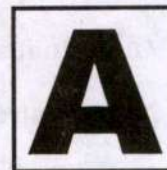

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

T.B.C. : FTRE-B-GHY

Test Booklet Series

Serial No. 1007201

TEST BOOKLET
PAPER—II



(Geology/Hydrogeology)

Time Allowed : Two Hours

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.

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4. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case, you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. *All* items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.
 - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
 - (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
 - (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. A common mistake in the study of the earth processes is to equate uniformitarianism with
 - (a) actualism
 - (b) catastrophism
 - (c) directionalism
 - (d) neocatastrophism

2. The process of differentiation explains low concentration of which one of the following elements near the earth surface?
 - (a) Iron
 - (b) Manganese
 - (c) Zinc
 - (d) Chromium

3. Water vapour constitutes what percentage of all volcanic gases?
 - (a) 5%–10%
 - (b) 15%–25%
 - (c) 30%–50%
 - (d) 50%–80%

4. Which one of the following is **not** related to volcanic and plutonic landforms?
 - (a) Lopolith
 - (b) Coulee
 - (c) Scoria cone
 - (d) Flatiron

5. Canada's Hudson Bay has gradually uplifted by 300 m in last 8000 years due to
 - (a) tectonic uplift
 - (b) isostatic adjustment
 - (c) orogenesis
 - (d) compression of the region

6. Consider the following statements regarding palaeomagnetic variations across the mid-oceanic ridges :
 1. Symmetrical magnetic intensity pattern is recorded in the ocean floor rocks across the ridges.
 2. The alternating magnetic stripes mirrored on opposite sides of the ridge axis are created by basaltic magma during times of normal and reversed polarities.
 3. Reversals of the magnetic field have occurred many times during the geological past and are simultaneous worldwide events.

Which of the statements given above are correct?

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

7. Which one of the following is the correct idealized sequence of stages in the evolution of a karst topography in temperate regions?

- (a) Nearly flat surface → Maximum relief → Low, conical knolls
- (b) Nearly flat surface → Low, conical knolls → Maximum relief
- (c) Maximum relief → Low, conical knolls → Nearly flat surface
- (d) Low, conical knolls → Nearly flat surface → Maximum relief

8. Consider the following statements regarding morphometric properties of stream networks and drainage basins :

1. Drainage density is the mean length of stream channels per unit area.
2. Stream frequency is the number of stream segments per unit area.
3. Basin relief is the mean upslope distance from channels to watershed.

Which of the statements given above is/are correct?

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

9. The type of dune having characteristics intermediate between a transverse dune and a star dune is known as

- (a) barchanoid
- (b) linear
- (c) parabolic
- (d) reversing

10. Which one of the following pairs regarding type of glacier and its common characteristic is **not** correctly matched?

- (a) Cirque : Bowl-shaped depression
- (b) Fjord : Submerged coastal valley
- (c) Ice shelf : Coastal embayment
- (d) Ice field : Domal shape

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

<i>List-I</i> (Term)	<i>List-II</i> (Region)
A. Alcrete	1. Humid to sub-humid tropical
B. Calcrete	2. Very arid
C. Gypcrete	3. Semi-arid
D. Silcrete	4. Humid and arid tropical

Code :

- (a) A B C D
1 2 3 4
- (b) A B C D
1 3 2 4
- (c) A B C D
4 3 2 1
- (d) A B C D
4 2 3 1

12. Which one of the following terms best describes the process of removal of metal ions from solids by binding with organic acids to form soluble organic matter-metal complexes?

- (a) Hydration
- (b) Hydrolysis
- (c) Dissolution
- (d) Chelation

13. Which one of the following statements regarding deformation is **not** correct?

- (a) If the stress is withdrawn, the body returns to its original shape and size, then the deformation is called elastic.
- (b) If the elastic limit is exceeded, the body does not return to its original shape and size.
- (c) Ductile substances are those that undergo a large plastic deformation before rupture.
- (d) In case of plastic deformation, the stress does not exceed elastic limit.

