

1. In a temperature-composition diagram of two components of A and B (involving no solid solution between A and B); liquid + A + B will exist : D
- Above liquidus
 - Between liquidus and solidus
 - Below solidus
 - At eutectic point
2. Regarding the structure of silicates, the type $(\text{Si}_2\text{O}_7)^{6-}$ is known as : B
- Cyclosilicate
 - Sorosilicate
 - Phyllosilicate
 - Tectosilicate
3. What is the mechanism of solid solution, if Pb^{2+} substitutes for K^+ in microcline ? C
- Simple substitution
 - Interstitial solid solution
 - Omission solid solution
 - Coupled substitution
4. Monticellite is Ca-bearing end member of which one of the following mineral groups ? B
- Pyroxene Group
 - Olivine Group
 - Garnet Group
 - Epidote Group
5. Which one of the following statements is *not* correct ? C
- The optic axial angle of olivine group minerals varies from $2V\gamma$ 82° for Mg_2SiO_4 and 134° for Fe_2SiO_4 .
 - Magnesium-rich olivine is distinguished from diopside by its poor cleavage, large optic axial angle and higher birefringence.
 - Iron-rich olivines occur in both alkaline and acid plutonic and hypabyssal rocks.
 - Olivines of nearly equal Fe-Mg are common constituents of Komatiite.
6. Which one of the following minerals does *not* belong to pyroxene group ? D
- Omphacite
 - Kosmochlor
 - Pigeonite
 - Eckermannite
7. Which one of the following statements in relation to CO_2 with silicate melts is correct ?
- CO_2 has lower solubility in melts with low polymerization. ---
 - CO_2 has higher solubility in melts with low polymerization.
 - CO_2 has higher solubility in melts with high polymerization.
 - CO_2 has lower solubility in melts with high polymerization.

8. The best-known synthetic analog of mantle composition is :

- (a) Pyrolite **A**
- (b) Spinel Lherzolite
- (c) Garnet Lherzolite
- (d) Peridotite

9. Ultramafic rock containing model values of Olivine (50%), Orthopyroxene (30%), Clinopyroxene (12%) and Spinel (8%) is classified under which one of the following ?

- (a) Websterite **B**
- (b) Lherzolite
- (c) Harzburgite
- (d) Troctolite

10. Stocks and batholiths are primarily distinguished on the basis of :

- (a) Shape **D**
- (b) Depth of emplacement
- (c) Mineralogical composition
- (d) Areal extent

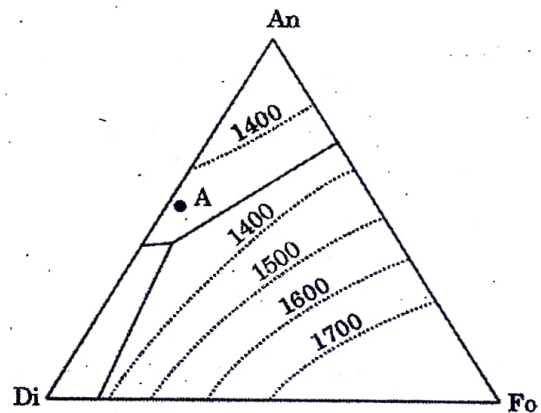
11. The texture in which exsolution lamellae of K-feldspar that occurs in albite host is called :

- (a) Antiperthite **A**
- (b) Perthite
- (c) Ocelli
- (d) Graphic intergrowth

12. A porphyritic basalt contains phenocrysts of plagioclase surrounded by glassy groundmass. Which one of the following statements on the petrogenesis of the basalt is correct ? **C**

- (a) Both plagioclase and groundmass crystallized at the deeper level of the crust.
- (b) Both plagioclase and groundmass formed during eruption of the basalt.
- (c) Plagioclase crystallized at deeper level of the crust, while the groundmass solidified at shallower depth.
- (d) Plagioclase crystallized at shallower depth during eruption of the basalt, while the groundmass solidified at deeper level of the crust.

13. Consider the following phase diagram :



What will be the correct sequence of appearance of the minerals for the equilibrium crystallization of magma with the bulk composition marked by point "A" in the diagram ?

