axial plane foliation.

Unconformity

It is a surface of erosion or non-deposition, usually the former that separates younger strata from older rocks. It is associated with mostly sedimentary rocks and is a break in stratigraphic record. The major stratigraphic breaks are diastem (smallest stratigraphic break introduced by Barrel, results due to diurnal fluctuations of sea level or tidal fluctuations), contact (smallest separation between beds) and non-sequence (break in stratigraphic record formed by non-deposition). The angular unconformity/structural unconformity/orogenic unconformity/discordance/angular discordance, parallel unconformity/disconformity/non-angular unconformity/erosional unconformity/stratigraphic unconformity, local unconformity, regional unconformity, non-conformity, blended unconformity, paraconformity/pseudo-conformity are types of unconformity. Unconformities can be recognized by sharp contrast in the degree of induration, presence of conglomerate horizon, significant differences in the intensity of folding, relation to plutonic rock, distinct differences in the grade of regional metamorphism, palaeontological relations, wavy nature of unconformities and radiometric dating techniques.

Fold

Folds are wavy undulations or flexures which are developed in country rocks whenever areas are subjected to several pressures of stress and are secondary structures. The two idealized folds are cylindrical and conical. A synform is a fold that concaves upwards and the limbs dip towards each other and converse condition antiform. An anticline is an antiform in which oldest beds occur at the core but syncline is a synform in which youngest beds occur at the core. A synclinal anticline is a fold having the shape of a syncline but the oldest beds at the core. Similarly, original syncline is a fold having the shape of an anticline but youngest beds are at the core. Symmetrical fold is a fold in which axial plane is vertical and both limbs have the same amount of dip, whereas an asymmetrical fold is one in which axial plane is inclined and has limbs with different dip. Overtaken fold or overfold is a fold in which the axial plane is inclined and one of the limbs has turned more than 90° . On the basis of orientation of hinge line folds are of three categories: non-plunging (hinge line is horizontal), plunging fold (hinge line is inclined) and vertical fold (hinge line is vertical). With respect to the attitude of axial plane upright fold with axial plane vertical, inclined fold with inclined axial plane and horizontal axial plane for recumbent fold. Reclined fold is a fold with inclined axial plane and inclined hinge line. Isoclinal folds is the one in which both limbs are parallel. Chevron fold is the one in which limbs are straight and the hinge is sharp and angular. A fan fold is one in which limbs are overturned and the crest is broad and rounded. In box fold the crest is broad and flat; two hinges are present, one on either side of the flat crest. Parallel (or concentric) and similar folds are those folds in which thickness of the folded bed measured perpendicular to the bedding surface remains constant however the thickness measured parallel to the axial plane varies considerably. The parallel or concentric fold die out with depth. Similar folds show a wide variation in thickness as

measured perpendicular to bedding but thickness measured parallel to the axial plane remains constant throughout the fold. Similar folds maintain their shape with depth. Kink bands are narrow bands, in which the beds assume a dip that is steeper or gentler than in the adjacent beds. Monocline: In plateau areas, where bedding is relatively flat, the strata locally assume a steeper dip. Homocline: strata or rock that dips in one direction with relatively uniform angle. Structural terrace: strata locally assuming a horizontal attitude. Closed and open folds: a closed or tight fold is one in which the limbs are close to each other and in open fold limbs lie far apart. Drag fold: major folds are accompanied by minor asymmetrical folds that are formed in incompetent (weak) beds sandwiched between the two competent (strong) beds. These minor and asymmetrical folds, developed by relative movement between the beds, are called drag folds. As per Poppelley's rule left handed drag folds occur in the left limb of the synform and right handed drag folds occur in right limb and converse condition in the case of antiform is right handed drag folds occurs in the left limb and left handed drag folds occur in the right limb. Ptygmatic folds appear in highly metamorphosed rocks with meandering appearance.