14. Consider the following statements regarding types of homogenous deformation :





1. Constriction is a pure triaxial strain that deforms a cube of material into an elongate rectangular prism for which one dimension of the cube is lengthened and other two dimensions are shortened.
2. Uniform dilation is a pure volumetric strain with change in the shape of deforming body.

3. Flattening is a pure uniaxial strain that deforms a cube of material into plate-like rectangular prism.

Which of the statements given above is/are correct?

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

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

<i>List-I</i> (Attitude of structure)	<i>List-II</i> (Map symbol)
A. Horizontal joint	1. 
B. Horizontal lineation trending NE	2. 
C. Vertical lineation	3. 
D. Horizontal foliation with horizontal lineation trending N45°W	4. 

Code :

- (a) A B C D
1 3 2 4
- (b) A B C D
4 3 2 1
- (c) A B C D
4 2 3 1
- (d) A B C D
1 2 3 4

16. Which one of the following statements regarding fabrics is **not** correct?

- (a) Linear fabric is characterized by elongate elements without a preferred orientation.
- (b) Planar fabric contains tabular or platy minerals or flat objects with common orientation.
- (c) Random fabric shows no preferred orientation of its elements.
- (d) Sedimentary and magmatic fabrics are also called primary fabrics.

17. Fault in which the displacement is essentially parallel to the strike of the fault is

- (a) detachment fault
- (b) wrench fault
- (c) peripheral fault
- (d) apparent normal fault

18. Consider the following statements regarding Ramsay's classification of folds :

1. Folds can be classified using three geometric parameters which are defined relative to a given pair of parallel lines that are tangent to inner (concave) and outer (convex) surfaces of the folded layers.
2. The orthogonal thickness t_{α} is the perpendicular distance between two parallel tangents.
3. The axial trace thickness T_{α} is the distance between the two tangents measured perpendicular to the axial surface.

Which of the statements given above are correct?

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

19. The diagram on a Cartesian plane in which the horizontal and vertical axes represent the normal stress (σ_n) and shear stress (σ_s) respectively, that act on a plane through a point, is called

- (a) Mohr diagram
- (b) phase diagram
- (c) QAPF diagram
- (d) TAS diagram

20. Consider the following statements regarding types of fractures classified on the basis of the relative motion that occurs across the fracture surface during its formation :

1. The relative motion during propagation in extension fractures is perpendicular to the fracture walls.
2. The relative motion during propagation in shear fractures is parallel to the fracture surface.
3. The oblique extension fracture has components of displacement both perpendicular and parallel to the fracture surface.

Which of the statements given above is/are correct?

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

21. Deformation bands in which mechanical grain breaking is significant are called

- (a) cataclastic bands
- (b) dilation bands
- (c) compaction bands
- (d) phyllosilicate bands

22. Which one of the following statements regarding outcrop pattern of horizontal strata is **not** correct?

- (a) The width of outcrop of a bed of uniform thickness is greatest where slopes are gentle.
- (b) The width of outcrop of a horizontal bed depends upon the thickness of the bed and upon the topography.
- (c) The outcrop of the top or bottom of a horizontal bed follows the topographic contours.
- (d) The width of outcrop of a bed of uniform thickness is maximum where the slopes are steep.

23. Consider the following related to range of physical properties of injected rocks in case of diapirs :

1. Solid rock that is thoroughly broken up and fractured with some liquid in the fractures
2. A loose aggregate of particles, buoyed up by gases or liquids that could be derived from either magmatic or sedimentary sources

3. Solid rock, which may have a small percentage of pore space and pore liquid

Which of the above is/are **not** correct?

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

24. Consider the following statements :

Statement-1 :

Stereographic projection differs from orthographic projection in a fundamental way.

Statement-2 :

Orthographic projection preserves spatial relation among structures but stereographic projection displays geometries and orientation of lines and planes without regard to spatial relation.