- (a) Anorthite → Forsterite → Diopside
- (b) Forsterite → Anorthite → Diopside **D**
- (c) Forsterite → Diopside → Anorthite
- (d) Anorthite → Diopside → Forsterite

14. As per the Bowen's reaction series, which one of the following represents the correct order of crystallization of minerals? **D**

- (a) Olivine → Biotite → Mg-pyroxene → Amphibole → Mg-Ca pyroxene
- (b) Biotite → Olivine → Mg-Ca pyroxene → Mg-pyroxene → Amphibole
- (c) Mg-pyroxene → Mg-Ca pyroxene → Olivine → Amphibole → Biotite
- (d) Olivine → Mg-pyroxene → Mg-Ca pyroxene → Amphibole → Biotite

15. Which one of the following mechanisms facilitate separation of crystals and liquid when the amount of trapped intercumulus liquid between cumulate minerals is > 60 vol.%? **B**

- (a) Flow segregation
- (b) Filter pressing
- (c) Gravity settling
- (d) Grain dispersive pressure

16. The idea, that many of the features of the landscape were to be explained by rapidly occurring events, is given by the principle of:

- (a) Uniformitarianism
- (b) Catastrophism **B**
- (c) Unconformities
- (d) Gradualism

17. The inclusions in meteorites considered to be droplets that have condensed from the original solar nebula from which the solar system derives, are known as:

- (a) Chondrules
- (b) Chondrites **A**
- (c) Achondrite
- (d) Eucrite

18. What is the average albedo of whole Earth?

- (a) 0.5 **C**
- (b) 0.1
- (c) 0.3
- (d) 0.7

19. Match List-I with List-II and select the correct answer using the code given below the lists:

List-I
(Type of magma/lava/external form)

List-II **B**
(Volcanic features)

- P. Pahoehoe lava flow
- Q. Aa lava flow
- R. Mafic magma
- S. Felsic magma
- 1. Explosive eruption
- 2. Smooth surface
- 3. Quiet eruption
- 4. Form blocks and rough surface

Code :

	P	Q	R	S
(a)	1	4	3	2
(b)	2	4	3	1
(c)	1	3	4	2
(d)	2	3	4	1

20. In some cases, the sediments on the downgoing plate are added to the accretionary prism when the basal thrust of the prism propagates into the downgoing sediments, forming a duplex structure and adding the sediments to the bottom of the accretionary prism. This process is called :

- (a) Obduction
- (b) Subduction **A**
- (c) Underplating
- (d) Accretion

21. Widespread asymmetrical bulges along continental edges that fall directly into the sea with steeper slope towards the coast are called :

- (a) Great escarpment **B**
- (b) Marginal swells
- (c) Fall line
- (d) Outlying plateau

22. Glacial drift represents :

- (a) Glacial sediments transported from accumulation zone
- C** (b) Coarse grained sediments transported by glacier
- (c) Sediment eroded by glaciers and transported by meltwater
- (d) All types of glacier transported sediments

23. In a delta, the thick layer consisting of coarse particles that drop soon after entering the water body is called :

- (a) Foreset layer **C**
- (b) Bottomset layer
- (c) Topset layer
- (d) None of the above

24. Which one of the following is *not* correctly matched ?

- (a) Mississippi River delta **B** : River-dominated delta
- (b) Ganges-Brahmaputra delta : River-dominated delta
- (c) Nile River delta : Wave-dominated delta
- (d) Fly River delta : Tide-dominated delta

25. A nearly horizontal or landward sloping bench developed due to deposition of sediments by ocean waves is called :

- (a) Wave-cut bench **B**
- (b) Berm
- (c) Beach
- (d) Marine platform

26. Kaolinite is generally a weathering product of which one of the following minerals ?

- (a) Feldspar
- (b) Muscovite **A**
- (c) Biotite
- (d) Carbonates

27. Consider the following statements regarding soil formation :

1. Similar soils can develop from different parent materials.
2. Time is not an important component.
3. Climate is more important than other factors in formation of soils.

Which of the statement(s) given above is/are correct ?

- (a) 1 and 2
- (b) 1 and 3 **C**
- (c) 2 and 3
- (d) 2 only

28. Poisson's ratio is :

B

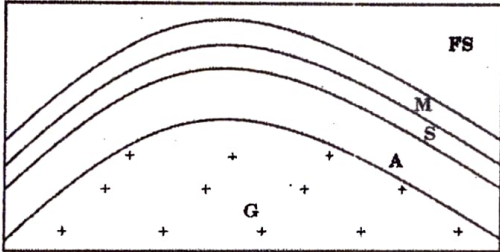
- (a) Axial strain / Transverse strain
- (b) Transverse strain / Axial strain
- (c) Elastic strain / Shear strain
- (d) Shear strain / Linear strain

29. The difference between the total stress and the mean stress of a geological system is called :

C

- (a) Deviatoric stress
- (b) Hydrostatic stress
- (c) Differential stress
- (d) Normal stress

30. Consider the following geological section of a folded terrain and the corresponding statements :



Codes : G-Archean Granite,
 A-Cambrian Arkose,
 S-Cambrian Shale,
 M-Miocene Mudstone,
 FS-Fine Sandstone

- 1. The rock sequences contain a disconformity.
- 2. The rock sequences contain a nonconformity.
- 3. Unconformity formed prior to folding.
- 4. Granite body got emplaced in the core of anticlinal fold.

Which of the statements given above are correct ?