Plunging Fold or Pitching Fold

A fold is said to be plunging if its hinge line is inclined at an angle of horizontal. A doubly plunging fold is one that reverses its direction of plunge. A doubly plunging synform with depression is called canoe and a doubly plunging anticline with culmination is an inverted canoe.

Structural Dome and Structural Basin

An anticlinal uplift that plunges in all directions is called a dome/pericline fold/quaquaversal fold and has no distinct trend. A synclinal depression dipping inward in all directions is a basin/centrocline.

Refolding/superposed folding/polyphase deformation/superimposed folding.

Refolding

Refolding refers to the folding of the already present fold. The term cross-fold is used if the axial plane of the second fold at right angles to the axial plane of the primary fold and results in the formation of "eye" structure. Co-axial fold is a refolded fold in which axial plane of the refolding is parallel to the axial plane of the primary fold after refolding.

Fault

Rupture or planar discontinuity along which opposite walls have moved past each other. The block above the fault plane is called hanging wall and below the footwall. The intersection of fault plane with the surface of the earth is called fault line or fault outcrop or fault trace. Depending upon the rake of net slip, fault is classified into strike slip fault (one in which net slip is parallel to the strike of the fault and there is no dip slip component, i.e., rake is zero), dip slip fault (one in which net slip is along the dip of the fault and there is no movement parallel to the strike of the fault, rake is 90° , no strike slip component) and diagonal or oblique slip fault (one in which net slip is neither parallel to the dip nor

to the strike of the fault plane, the net slip has both strike slip and dip slip components, rake is between 0° and 90°); based on fault pattern faults are classified as parallel faults (strikes and dips which are parallel to each other), en échelon faults (short faults that overlap each other), radial faults (faults that radiate out from a central point) and peripheral faults (circular or arcuate faults that bound a circular area or part of a circular area). The reverse thrust is a thrust in which fault dips more than 45° , a thrust is one that dips $<45^\circ$ and over thrust is a very gently dipping fault usually $<10^\circ$. In normal (gravity) fault hanging wall moves down relative to footwall. A strike slip fault, also called wrench fault is one along which movement has taken place parallel to the strike of the fault. Horse is the block caught along normal fault and slice along the reverse fault. The graben is equivalent to horse. The grabens of larger dimension are known as rift valleys. The horst is equivalent to slice. The horst of larger dimension are known as block mountains. The faults can be recognized in the field by discontinuity of structures, silicification and mineralisation, physiographic features, sudden changes in sedimentary facies, repetition or omission of strata and features characteristic of fault planes.

Joints

Joints are planar discontinuities in rocks, movements parallel to the discontinuity surface is often absent, but perpendicular movement may occur. Joint set is a group of joints of common origin, a group of joint set is joint system and conjugate system of joints are the intersecting sets of joint oriented at right angles to each other. The joints perpendicular to fold axis are known as ac joints, parallel to fold axis and perpendicular to layering are radial joints and feather joints/pinnate joints/pinnate fractures are formed during faulting and indicate relative movement. The primary joints occur in all types of rocks (igneous, sedimentary, and metamorphic) and major joint/master joint is a large joint at the time of formation of rock. Along murals granites break into large blocks. The columnar joints/polygonal joints/prismatic joints found in basalt develop during cooling and consolidation of lava, due to tensile stresses and contraction. The long axes of columnar joints are perpendicular to cooling surfaces and are hexagonal joints noted for groundwater potential zone. The right angles to both rift and grain granites break with irregular fracture and called hard way/tough way/head. Along rift and grain, quarrymen can break the rock into smaller pieces. The sheet joints are parallel to layering, due to unloading and erosion; the sheeting surface is usually curved.

Palinspastic Maps

These maps show the geography at some specified time in the past—petrofabric analysis/microscopic structural analysis/structural petrology/microstructural analysis. It was initially directed toward the correlation of megascopic structure, with microscopic data of mineral orientation by statistical treatment using equal area net and U-stage, introduced by Sander (1920). The principal stress axis may be deduced by this analysis. The various symmetry elements obtained during the analysis are axial or spherical symmetry (highest symmetry with 'n' number of symmetry planes), orthorhombic symmetry (two planes of symmetry), monoclinic symmetry (one plane of symmetry) and triclinic symmetry (no plane of symmetry, lowest symmetry).