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

- (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 and 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

25. What will be the Miller indices of the crystal face having Weiss parameters $\infty a, 1b, \infty c$?

(a) (abc)

(b) (010)

(c) 011

(d) (a, b, c)

26. What will be the relationship between interfacial angles of similar faces of two olivine crystals separated in space and time?

(a) Same

(b) Different

(c) No relation

(d) Higher for larger crystal

27. In crystallography, how many plane lattices are possible?

(a) 4

(b) 5

(c) 6

(d) 14

28. Which one among the following is a phosphate mineral?

(a) Apatite

(b) Topaz

(c) Gypsum

(d) Corundum

29. How many oxygen atoms in each SiO_4 tetrahedra are shared in double-chain silicates?

(a) Two

(b) Three

(c) Half of the tetrahedra share 3 and other half share 2

(d) Four

30. Which one of the following feldspar compositions does **not** occur naturally?

(a) $\text{Or}_{56}\text{An}_{44}$

(b) $\text{An}_{56}\text{Ab}_{44}$

(c) $\text{Or}_{56}\text{Ab}_{44}$

(d) $\text{Or}_{26}\text{Ab}_{66}\text{An}_8$

31. Which type of chemical bond is found between Si and O in tetrahedral SiO_4 ?

- (a) Covalent
- (b) Ionic
- (c) 50% ionic and 50% covalent
- (d) Metallic

32. Si is in 6-fold coordination in which one of the following polymorphs of silica?

- (a) Tridymite
- (b) Cristobalite
- (c) Coesite
- (d) Stishovite

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

<i>List-I</i> (Silicate class)	<i>List-II</i> (Mineral)
A. Sorosilicate	1. Benitoite
B. Cyclosilicate	2. Kaolinite
C. Inosilicate	3. Epidote
D. Phyllosilicate	4. Spodumene

Code :

- (a) A B C D
2 4 1 3
- (b) A B C D
3 1 4 2
- (c) A B C D
2 1 4 3
- (d) A B C D
3 4 1 2

34. Olivine does not show cleavage. Consider the following possible reasons for this :

- 1. Bond strength is about equal in all directions.
- 2. SiO_4 tetrahedra is isolated.
- 3. There is no bridging oxygen.

Which of the above reasons is/are correct?

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

35. Which mineral is distinguished from pyroxene by its two sets of cleavage at angles of approximately 56° and 124° ?

- (a) Hornblende
- (b) Augite
- (c) Anorthite
- (d) Biotite

36. Based on which main physical property, muscovite and biotite can be distinguished?

- (a) Cleavage
- (b) Colour
- (c) Hardness
- (d) Habit

37. Which one of the following basaltic magmas with low K_2O content originates close to Benioff zone?

- (a) Mid-oceanic ridge basalt
- (b) Shoshonite
- (c) Boninite
- (d) Island arc tholeiite

38. Match List-I with List-II for polymerized Si-Al rich melts and select the correct answer using the code given below the Lists :

<i>List-I</i> (Ion type)	<i>List-II</i> (Common example)
A. Non-bridging ions	1. O
B. Bridging ions	2. OH
C. Network-modifying ions	3. Mg
D. Network-forming ions	4. Si

Code :

(a) A B C D
4 1 3 2

(b) A B C D
2 3 1 4

(c) A B C D
4 3 1 2

(d) A B C D
2 1 3 4

39. Which one of the following ultramafic rocks represents undepleted/fertile mantle?

- (a) Dunite
- (b) Harzburgite
- (c) Websterite
- (d) Lherzolite

40. Which one of the following rock types does **not** come under the IUGS classification of rocks?

- (a) Tonalite
- (b) Diorite
- (c) Dolerite
- (d) Troctolite

41. Clinopyroxene-bearing nephelinite is called

- (a) grazinite
- (b) ijolite
- (c) foyaite
- (d) grennaite

42. Alkali-feldspar rich metasomatic rock associated with carbonatite is known as

- (a) sovite
- (b) beforosite
- (c) rauhaugite
- (d) fenite

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

List-I
(Intrusive igneous body)