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

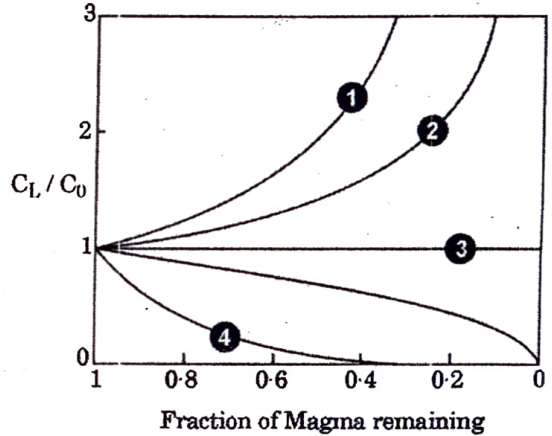
C

31. Which one of the given trace element ratios can be used to discriminate olivine fractionation from clinopyroxene fractionation ?

D

- (a) La/Y
- (b) K/Rb
- (c) Sr/Ba
- (d) Ni/Cr

32. Consider the following diagram related to Rayleigh fractionation showing the enrichment/depletion (C_L) of trace elements in a crystallizing magma relative to their concentrations in the original melt (C_0) :



Which one of the following statements is correct with respect to the above diagram ?

- (a) Elements (1) and (2) are incompatible while elements (3) and (4) are compatible.
- (b) Elements (1) and (2) are compatible while elements (3) and (4) are incompatible.
- (c) Elements (1) and (2) are incompatible while element (4) is compatible.
- (d) Element (3) partitions equally into solids and melt while element (4) partitions preferentially into the melt.

C

33. Which one of the following is *not* a potassic group of rocks ?
- (a) Lamproite **C**
 (b) Kimberlite
 (c) Komatiite
 (d) Shoshonite
34. Which one of the following is the most appropriate example of high-stress metamorphism ? **A**
- (a) Dynamic metamorphism
 (b) Contact metamorphism
 (c) Burial metamorphism
 (d) Ocean-floor metamorphism
35. Which one of the following type of metamorphic reactions can be successfully used for Geothermometry ? **D**
- (a) Reactions involving fluid
 (b) Polymorphic transition reactions
 (c) Terminal reactions
 (d) Exchange reactions
36. The low temperature limit of metamorphism is generally considered to be :
- (a) $350^{\circ}\text{C} \pm 50^{\circ}\text{C}$ **C**
 (b) $50^{\circ}\text{C} \pm 50^{\circ}\text{C}$
 (c) $150^{\circ}\text{C} \pm 50^{\circ}\text{C}$
 (d) $450^{\circ}\text{C} \pm 50^{\circ}\text{C}$
37. The cleavage related to micro-folding of pre-existing foliation is called :
- (a) Fracture cleavage **C**
 (b) Lineation
 (c) Crenulation cleavage
 (d) Slaty cleavage
38. In a metamorphic rock, when solution transfer dissolves a matrix mineral from high-stress areas and reprecipitates it in low-stress areas adjacent to a porphyroblast, it produces : **B**
- (a) Kink bands
 (b) Pressure shadow zones
 (c) Deformation twins
 (d) Micro-boudinage
39. A type of granoblastic texture found in a fine grained rock in the contact aureole of an intrusion is called :
- (a) Hornfels **C**
 (b) Porphyroblast
 (c) Mosaic texture
 (d) Idioblast
40. Porphyroblasts which grow over randomly oriented grains in matrix, prior to the development of foliation are called :
- (a) Inter-tectonic porphyroblasts **B**
 (b) Pre-tectonic porphyroblasts
 (c) Syn-tectonic porphyroblasts
 (d) Post-tectonic porphyroblasts

41. During progressive regional metamorphism of Fe-rich aluminous pelites, staurolite is produced at the cost of :

- (a) Biotite **A**
- (b) Kyanite
- (c) Muscovite
- (d) Chloritoid

42. The stable mineral assemblage hornblende + plagioclase \pm garnet \pm epidote in a mafic protolith represents the :

- (a) Amphibolite facies **A**
- (b) Blueschist facies
- (c) Granulite facies
- (d) Eclogite facies

43. In low P/T type of prograde metamorphism, which one of the following is most appropriate ? **A**

- (a) Andalusite is converted to sillimanite
- (b) Sillimanite is converted to andalusite
- (c) Kyanite is converted to sillimanite
- (d) Sillimanite is converted to kyanite

44. A calc-silicate rock formed by metasomatic interaction between marble and granitic intrusion is called :

- (a) Skarn **A**
- (b) Greenstone
- (c) Charnockite
- (d) Khondalite

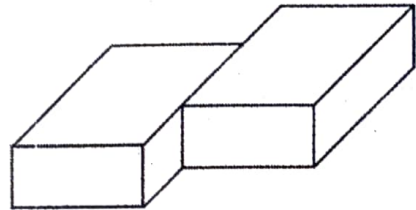
45. Presence of the characteristic assemblage of garnet + clinopyroxene + plagioclase \pm hornblende is characteristic of which facies ? **A**