Isostasy

Isostasy might be defined as the state in which the earth maintains its density inhomogeneities against dissipation over geologically significant time period and the concept of isostasy was first introduced by Hutton. As per Sir George Airy's compensation elevated areas are underlain by thick crustal roofs with same density and different thickness, Pratt's concept of compensation (crustal plates with different density and thickness) and Haskanen's theory of compensation (plates with different density and thickness, but bottom of the plates with same density).

Inlier, Outlier, Overlap and Offlap

An inlier is an area of older rocks surrounded by younger rocks and an outlier is an area of younger rocks surrounded by older rocks. Onlap or overlap is the geologic phenomenon of successively younger rock strata extending progressively further across an erosion surface cut in older rocks and is generally associated with a marine transgression. Overlap (onlap) refers to the situation above the surface of unconformity. Offlap/regressive offlap, the deposit of strata of sedimentary rock as a result of regression of the sea.

Window

Window is an erosional opening in the sole of a nappe (thrust) through which we can see the underlying rocks that belong to another tectonic unit (Fenster in German and Fenestre in French). This type of window includes window (proper), slot window, fragmented window, scissor window (after Sander) and half window.

Diastrophism

Diastrophism are the general processes or combination of processes by which earth's crust is deformed and the concept was given by J.W. Powell. The diastrophism (after Gilbert) is of two kinds: orogenesis (process of mountain building, period during which a particular orogenesis occurred is orogeny and horizontal movements involved in orogenesis) and epeirogenesis (process of continent building, period during which a particular epeirogenesis occurred is epeirogeny and vertical movements involved in epeirogenesis). Modern diastrophic movements are earthquake, measurable displacement of land surface, folding, fracturing, metamorphism and major igneous activity. The various other types of diastrophic movement are unconformities, earthquakes, rock flowage, rock fracture, fold, faults, joints, etc.

Salt Domes and Diapirs

Horizontal and vertical movements in a concentric fold leads to diapirism. The diapir is a piercement structure in which solid but mobile core material is injected through overlying less mobile layers. Anticline/dome structure where core of mobile rock has broken through the overlying strata. Rocks most commonly involved are evaporates (Rock salt - NaCl, Gypsum - $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, Anhydrite - CaSO_4). Salt dome is not considered a diapir because much flowage of salt takes place before the actual piercement.

MULTIPLE-CHOICE QUESTIONS

1. The mountain building process is called
 - (a) Orogeny
 - (b) Orogenesis
 - (c) Both a and b
 - (d) Epeirogenesis
2. Match the following and choose the best alternative

a) Diastrophism	1. Period of mountain building process
b) Orogeny	2. Process of formation of continents
c) Epeirogenesis	3. The process of deformation of crust
d) Cordilleran region	4. Type area of diastrophism after J.W. Powell

- (a) a-3, b-1, c-2, d-4
 - (b) a-3, b-2, c-1, d-4
 - (c) a-2, b-3, c-1, d-4
 - (d) a-4, b-2, c-1, d-3
3. The time span represented by an unconformity surface or any break in stratigraphic succession
 - (a) Hiatus
 - (b) Contact
 - (c) Eon
 - (d) Era
4. Match the following and choose the correct answer

a) Disconformity/ Parallel Unconformity	1. Older beds truncate at unconformity surface
b) Angular unconformity	2. Older and younger beds and unconformity surface are parallel
c) Non-conformity	3. Older and younger beds are parallel
d) Paraconformity or Pseudoconformity	4. Older (igneous mass) separates younger bed