List-II
(Common form/ shape/occurrence)

- | | |
|---------------|---------------------------------------------------------------|
| A. Sill | 1. Non-tabular pluton with exposed area > 100 km ² |
| B. Cone sheet | 2. Concordant tabular body |
| C. Batholith | 3. Concordant pluton intrusive into structural basin |
| D. Lopolith | 4. Inward dipping nest of concentric cones |

Code :

(a) A B C D
3 1 4 2

(b) A B C D
3 4 1 2

(c) A B C D
2 4 1 3

(d) A B C D
2 1 4 3

44. Which one of the following crystal growth mechanisms can be explained by Flick's law?

- (a) Phase boundary reaction-controlled growth
- (b) Surface nucleation-controlled growth
- (c) Screw dislocation-controlled growth
- (d) Diffusion-controlled growth

45. Which of the following are directly controlled by the cooling rate of magma?

1. Rate of crystal growth
2. Rate of nucleation
3. Diffusion rate
4. Degree of undercooling of magma

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1 and 3 only

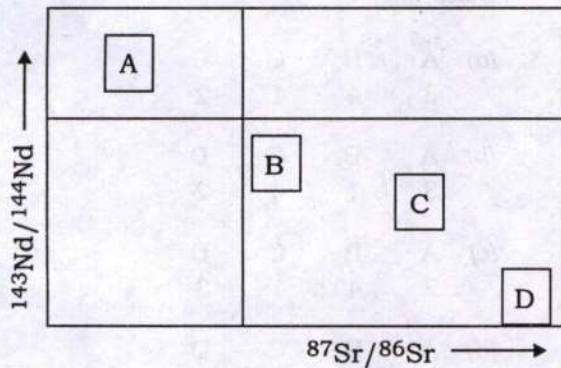
(c) 1, 2 and 3 only

(d) 1, 2, 3 and 4

46. In the $Mg_2SiO_4-SiO_2$ binary phase diagram (at 1 atm pressure), when the liquid reaches point X at 1557 °C, it begins to react with the crystals of forsterite to form enstatite and the liquid remains at point X until the enstatite-forming reaction has gone to completion. The point X is called
- (a) solvus point (b) peritectic point
(c) cotectic point (d) eutectic point

47. Consider the following four geochemical reservoirs :
1. Depleted mantle
 2. Enriched mantle-I
 3. Enriched mantle-II
 4. Continental crust

Identify the correct code as per their $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios shown in the diagram below.



Code :

- (a) A B C D
1 2 3 4
- (b) A B C D
1 3 2 4
- (c) A B C D
4 3 2 1
- (d) A B C D
4 2 3 1

48. Which one of the following rocks shows high LIL/HFS subduction signature?

- (a) Mid-oceanic ridge basalt
(b) Lamproite
(c) Anorthosite
(d) Continental flood basalt

49. Which one of the following chemical systems is closest to the composition of a shale?

- (a) $K_2O-FeO-MgO-Al_2O_3-SiO_2-H_2O$
(b) $CaO-FeO-MgO-Al_2O_3-SiO_2-H_2O$
(c) $Na_2O-FeO-MgO-Al_2O_3-SiO_2-H_2O$
(d) $K_2O-FeO-MgO-Al_2O_3-SiO_2$

50. Which one of the following characteristic minerals forms due to shock metamorphism and is normally **not** present on the earth?