- (a) Granulite facies
- (b) Eclogite facies
- (c) Blueschist facies
- (d) Amphibolite facies

46. The L-S tectonite is : **A**

- (a) A strongly deformed rock dominated by both linear and planar fabric elements
- (b) A rock subjected to listric faulting
- (c) A rock produced by intense crushing
- (d) A rock subjected to only severe linear stretching

47. Consider the following diagram of fault and the corresponding statements :



1. The hanging wall has moved neither up nor down, but displaced horizontally relative to the foot wall in the fault.
2. The fault is a strike fault.
3. The fault is a left-handed strike-slip fault.
4. The slickenside lineation formed due to faulting is expected to be horizontal.

Which of the statements given above are correct ? **A**

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

48. Consider the following statements :

1. An antithetic fault dips towards the master fault.
2. An antithetic fault dips in the same direction as the master fault.
3. A synthetic fault dips towards the master fault.
4. A synthetic fault dips in the same direction as the master fault.

Which of the statement(s) given above is/are correct ?

- (a) 1 and 4 **D**
(b) 2 and 3
(c) 1 only
(d) 2 only

49. The angle of internal friction (ϕ) of a rock is 28° . According to the Coulomb failure criterion, the acute angle between two conjugate shear fracture planes formed in the rock should ideally be :

- (a) 28°
(b) 58° **A**
(c) 60°
(d) 62°

50. Consider the following statements regarding homogeneous deformation due to shearing :

1. Straight lines remain straight after deformation.
2. Straight lines become curved after deformation.
3. Parallel lines remain parallel after deformation.
4. Parallel lines lose their parallelism after deformation.

Which of the statement(s) given above is/are correct ?

- (a) 1 only **B**
(b) 1 and 3
(c) 2 and 3
(d) 1 and 4

51. The section of a mylonite on which the asymmetric shear-sense indicators are best observed and analyzed is : **B**

- (a) Parallel to the mylonitic foliation and perpendicular to the aggregate lineation
(b) Perpendicular to the mylonitic foliation and parallel to the aggregate lineation
(c) Parallel to the mylonitic foliation and parallel to the stretching lineation
(d) Perpendicular to the mylonitic foliation and perpendicular to the stretching lineation

52. In a river valley a dipping bed shows a straight linear outcrop across the river on the geological map. The bed is :

- (a) Folded **B**
(b) Vertical
(c) Dipping at an angle less than valley slope in downstream direction
(d) Dipping at an angle more than valley slope in upstream direction

53. Which one of the following statements regarding the outcrop pattern of a reclined fold is correct ? **C**

- (a) The fold axis trends nearly at 45° to the axial trace of the fold.
(b) The fold axis plunges towards the concave side of the fold outcrop.
(c) The fold axis trends nearly at a right angle to the axial trace of the fold.
(d) The outcrop pattern of the fold is closed with an eye-shaped geometry.

54. A limestone bed strikes N30°E and dips 70° towards SE. What should be the expected dip of the bed if it is seen on a E-W road section ?

- B**
- (a) 8° towards east
 - (b) 67° towards east
 - (c) 78° towards west
 - (d) 45° towards west

55. If in a crystal, the glide component is represented by $\frac{a}{2} + \frac{b}{2}$, $\frac{a}{2} + \frac{c}{2}$, $\frac{b}{2} + \frac{c}{2}$ or $\frac{a}{2} + \frac{b}{2} + \frac{c}{2}$, then the glide is called :

- (a) a glide
- (b) Diagonal glide
- (c) Diamond glide
- (d) c glide

56. An open crystal form composed of 3, 4, 6, 8 or 12 faces, all of which are parallel to the same axis, is called :

- B**
- (a) Pyramid
 - (b) Prism
 - (c) Pinacoid
 - (d) Sphenoid

57. Which one among the following pairs is *not* correctly matched ?

- D**
- (a) Pyrope : $Mg_3Al_2Si_3O_{12}$
 - (b) Almandine : $Fe_3Al_2Si_3O_{12}$
 - (c) Spessartine : $Mn_3Al_2Si_3O_{12}$
 - (d) Uvarovite : $Ca_3Al_2Si_3O_{12}$

58. Consider the following statements :

Statement 1 :

The relative importance of crystal forms is proportional to the point densities or spacings of the respective lattice planes.

Statement 2 :

The rate of crystal growth in any lattice direction is proportional to the point density in that direction.

The above statements belong to which rule/law ?