- (a) a-1, b-2, c-3, d-4
 - (b) a-2, b-1, c-4, d-3
 - (c) a-3, b-1, c-4, d-2
 - (d) a-4, b-3, c-1, d-2
5. An unconformity surface can be recognised by
 - (a) Sharp contrast in the degree of induration and presence of conglomerate horizon.
 - (b) Distinct difference in the grade of regional metamorphism and intensity of folding.
 - (c) Plutonic relation, palaeontologic relation and wavy nature of unconformity surface.
 - (d) All of the above.
6. Which among the following is used for younging purpose (top and bottom of beds)?
 - (a) Graded bedding, turbidities, mud cracks, local unconformities, and pillow lava
 - (b) Drag fold, cross bedding, delta, mould, cast, bioturbation structures

- (c) Load metamorphism
(d) All of the above
15. Liquids and gases possess
(a) Bulk modulus of elasticity (b) Young's modulus of elasticity
(c) Rigid modulus of elasticity (d) Both (a) and (b)
16. The change in cleavage direction is known as
(a) Cleavage fanning (b) Cleavage refraction
(c) Cleavage reflection (d) Cleavage interference
17. Hooke's law is applicable in the case of
(a) Stretching (b) Bending
(c) Twisting (d) All of the above
18. A group of joints of common origin is a joint set and joint system is a group of joint set. The intersecting sets of joints oriented at right angles to each other are known as
(a) Joint group (b) Conjugate system of joints
(c) Joint pattern (d) Pinnate joints
19. Joints perpendicular to fold axis
(a) a-b joint (b) a-c joint
(c) Radial joint (d) None of the above
20. Substances that undergo a large plastic deformation before rupture are called
(a) Ductile (b) Brittle
(c) Malleable (d) Sectile
21. Match the following and choose the best alternative

a) Tension fractures	1. Develop when forces tend to slide one part over other
b) Shear fractures	2. Develop when forces move away from a common centre
c) Compressive fractures	3. Two equal forces that act in opposite directions in the same plane
d) Torsion	4. Develop when two forces move towards a common centre
e) Couple	5. Opposite ends of a body rotated in opposite directions

- (a) a-4, b-5, c-2, d-3, e-1 (b) a-5, b-4, c-3, d-2, e-1
(c) a-1, b-2, c-3, d-4, e-5 (d) a-2, b-1, c-3, d-5, e-3

22. Large joints which can be traced over an extensive area are known as
 (a) Master joints (b) Feather joints
 (c) Major joints (d) Both a and c
23. A fold profile is taken in the direction
 (a) Perpendicular to fold axis (b) Parallel to fold axis
 (c) Inclined to fold axis (d) 60° to fold axis
24. Which among the following is correct?
 (a) Mural joints in granites help to break the rock into large blocks.
 (b) Rift and grain in granites are horizontal and vertical which help to break the rocks into smaller blocks.
 (c) Right angles to both rift and grain granites break with a rough irregular fractures called head way/tough way/head but along sheeting rocks peels out along curved surfaces and sheeting best developed in granitoids but also common in sandstone.
 (d) All of the above
25. The fractures of anisotropy and secondary structures with wavy undulations or flexures which are developed on country rocks whenever the area is subjected to severe pressure or stress are called
 (a) Fault (b) Fold
 (c) Window (d) None of the above
26. The section of a fold at right angles to its hinge line is called
 (a) Axial plane (b) Hinge plane
 (c) Profile (d) Flank
27. Match the following and choose the best alternative in the case of a fold:

a) Hinge	1. Highest point on a folded surface
b) Crust	2. Point with maximum curvature
c) Synformal anticline	3. Fold having the shape of anticline with oldest bed at the core
d) Anticline	4. Fold having the shape of synform but the oldest bed at the core

- (a) a-4, b-3, c-1, d-2 (b) a-4, b-3, c-2, d-1
 (c) a-1, b-2, c-3, d-4 (d) a-2, b-1, c-4, d-3

28. Match the following and choose the best alternative in the case of a fold:

a) Plunging fold	1. Hinge line vertical
b) Non-plunging fold	2. Inclined axial plane and inclined hinge line
c) Vertical fold	3. Hinge line horizontal
d) Reclined fold	4. Hinge line inclined