- (a) Quartz
(b) Stishovite
(c) Labradorite
(d) Omphacite

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

<i>List-I</i> (Type of metamorphism)	<i>List-II</i> (Attribute)
A. Thermal metamorphism	1. Mylonites
B. Regional metamorphism	2. Metasomatism
C. Dynamic metamorphism	3. Hornfels
D. Hydrothermal metamorphism	4. Schistosity

Code :

(a) A B C D
3 1 4 2

(b) A B C D
3 4 1 2

(c) A B C D
2 1 4 3

(d) A B C D
2 4 1 3

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

<i>List-I</i> (Metamorphic structure)	<i>List-II</i> (Characteristic feature)
A. Gneissose structure	1. Perfectly developed foliation independent of bedding resulting from the parallel arrangement of very fine-grained phyllosilicates
B. Slaty cleavage	2. Regular layering on a centimetre or smaller scale
C. Lineation	3. Flaser structure/Augen structure
D. Foliation	4. Slickenside striations

Code :

(a) A B C D
3 4 1 2

(b) A B C D
3 1 4 2

(c) A B C D
2 4 1 3

(d) A B C D
2 1 4 3

53. Helicitic folds are indicator of post-kinematic porphyroblast growth because

(a) S_i is folded

(b) S_e is folded

(c) both S_i and S_e are not folded

(d) pressure shadows are developed

54. During compression one stress direction (σ_1) is dominant, which produces the deformation features known as
- fold or flattening
 - tension fracture
 - pure shear
 - lithostatic pressure
55. Deformation through change of shape of grains by crystal plasticity is known as
- dislocation creep
 - diffusion creep
 - grain boundary sliding
 - brittle deformation
56. Which facies represent the essential assemblage of omphacite-garnet-kyanite?
- Eclogite facies
 - Blueschist facies
 - Granulite facies
 - Amphibolite facies
57. Blueschist facies rocks are formed at unusually high pressure and low temperature conditions which occur at
- subduction zone only
 - collision zone only
 - both subduction zone and collision zone
 - neither subduction zone nor collision zone
58. Which of the following minerals are commonly present as a characteristic assemblage of amphibolite facies of mafic rocks?
- Hornblende + plagioclase \pm garnet \pm quartz
 - Diopside + grossularite \pm calcite
 - Microcline + biotite + muscovite
 - Chloritoid + almandine + chlorite \pm muscovite \pm quartz
59. Which one of the following represents the correct sequence of high P/T metamorphic facies series?
- Zeolite facies \rightarrow Prehnite-Pumpellyite facies \rightarrow Greenschist facies \rightarrow Amphibolite facies \rightarrow Granulite facies
 - Zeolite facies \rightarrow Prehnite-Pumpellyite facies \rightarrow Blueschist facies \rightarrow Eclogite facies
 - Zeolite facies \rightarrow Albite-Epidote-Hornfels facies \rightarrow Hornblende-Hornfels facies \rightarrow Pyroxene-Hornfels facies
 - Zeolite facies \rightarrow Greenschist facies \rightarrow Amphibolite facies \rightarrow Pyroxene-Hornfels facies \rightarrow Sanidinite facies
60. The medium P/T series is also known as
- contact facies series
 - Buchan facies series
 - Barrovian facies series
 - Franciscan facies series

61. The sharpness or peakedness of a grain-size frequency curve is referred to as

- (a) skewness
- (b) kurtosis
- (c) mode
- (d) standard deviation

62. Consider the following statements regarding origin and distribution of different sedimentary rocks through geological ages :

1. Relative volume of shale per unit age has remained nearly constant since Precambrian.
2. Iron-rich sedimentary rocks preserved per unit age have decreased in the post-Precambrian time.
3. Preserved carbonate rocks per unit age have decreased in the post-Precambrian time.

Which of the statements given above are correct?

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

63. Intercrystalline porosity represents

- (a) pore spaces between chemically formed crystals
- (b) pore spaces between framework grains
- (c) cavities formed in rocks by solution
- (d) fractures in a rock

64. The depth to which surface waves affect a water body is referred to as

- (a) wavefront
- (b) wave base
- (c) wave vortex
- (d) amplitude of wave

65. Which of the following is/are diagnostic feature(s) of wave ripple cross-bedding?

1. Chevron upbuilding of foreset
2. Bundled upbuilding of foreset
3. Offshooting and draping foreset
4. Swollen lenticular set

Select the correct answer using the code given below.