- B**
- (a) Pauling's Rules
 - (b) Bravais Law
 - (c) Bragg's Law
 - (d) Stokes' Law

59. Spinel group is an example of :

- B**
- (a) Polymorphism
 - (b) Isomorphism
 - (c) Pseudomorphism
 - (d) Paramorphism

60. Consider the following statements regarding polymorphism :

Statement 1 :

Polytypism is a variety of polymorphism.

Statement 2 :

It involves stacking of identical layers in different sequences within a structure which have same unit cell lengths in two dimensions but commonly have a different cell length in the third dimension, which is essentially perpendicular to the layers.

Which one of the following is correct in respect of the above statements ?

- A**
- (a) Both statement 1 and statement 2 are true and statement 2 is the correct explanation of statement 1.
 - (b) Both statement 1 and statement 2 are true, but statement 2 is *not* the correct explanation of statement 1.
 - (c) Statement 1 is true, but statement 2 is false.
 - (d) Statement 1 is false, but statement 2 is true.

61. The Banded Gneissic Complex forms the basement of : **A**

- (a) Aravali Group
- (b) Papaghni Group
- (c) Singhbhum Group
- (d) Chitradurga Group

62. The Jhamarkotra Formation in the Aravali succession is well known for : **C**

- (a) Iron ore deposits
- (b) Gold deposits
- (c) Phosphorite deposits
- (d) Copper deposits

63. Varangian Glaciation occurred during :

- (a) Cenozoic **D**
- (b) Mesozoic
- (c) Paleoproterozoic
- (d) Neoproterozoic

64. The placer diamond-bearing conglomerate horizon of Vindhyan Supergroup is present within :

- (a) Rewa Group **A**
- (b) Rohtas Formation
- (c) Kaimur Group
- (d) Kheinjua Formation

65. Which one of the following is the youngest marine formation of the Himalayas ?

- (a) Dagshai Formation **B**
- (b) Kasauli Formation
- (c) Pinjor Formation
- (d) Subathu Formation

66. Panjal volcanics of Lidar valley of Kashmir belong to :

- (a) Permian **A**
- (b) Ordovician
- (c) Cretaceous
- (d) Carboniferous

67. Match List-I with List-II and select the correct answer using the code given below the lists :

<i>List-I</i> (Mineral)	<i>List-II</i> (Mineral class)
P. Spodumene	1. Sulphosalt
Q. Cassiterite	2. Silicate
R. Galena	3. Sulphide
S. Tetrahedrite	4. Oxide

Code :

	P	Q	R	S	
(a)	1	3	4	2	D
(b)	2	3	4	1	
(c)	1	4	3	2	
(d)	2	4	3	1	

68. Consider the following statements :

Statement 1 :

Higher concentration of chromium is found in felsic rocks of continental crust.

Statement 2 :

Podiform chromitites are never hosted in granitic rocks.

Which of the statement(s) given above is/are correct ?

- (a) 1 and 2 **C**
(b) 1 only
(c) 2 only
(d) Neither 1 nor 2

69. Mineralization within the open spaces of a breccia or any other fragmental rock, that produces a special pattern of symmetrical banding or crustification together with host rock fragments coated with layers of inward radiating crystals is called : **C**

- (a) Cockade structure
(b) Colloform structure
(c) Comb structure
(d) Replacement texture

70. Consider the following statements regarding genesis of mineral deposits :

1. Stratiform chromite deposits are formed by weathering of ultramafic rocks.
2. Nickeliferous laterite is a type of palaeo-placer deposit.
3. Gold bearing quartz veins are formed by hydrothermal process.

Which of the statement(s) given above is/are correct ?

- (a) 1 only **C**
(b) 1 and 2
(c) 2 and 3
(d) 3 only

71. Hydrothermal processes rarely yield Ni and V ore deposits. Which of the following statement(s) is/are the correct explanation for this ?

1. Ni and V do not form strongly soluble complexes with common ligands in hydrothermal fluids.
2. Hydrothermal deposits form only in continental crust that has a poor concentration of Ni and V.

Select the answer using the code given below :

- (a) 1 only
(b) 2 only **A**
(c) Both 1 and 2
(d) Neither 1 nor 2

72. Which one of the following type of ore deposits is formed by hydrothermal process, but without any direct link to igneous activity ?

- (a) Porphyry Cu
(b) Sedex type Zn-Pb **B**
(c) Skarn W
(d) Greisen Sn

73. Match List-I with List-II and select the correct answer using the code given below the lists :

<i>List-I</i> (Mineral)	<i>List-II</i> (Element)
P. Sphalerite	1. Tin
Q. Cuprite	2. Copper
R. Cassiterite	3. Silver
S. Argentite	4. Zinc

Code :

	P	Q	R	S
(a)	4	1	2	3
(b)	4	2	1	3
(c)	3	1	2	4
(d)	3	2	1	4

74. Assume that a stream is carrying identical size of detrital grains of chromite, magnetite, diamond and garnet. After repeated reworking of sediments in a clastic sedimentary environment, which one of the following minerals will have the largest grain size?