- (c) The series of parallel columns in competent beds are known as mullions and when schistosity/cleavage may be folded into small corrugations/crinkles, known as microcorrugation structures
- (d) All of the above
53. The surface of erosion or non-deposition, usually the former that separates younger strata from older is
- (a) Non-conformity (b) Non-sequence
(c) Unconformity (d) Diastem
54. The time span represented by an unconformity surface is known as
- (a) Diastem (b) Hiatus
(c) Non-sequence (d) Contact
55. Match the following and choose the best alternatives

a) Angular unconformity/ Orogenic unconformity/ Discordance	1. Unconformity surface separates older igneous mass/massive metamorphic rock from younger beds
b) Disconformity/ Parallel unconformity	2. Younger beds, older beds and depositional breaks are parallel to each other
c) Non-conformity	3. Older beds truncate at the unconformity surface
d) Paraconformity/ Pseudoconformity	4. Older and younger beds are parallel to each other
e) Blended unconformity	5. Unconformity surface lacks sharp contact

- (a) a-3,b-4,c-1,d-2,e-5 (b) a-1,b-2,c-3,d-4,e-5
(c) a-1, b-3, c-2, d-5, e-4 (d) a-5, b-4, c-3, d-2, e-1
56. Which among the following is a characteristic to identify unconformity:
- (a) Presence of conglomerate horizon and distinct difference in the grade of regional metamorphism
(b) Significant difference in the intensity of folding and relation to plutonic rock
(c) Palaeontological relation and wavy nature of depositional break
(d) All of the above
57. Joints are planar discontinuities in rocks and the movements parallel to the discontinuity surface is often absent. The discontinuities in rocks in which movement occurs parallel to discontinuity surface occurs in the case of
- (a) Foliation (b) Fault
(c) Unconformity (d) None of the above

74. The direction of the line formed by intersection of horizontal plane with an inclined plane

- (a) Dip (b) Trend
(c) Strike (d) True Dip

75. Match the following and choose the correct answer.

a) True dip	1. The 3-dimensional orientation of geological features
b) Dip	2. Dip measured in any direction other than true dip direction
c) Apparent Dip or Partial Dip	3. The angle between the horizontal and inclined plane measured along a vertical plane at right angles to the strike
d) Altitude	4. Angle formed when a horizontal plane intersects an inclined plane

- (a) a-3, b-4, c-2, d-1 (b) a-1, b-2, c-3, d-4
(c) a-4, b-3, c-2, d-1 (d) a-3, b-2, c-1, d-4

76. A rock body formed by the consolidation of magma below the surface of the earth, but now exposed due to erosion is called

- (a) Magmatic body (b) Pluton
(c) Granitic intrusive (d) All of the above

77. Match the following and choose the best alternative.

a) Lacolith	1. Spoon shaped concordant pluton
b) Lopolith	2. Doubly convex concordant pluton
c) Phacolith	3. Cake shaped concordant pluton
d) Bysmalith	4. The body of which roof uplifted along a circular or arcuate fault

- (a) a-1, b-4, c-3, d-2 (b) a-2, b-3, c-4, d-1
(c) a-1, b-2, c-3, d-4 (d) a-3, b-1, c-2, d-4

78. Which igneous pluton is considered both concordant and discordant?

- (a) Lacolith (b) Cone sheet
(c) Bysmalith (d) Ring dyke

79. Match the following and choose the best alternative

a) Simple sill	1. Two or more injections of some kind of magma
b) Multiple sill	2. Sill formed by magmatic differentiation
c) Composite sill	3. Results from single injection of magma
d) Differentiated sill	4. Two or more injections of magma of different composition

- (a) a-1, b-2, c-3, d-4 (b) a-3, b-1, c-4, d-2
(c) a-4, b-3, c-2, d-1 (d) a-2, b-3, c-4, d-1