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

66. Consider the following statements regarding reactivation surfaces in a cross-strata set :

1. They attribute to modification in previously formed bedforms.
2. They form due to erosion by wave or current.
3. They form due to change in flow direction.
4. They form due to erosion resulting from interaction of bedforms.

Which of the statements given above is/are correct?

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

67. Which one of the following assemblages correctly represents coated, non-skeletal allochems in a carbonate rock?

- (a) Ooids, bioclasts, peloids
- (b) Ooids, oncoids, limeclasts
- (c) Pisoids, peloids, oncoids
- (d) Ooids, pisoids, oncoids

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

- (a) Packstone : Grain-supported allochthonous limestone
- (b) Bindstone : Autochthonous limestone with encrustation by organisms
- (c) Wackestone : Allochthonous limestone with < 10% grains and no lime mud
- (d) Floatstone : Allochthonous matrix-supported limestone

69. Which one of the following arrangements correctly represents the sub-environments from landward to seaward direction in shallow marine setting?

- (a) Backshore—Swash zone—Surf zone—Shoaling zone
- (b) Surf zone—Swash zone—Breaker zone—Shoaling zone
- (c) Swash zone—Breaker zone—Surf zone—Shoaling zone
- (d) Backshore—Shoaling zone—Surf zone—Swash zone

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

<i>List-I</i> (Feature)	<i>List-II</i> (Sedimentary environment)
A. Moraines	1. Shelf
B. Natural levee	2. Shore
C. Hummocky cross-strata	3. Meandering river
D. Berm	4. Glacier

Code :

(a) A B C D
2 1 3 4

(b) A B C D
4 3 1 2

(c) A B C D
4 1 3 2

(d) A B C D
2 3 1 4

71. A bay-head delta develops commonly in

- (a) tide-dominated estuary
(b) wave-dominated estuary
(c) tidal flat
(d) macrotidal coast

72. Which one of the following is the characteristic of pressure solution process during diagenesis of carbonate rocks?

- (a) Deformation of sediment-filled circular burrows
(b) Conversion of grain-poor lime mud to grain-supported

- (c) Crushing of shells, ooids and fracturing
(d) Formation of interpenetrating sutured contacts between grains

73. Consider the following statements :

The state of preservation of fossils depends on

1. structure and composition of the original shell
2. nature and grain size of the enclosing sediment
3. chemical conditions at the time of sedimentation
4. diagenesis taking place in the rock after deposition

Which of the statements given above are correct?

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

74. When a holotype has been lost, a new specimen of a previously described species designated to serve as the type specimen is known as

- (a) neotype (b) paratype
(c) syntype (d) lectotype

75. The earliest brachiopods are of

- (a) Lower Cambrian
(b) Upper Ordovician
(c) Lower Silurian
(d) Upper Carboniferous

76. The trilobites having larger pygidium than the cephalon are known as

- (a) micropygous
- (b) heteropygous
- (c) isopygous
- (d) macropygous

77. The type of dentition in bivalves consisting of small simple teeth near the edge of the valve is known as

- (a) taxodont
- (b) dysodont
- (c) schizodont
- (d) heterodont

78. Consider the following statements regarding cephalopods :

1. The cephalopods are marine and are one of the highly evolved molluscs.
2. The class Cephalopoda is classified into three subclasses namely, Nautiloidea, Ammonoidea and Coleoidea.
3. The only living cephalopod genus with a coiled external shell is *Nautilus*.

Which of the statements given above is/are correct?