- (a) Chromite **B**
- (b) Diamond
- (c) Magnetite
- (d) Garnet

75. Consider the following statements with reference to formation of sedimentary Fe and Mn deposits:

Statement 1:

In modern environment, Mn is better soluble in surficial water as against Fe.

Statement 2:

The boundary between the conditions at which Mn^{2+} and Mn^{4+} species are dominant, is at lower oxidation levels than the equivalent boundary for Fe^{2+} and Fe^{3+} species.

Which of the statement(s) given above is/are correct?

- (a) Both 1 and 2 **A**
- (b) 1 only
- (c) 2 only
- (d) Neither 1 nor 2

76. Calcite, gypsum and apatite are termed as:

- (a) Carbonaceous constituents
- (b) Siliciclastic constituents **C**
- (c) Chemical/biochemical constituents
- (d) Terrigenous constituents

77. Three straight line segments are ideally demarcated when cumulative percentage data of sediment having normal grain size distribution is plotted on log probability paper. Which one of the following represents the correct ascending order of incidence among the three line segments? **A**

- (a) Traction population — Saltation population — Suspension population
- (b) Saltation population — Traction population — Suspension population
- (c) Suspension population — Saltation population — Traction population
- (d) Traction population — Suspension population — Saltation population

78. Which one of the following methods of grain size measurement is *not* preferred for unconsolidated fine-size sediment (fine silt and clay)?

- (a) Sedigraph **D**
- (b) Pipette analysis
- (c) Sieving
- (d) Laser diffractometry

79. Rarely migrated sand ridges in an eolian environment with unusual heights and in alternately opposite directions are called :
- (a) Star dunes
 - (b) Reversing dunes **B**
 - (c) Seif dunes
 - (d) Parabolic dunes
80. The paleocurrent vector data from sedimentary rocks are commonly plotted on a circular histogram. The diagram is called :
- (a) Flower structure **B**
 - (b) Rose diagram
 - (c) Fence diagram
 - (d) Pie diagram
81. Small lenses of sand in muddy beds, formed when sandy ripple is trapped in a muddy substrate, are called :
- (a) Herring-bone cross-strata
 - (b) Flaser bedding **D**
 - (c) Wavy bedding
 - (d) Lenticular bedding
82. Based on depositional texture, an allochthonous limestone, with mud-supported fabric and > 10% grains of 0.03 - 2 mm size, is termed as :
- (a) Packstone **C**
 - (b) Floatstone
 - (c) Wackestone
 - (d) Grainstone
83. Quartz arenite is a sandstone that contains :
- (a) At least 90% quartz and more than 15% matrix **B**
 - (b) At least 95% quartz and less than 15% matrix
 - (c) At least 90% quartz and less than 15% matrix
 - (d) At least 95% quartz and more than 15% matrix
84. Hamada are the rocky terrains with vertical cliffs and flat rock surfaces in a :
- (a) Desert **A**
 - (b) Glacier valley
 - (c) Beach
 - (d) Delta plain
85. A broad expanse of unconfined sediment-laden runoff water that moves downslope in an alluvial fan surface at times of catastrophic discharge is referred to as :
- (a) Debris flow **A**
 - (b) Sheetflood
 - (c) Incised-channel flow
 - (d) Landslides

86. Consider the following statements regarding lahars :

Statement 1 :

A lahar is a debris flow that contains a significant proportion of material of volcanic origin.

Statement 2 :

Lahar is formed as a result of mixing of unconsolidated volcanic material with water and subsequent movement of the dense mixture as a sediment gravity flow.

Which one of the the following is correct in respect of the above statements ?

- (a) Both the statements 1 and 2 are true and statement 2 is the correct explanation of statement 1. **A**
- (b) Both the statements 1 and 2 are true but statement 2 is *not* the correct explanation of statement 1.
- (c) Statement 1 is true, but statement 2 is false.
- (d) Statement 1 is false, but statement 2 is true.

87. During diagenesis of carbonate rocks, all transformations of one mineral to itself or a polymorph, is called :

- (a) Replacement **D**
- (b) Recrystallization
- (c) Inversion
- (d) Neomorphism

88. When the organism's original skeleton materials have been washed away by the presence of pore water but replica of hard part is preserved, the related process is termed as :

- (a) Molding
- (b) Permineralization **A**
- (c) Replacement process
- (d) Recrystallization

89. In a branching diagram that depicts proximity of relationship amongst species without a temporal dimension, the points where the branches join are termed as :

- (a) Clade
- (b) Sister clade **C**
- (c) Nodes
- (d) Lineage sequence

90. A variety of dentition patterns are observed in Bivalves. Dentition pattern helps in classification of Bivalves. The correct dentition pattern which shows numerous subequal teeth arrangement in a sub parallel pattern is :

- (a) Taxodont **A**
- (b) Actinodont
- (c) Heterodont
- (d) Desmodont

91. Finely divided plant residue composed of resistant plant products is called :

- (a) Anthraxylon
- (b) Attritus
- (c) Durain **C**
- (d) Clarain

92. Consider the following statements regarding petroleum generation :

Statement 1 :

Thermal cracking process refers to the early biological and chemical changes that occur in organic-rich sediments at less than 50°C.