80. Which among the following is correct?
 (a) Batholiths with an area $> 100^2$ km without visible floor (subjacent)
 (b) Stocks is irregular batholith and boss is a batholith of circular shape
 (c) Roof of the batholiths are known as roof pendants
 (d) All of the above
81. The mechanism of formation of ring dyke is called
 (a) Forceful injection (b) Cauldron subsidence
 (c) Magmatic stoping (d) Metasomatic replacement
82. The method of emplacement of plutons is
 (a) Forceful injection (b) Magmatic stoping
 (c) Metasomatic replacement (d) All of the above
83. Palinspastic maps
 (a) Show geography at some specified time in the past
 (b) Show same bed thickness
 (c) Show geographical distribution of faunas
 (d) All of the above
84. The concept of Petrofabric analysis / Microstructural analysis / Microscopic structural analysis in structural geology was first introduced by
 (a) Hobbs (b) Billings
 (c) Sander (d) Hills
85. Among the symmetry elements of petrofabric diagrams, Match the following and choose the best alternative.

a) Axial/Spherical symmetry	1. Two planes of symmetry
b) Orthorhombic symmetry	2. Maximum symmetry elements, 'n' number of symmetry planes
c) Monoclinic symmetry	3. Lowest symmetry, no planes of symmetry
d) Triclinic	4. One plane of symmetry

- (a) a-1, b-2, c-3, d-4 (b) a-2, b-1, c-4, d-3
 (c) a-4, b-1, c-2, d-3 (d) a-4, b-3, c-1, d-2
86. The principal stress axis may be deduced by the analysis of
 (a) Petrofabric diagrams (b) Rose diagrams
 (c) Palinspastic diagrams (d) None of the above
87. The angle which a fault plane makes with vertical plane and is considered complement of dip
 (a) Rake (b) Hade
 (c) Throw (d) Heave

88. The fault block situated above fault plane is called
 (a) Hanging wall (b) Foot wall
 (c) Dextral wall (d) None of the above
89. The intersection of fault plane with the surface of the earth is called
 (a) Fault line/Fault outcrop/Fault trace
 (b) Fault geometry
 (c) Fault profile
 (d) None of the above
90. The Net slip/Slip/Displacement/Shift is the
 (a) Offset shown by a planar feature in vertical cross section perpendicular to fault.
 (b) The distance measured on a fault plane between two originally adjacent points on the foot wall and hanging wall.
 (c) Line developed on fault plane
 (d) Synonym of fault trace
91. The offset shown by a planar feature in vertical cross section perpendicular to the fault is known as
 (a) Dip separation (b) Heave
 (c) Throw (d) Rake
92. The vertical component of dip separation is called throw and the horizontal component is
 (a) Rake (b) Net slip
 (c) Strike slip (d) Heave
93. The angle that a line in the fault plane makes with the horizontal line in that plane is called
 (a) Hade (b) Rake
 (c) Dip (d) None of the above
94. Match the following and choose the best alternative.

a) Strike slip fault	1. Faulting parallel to dip of adjacent bedding
b) Dip slip fault	2. Rake between 00 and 900
c) Diagonal slip fault	3. No dip slip component, rake = 0
d) Dip fault	4. No strike slip, rake = 90

- (a) a-2, b-1, c-4, d-3 (b) a-4, b-3, c-2, d-1
 (c) a-3, b-4, c-2, d-1 (d) a-1, b-2, c-3, d-4
95. A fault perpendicular to the strike of regional structure is called
 (a) Dip fault (b) Transverse fault
 (c) Bedding fault (d) Strike fault

- (a) a-4, b-1, c-2, d-3, e-5
- (b) a-1, b-2, c-3, d-4, e-5
- (c) a-5, b-4, c-3, d-2, e-1
- (d) a-3, b-2, c-1, d-4, e-5

101. The offset streams, hot springs aligned along the foot of a mountain range and breaking in stream profile in an area indicate