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

79. The planktic larvae formed by hatching of gastropod eggs are known as

- (a) trochophores
- (b) osphradia
- (c) varices
- (d) operculum

80. Which one of the following major changes has **not** been observed during the evolutionary history of the horses?

- (a) Increase in the number of toes
- (b) Increase in body size
- (c) Deepening of cheek teeth
- (d) Reduction in the number of toes

81. Which one of the following hominin species was the first widespread human, spread across Africa, Europe and Asia?

- (a) *Homo erectus*
- (b) *Australopithecus sediba*
- (c) *Homo habilis*
- (d) *Homo rudolfensis*

82. Which one of the following is **not** an Upper Gondwana plant fossil?

- (a) *Otozamites*
- (b) *Dictyozamites*
- (c) *Nilssonia*
- (d) *Euryphyllum*

83. The blocks of the Great Pyramids of Gizeh, near Cairo are composed of the limestones containing
- (a) *Nummulites*
 - (b) *Fusulinella*
 - (c) *Parafusulina*
 - (d) *Triticites*
84. Which one of the following is a Lower Gondwana root fossil?
- (a) *Neomariopteris*
 - (b) *Gondwanadium*
 - (c) *Euryphyllum*
 - (d) *Vertebraria*
85. Which one of the following shows the correct arrangement of the epochs (series) in order of decreasing age in the standard geological time scale?
- (a) Mississippian > Senonian > Eocene > Pliocene
 - (b) Neocomian > Pennsylvanian > Oligocene > Pliocene
 - (c) Palaeocene > Neocomian > Mississippian > Eocene
 - (d) Mississippian > Palaeocene > Senonian > Pliocene
86. Which one of the following is a chronostratigraphic unit?
- (a) Formation
 - (b) System
 - (c) Member
 - (d) Epoch
87. The line joining the points of equal thickness of a particular stratigraphic unit on different parts of a sedimentary basin is known as
- (a) isohyet
 - (b) isoneph
 - (c) isobath
 - (d) isopach
88. The peninsular gneisses are typically
- (a) granite gneisses
 - (b) biotite gneisses
 - (c) garnet-sillimanite gneisses
 - (d) migmatitic gneisses
89. Shimoga Schist Belt constitutes a part of
- (a) Dharwar Cratonic Area
 - (b) Singhbhum Cratonic Area
 - (c) Aravalli Cratonic Area
 - (d) Central Indian Tectonic Zone
90. Ajabgarh Group belongs to
- (a) Chitradurga Greenstone Belt
 - (b) Singhbhum Shear Zone
 - (c) North Delhi Fold Belt
 - (d) Eastern Ghats Mobile Belt

91. Which one of the following formations contains some of the richest manganese deposits of India?
- Mansar
 - Bichua
 - Sitasaongi
 - Kadibikhera
92. Which one of the following Groups comprises Bijli Rhyolites?
- Amgaon
 - Nandgaon
 - Sakoli
 - Khargarh
93. Mahakoshal Group belongs to
- Aravalli-Delhi Mobile Belt
 - Eastern Ghats Mobile Belt
 - Central Indian Tectonic Zone
 - Cuddapah Basin
94. Which one of the following formations of Vindhyan Supergroup contains well-preserved stromatolites?
- Kheinjua
 - Porcellanite
 - Lower Kaimur Sandstone
 - Lower Rewah Sandstone
95. Which one of the following stratigraphic units was deposited in a foreland basin?
- Bagh Group
 - Damuda Group
 - Siwalik Supergroup
 - Uttatur Group
96. The correct stratigraphic order of Siwalik Group is
- Kamlial—Chinji—Dhok Pathan—Nagri—Pinjor—Tatrot—Boulder Conglomerate
 - Dhok Pathan—Nagri—Chinji—Kamlial—Boulder Conglomerate—Tatrot—Pinjor
 - Tatrot—Pinjor—Boulder Conglomerate—Dhok Pathan—Nagri—Kamlial—Chinji
 - Kamlial—Chinji—Nagri—Dhok Pathan—Tatrot—Pinjor—Boulder Conglomerate
97. Which one of the following statements regarding stratabound deposits is **not** correct?
- Stratabound deposits can be discordant.
 - Stratabound deposits are restricted to a particular part of the stratigraphical column.
 - All stratiform ore deposits are stratabound.
 - All stratabound deposits are stratiform.