Statement 2 : Catalytic cracking is the dominant process in petroleum generation up to about 120°C.

Which of the statement(s) given above is/are correct ?

- (a) Both 1 and 2
- (b) 1 only **---**
- (c) 2 only
- (d) Neither 1 nor 2

93. Match List-I with List-II and select the correct answer using the code given below the lists :

<i>List-I</i> (Mineral deposit)	<i>List-II</i> (Location)
P. Sillimanite	1. Jhamarkotra
Q. Magnesite	2. Mangampeta
R. Phosphorite	3. Salem
S. Barite	4. Sonapahar

Code :

	P	Q	R	S
(a)	2	1	3	4
(b)	2	3	1	4
(c)	4	3	1	2
(d)	4	1	3	2

94. Consider the following statements regarding storage coefficient :

1. Storage coefficient can best be determined from pumping tests of wells.
2. Storage coefficient for an unconfined aquifer corresponds to its specific yield.

Which of the statement(s) given above is/are correct ?

- (a) 1 only **C**
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

95. The correct order of decreasing permeability of confining layers is :

- (a) Aquitards, Aquifuges, Aquicludes **B**
- (b) Aquitards, Aquicludes, Aquifuges
- (c) Aquifuges, Aquicludes, Aquitards
- (d) Aquifuges, Aquitards, Aquicludes

96. A ten-meter thick confined aquifer has hydraulic conductivity of 10 m/day. The groundwater discharge through one meter saturated width of the aquifer under influence of the hydraulic gradient of 0.01 would be :

- (a) 10 m³/day
- (b) 100 m³/day **C**
- (c) 1 m³/day
- (d) 0.1 m³/day

97. Which of the following are examples of secondary porosity?

1. Fractures
2. Solution openings
3. Bedding planes
4. Openings formed by plants

Select the correct answer using the code given below :

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

C

98. Match List-I with List-II and select the correct answer using the code given below the lists :

<i>List-I</i> (Hydrologic parameter)	<i>List-II</i> (Unit)
P. Porosity	1. m^2/s
Q. Hydraulic conductivity	2. m/s
R. Transmissivity	3. m
S. Head loss	4. Unit less

Code :

	P	Q	R	S
(a)	3	1	2	4
(b)	4	2	1	3
(c)	4	1	2	3
(d)	3	2	1	4

B

99. In a homogeneous aquifer :

- (a) There is a spatial variation in the value of Transmissivity.
- (b) There is directional variation in the value of Transmissivity and it varies in space.
- (c) There is no directional variation in the value of Transmissivity and it is different at different locations.
- (d) There is no spatial variation in the value of Transmissivity and it is same at all locations.

D

100. Consider the following statements regarding Darcy's law :

1. Rate of flow through porous media is proportional to the head loss.
2. Rate of flow through porous media is inversely proportional to the head loss.
3. Rate of flow through porous media is proportional to the length of flow path.
4. Rate of flow through porous media is inversely proportional to the length of flow path.

Which of the statements given above are correct?

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

D

101. Which one of the following is the correct expression for Reynolds number (N_R)?
(given ρ = fluid density, v = velocity of fluid, D = diameter of fluid pathway, μ = dynamic viscosity of fluid)

(a) $N_R = \frac{\rho\mu D}{v}$ **D**

(b) $N_R = \frac{\rho D}{v\mu}$

(c) $N_R = \frac{\mu v D}{\rho}$

(d) $N_R = \frac{\rho v D}{\mu}$

102. A groundwater sample contains 16 meq/L, 80 meq/L and 48 meq/L of Na^+ , Ca^{2+} and Mg^{2+} respectively. What will be the Sodium Adsorption Ratio (SAR) of the groundwater sample?