- (a) Folding
- (b) Jointing
- (c) Faulting
- (d) All of the above

102. Match the following and choose the best alternative.

a) Mylonite	1. Smooth planar surface formed during faulting
b) Slickenside	2. Micro fault breccia
c) Horse	3. A block caught along a thrust fault
d) Slice	4. A block caught along a normal fault

- (a) a-3, b-2, c-1, d-4
- (b) a-2, b-1, c-4, d-3
- (c) a-1, b-2, c-3, d-4
- (d) a-4, b-3, c-2, d-1

103. Garbens of gigantic size are known as rift valley and the gigantic horsts are

- (a) Horse
- (b) Slice
- (c) Block mountains
- (d) None of the above

104. A piercement structure in which a solid but mobile core material is injected through overlying, less mobile layers and can also be considered an anticline or dome in which a core of mobile rock has been broken through the overlying strata

- (a) Inverted canoe
- (b) Diapir/diapiric intrusion
- (c) Evaporites
- (d) Scuppen structure

105. In salt domes, the cap rock sulphur is produced by

- (a) Sulphate reducing bacteria
- (b) Oxidation processes
- (c) Both (a) and (b)
- (d) None of the above

106. An erosional opening in the sole of a nappe/thrust through which one can see the underlying rocks that belong to another tectonic unit

- (a) Festoon
- (b) Scuppen structure
- (c) Window/Fenster/Fenetre
- (d) All of the above

107. Which among the following is correct according to Anderson's theory of fault genesis?

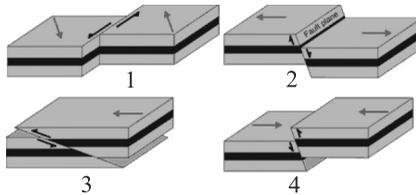
- (a) If greatest principal stress axis is vertical and others horizontal, normal fault will result.
- (b) If the least principal stress axis is vertical and others horizontal, thrust fault will result.

- (c) If the intermediate principal stress axis is vertical and others horizontal, strike slip fault will result.
 (d) All of the above
- 108.** The change in volume is known as dialation but that of shape/ form
 (a) Deformation (b) Tension
 (c) Distortion (d) All of the above
- 109.** The science of deformation is known as
 (a) Rheology (b) Mechanics
 (c) Dynamics (d) All of the above
- 110.** The plastic-viscous body is known as
 (a) Semi-viscous body (b) Cohesive viscous body
 (c) Bingham body (d) All of the above
- 111.** In the case of geosynclines, deposition of sediments occurs at
 (a) Intermediate depth (b) Shallow depth
 (c) Deeper depth (d) No particular depth relation
- 112.** The geosynclinal phase is characterised by negative vertical motion. The negative vertical motion is known as
 (a) Uplift (b) Subsidence
 (c) Tilting (d) All of the above
- 113.** The theory of isostasy was introduced by
 (a) Dutton (b) Powell
 (c) Schuchert (d) Dana
- 114.** Which among the following is correct as per the theory of isostasy?
 (a) Mountainous areas are occupied by light rock materials and plains heavy rocks.
 (b) The best way to study the isostasy is to utilise gravity data
 (c) Both (a) and (b)
 (d) None of the above
- 115.** Match the following and choose the best alternative.

a) Theory of isostasy after Sir George Airy (crustal model of isostasy)	1. Beds with different thickness and different density
b) Theory of isostasy after Pratt	2. Beds with same density and different thickness
c) Theory of isostasy after Haskanen	3. Beds with different density and thickness but bottom with same density
d) Isopiestic level	4. Beds experiencing uniform pressure