(a) 5

(b) 1 **C**

(c) 2

(d) 3

103. Precipitation in areas with lower temperature or at higher latitudes will tend to have :

(a) Lower $\delta^{2\text{H}}$ and lower $\delta^{18\text{O}}$ values **A**

(b) Lower $\delta^{2\text{H}}$ and higher $\delta^{18\text{O}}$ values

(c) Higher $\delta^{2\text{H}}$ and lower $\delta^{18\text{O}}$ values

(d) Higher $\delta^{2\text{H}}$ and higher $\delta^{18\text{O}}$ values

104. Soil Aquifer Treatment (SAT) involves :

(a) Treatment of soil for better fertility

(b) Infiltration of untreated sewage effluent to the aquifer through recharge basins

(c) Infiltration of appropriately treated sewage effluent to the aquifer through recharge basins for improvement in water quality

(d) Injection of saline water into soil and aquifer **C**

105. Consider the following statements regarding artificial recharge of groundwater projects :

1. They are designed to maintain or augment the natural groundwater resource.

2. They are designed to reduce or stop significant land subsidence.

3. They are designed to conserve or extract energy in the form of hot or cold water.

Which of the statement(s) given above is/are correct ?

(a) 3 only **B**

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

106. What is the total geological range of *Turritella* ?

- (a) Miocene to Recent
- (b) Cretaceous to Recent
- (c) Cambrian to Recent
- (d) Paleogene to Recent

B

107. Gastropods egg turns into planktic larvae after hatching. The larvae are termed as :

- (a) Veliger
- (b) Trochophores
- (c) Velum
- (d) Osphradium

A

108. The most primitive type of eyes in Trilobites are known as :

- (a) Holochroal
- (b) Schizochroal
- (c) Abatochroal
- (d) Hypostoma

A

109. Brachiopods are sessile marine organisms and they are divided into number of classes on the basis of :

- (a) Two dissimilar but equilateral valves
- (b) Presence and absence of hinge structure
- (c) Presence of pedicle valve
- (d) Presence or absence of brachial valves

B

110. Which one of the following represents the correct sequence of evolution of horses ?

- (a) Merychippus - Parahippus - Pliohippus - Equus
- (b) Equus - Merychippus - Parahippus - Pliohippus
- (c) Mesohippus - Parahippus - Pliohippus - Equus
- (d) Parahippus - Mesohippus - Pliohippus - Equus

C

111. *Homo erectus* evolved during :

- (a) Pleistocene
- (b) Holocene
- (c) Pliocene
- (d) Miocene

A

112. Which one of the following microfossil's higher abundance records can be used to decipher intensified Southwest Monsoonal Wind (summer monsoon) in the Western Arabian Sea ?

- (a) *Globigerinoides sacculifer*
- (b) *Globigerina bulloides*
- (c) *Globigerinoides ruber*
- (d) *Globorotalia menardii*

C

113. Microfossil groups have a variety of shells or hard skeleton to protect their soft body parts. The term 'carapace' refers to the shell of :

- (a) Diatom
- (b) Radiolaria
- (c) Ostracoda
- (d) Conodont

C

114. Which of the following Fossil group(s) could be used to do paleobiogeographic study of Gondwana Supergroup during Carboniferous and Permian Periods ?

- (a) Ammonoids
- (b) Glossopteris fauna only
- (c) Mesosaurus flora only
- (d) Both Glossopteris fauna and Mesosaurus flora

B

115. Match List-I with List-II and select the correct answer using the code given below the lists :

<i>List-I</i> (Example)	<i>List-II</i> (Time Unit)
P. Miocene	1. Period
Q. Cretaceous	2. Era
R. Palaeozoic	3. Age
S. Meghalayan	4. Epoch

Code :

	P	Q	R	S	
(a)	3	2	1	4	D
(b)	3	1	2	4	
(c)	4	2	1	3	
(d)	4	1	2	3	

116. Consider the following granitic bodies :

1. Erinpura Granite
2. Closepet Granite
3. Singhbhum Granite

Which one of the following represents the correct order of granitic bodies according to their timing of emplacement (older to younger) ?

- (a) 3 → 2 → 1
- (b) 3 → 1 → 2 **A**
- (c) 1 → 2 → 3
- (d) 2 → 3 → 1

117. Law of Superposition is applicable to a sequence of rock strata where the contacts are :

- (a) Unconformable
- (b) Faulted **D**
- (c) Thrusted
- (d) Conformable

118. Which one of the following lithostratigraphic units is known for manganese ores ?

- (a) Singhbhum Granite
- (b) Sausar Group **B**
- (c) Dongargarh Granite
- (d) Betul Supergroup

119. The shield areas of various cratons evolved in four stages. One of these stages termed 'avlacogens' refers to the :

- (a) Earliest stage
- (b) Last stage **B**
- (c) Third stage
- (d) Second stage

120. Which one of the following represents the correct ascending stratigraphic order for Precambrian rocks of Bastar Craton ? **A**

- (a) Amgaon Group - Sausar Group - Nandgaon Group - Dongargarh Granite **A**
- (b) Dongargarh Granite - Sausar Group - Amgaon Group - Nandgaon Group
- (c) Nandgaon Group - Dongargarh Granite - Sausar Group - Amgaon Group
- (d) Sausar Group - Nandgaon Group - Dongargarh Granite - Amgaon Group