- (c) Due to torsion
(d) Due to couple
- 124.** Thickening and thinning of beds at crests and troughs is found in
(a) Similar folds (b) Open folds
(c) Tight folds (d) Concentric folds
- 125.** In suprataneous folds the beds are
(a) Uniformly thick at the crests and troughs
(b) Thin at the limbs but thickened at the crests
(c) Thin at the crests but thickened at the limbs
(d) None of the above
- 126.** Which of the following are low angle faults?
(a) Overthrust, underthrust and detachment faults
(b) Overthrust, underthrust and cylindrical faults
(c) Cylindrical faults, underthrust and detachment faults
(d) Detachment faults, cylindrical faults and overthrust
- 127.** Lag faults are
(a) High angle reverse faults
(b) High angle normal faults
(c) Low angle faults with reverse displacement
(d) Low angle faults with normal displacement
- 128.** In a geologic map, domes and basins are represented by
(a) Paraboles (b) Hyperboles
(c) Concentric circles (d) Concentric ellipses
- 129.** The statistical study of the recognition and description of the geometrical properties of planar and linear discontinuities of rocks is described as
(a) Dynamic analysis (b) Petrofabric analysis
(c) Kinematic analysis (d) Mechanical analysis
- 130.** Pitch and plunge of a fold coincides in the case of
(a) Isoclinals (b) Disharmonic
(c) Symmetrical (d) Asymmetrical
- 131.** Gravity faults are developed by
(a) Shear stress (b) Tensile stress
(c) Compressive stress (d) Torsion
- 132.** Schuppen structures are associated with
(a) Recumbent folding (b) Normal faulting
(c) Thrust faulting (d) Reverse faulting

133. The expression of topography is most striking in
 (a) Foliation (b) Faults
 (c) Folds (d) Basins
134. The 90% of the present landscapes belong to
 (a) Pre-tertiary age (b) Quaternary age
 (c) Pre-mesozoic age (d) Post-tertiary
135. The different types of fault (1, 2, 3, 4) given in the figure are:



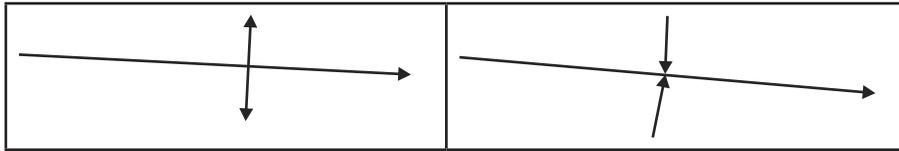
- (a) 1-Reverse fault, 2-Normal fault, 3-Thrust fault, 4-Strike slip fault
 (b) 1-Reverse fault, 2-Normal fault, 3-Strike slip fault, 4-Thrust fault
 (c) 1-Normal fault, 2-Reverse fault, 3-Thrust fault, 4-Strike slip fault
 (d) 1-Strike slip fault, 2-Normal fault, 3-Thrust fault, 4-Reverse fault
136. The fold types marked as a, b, c and d in the figure represents



- (a) a-Symmetrical, b-Asymmetrical c-Overturned, d-Recumbent
 (b) a-Symmetrical, b-Anticline c-Overturned, d-Recumbent
 (c) a-Symmetrical, b-Asymmetrical c-Box fold, d-Recumbent
 (d) a-Symmetrical, b-Asymmetrical c-Overturned, d-Box Fold
137. Name the unconformities given in the figure

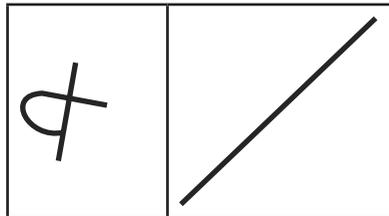
<p>a)</p>	<p>1. Nonconformity</p>
<p>b)</p>	<p>2. Paraconformity</p>

140. The symbols given in the figures are



- (a) Plunging anticline and syncline
- (b) Non-plunging anticline and syncline
- (c) Both (a) and (b)
- (d) None of these

141. The symbols used below are



- (a) Horizontal beds and fault
- (b) Vertical beds and fault
- (c) Overturned beds and fault
- (d) None of the above

142. Identify the feature shown in the figure



- (a) Mullions
- (b) Sausage structure
- (c) Boulders
- (d) Puckers

143. Identify the joints shown in the figure



- (a) Vertical joints
- (b) Horizontal joints
- (c) Mural joints
- (d) Columnar joints