98. Consider the following statements regarding wall rock alterations :

Statement-1 :

The transformation of K-feldspar to sericite is a common alteration process in hydrothermal systems.

Statement-2 :

Hydration is the process of removal of molecular water from a fluid into a mineral during alteration.

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

- (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 and 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

99. Which one of the following terms may be used to refer to a W- and Sn-rich rock comprising hydrothermal alteration assemblage of quartz, muscovite, topaz, fluorite and tourmaline?

- (a) Skarn
- (b) Tactite
- (c) Greisen
- (d) Fenite

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

<i>List-I</i> (Host rock)	<i>List-II</i> (Nature of ore)
A. Pegmatite	1. Ore of Li, Nb and Ta
B. Carbonatite	2. Chromitite ore
C. Layered ultramafic intrusion	3. Ni-dominated sulphide ore
D. Komatiite	4. Ore of light rare earth elements

Code :

(a)	A	B	C	D
	1	2	4	3
(b)	A	B	C	D
	3	4	2	1
(c)	A	B	C	D
	1	4	2	3
(d)	A	B	C	D
	3	2	4	1

101. Consider the following statements regarding phosphorite deposits :

1. Phosphorites often show a texture of nodular or peloidal aggregates of fine-grained apatite.
2. During phosphorite formation, apatite never grows diagenetically in the sediment column.

Which of the statements given above is/are correct?

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

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

<i>List-I</i> (Element)	<i>List-II</i> (Classification term)
A. Beryllium	1. Siderophile
B. Helium	2. Chalcophile
C. Zinc	3. Atmophile
D. Platinum	4. Lithophile

Code :

(a) A B C D
 1 2 3 4

(b) A B C D
 4 3 2 1

(c) A B C D
 4 2 3 1

(d) A B C D
 1 3 2 4

103. Which one of the following deposit types is unlikely to be preserved due to 'rapid' (in terms of geological time scale) erosion after its formation?

- (a) Orogenic gold deposit
- (b) Hypothermal tungsten deposit
- (c) Peridotite-hosted chromite deposit
- (d) Au-Ag epithermal deposit

104. Consider the following statements regarding oxidation of sulphide deposits :

Statement-1 :

Gossans are rich in chalcopyrite.

Statement-2 :

Gossans are eagerly sought by mineral prospectors.

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

(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 and 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

105. If oil-wet shales are in contact with water-wet sandstones, the water tends to move from sandstone pores into shale pores, and displaces the oil therefrom into adjacent sandstone. In this process, which one of the following fluid properties and natural forces has **no** bearing?

- (a) Capillarity
- (b) Surface tension
- (c) Relative density
- (d) Gravity

106. Which one of the following is **not** a structural trap for oil and gas deposits?

- (a) Terrace
- (b) Salt dome
- (c) Fault-fissure
- (d) Up-dip wedging of sands

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

- (a) Hutti : Placer gold deposit
- (b) Jaduguda : Uranium deposit
- (c) Hospet : Iron deposit
- (d) Malanjkhand : Copper deposit

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

<i>List-I</i> (Geologic belt/ province)	<i>List-II</i> (Metal/Mineral in ore)
A. Sausar Belt	1. Copper
B. Chatrapur Coastal Tract (Odisha)	2. Gold
C. Dharwar Greenstone Belt	3. Heavy mineral (detrital monazite, ilmenite, etc.)
D. North Delhi Fold Belt	4. Manganese

Code :

- (a) A B C D
4 2 3 1
- (b) A B C D
4 3 2 1
- (c) A B C D
1 2 3 4
- (d) A B C D
1 3 2 4

109. What is the average drawdown over 150 sq. km area where 30 million cubic metre of water is pumped through a number of uniformly distributed wells? (The specific yield of the unconfined aquifer is 25%)

- (a) 0.8 m
- (b) 0.67 m
- (c) 5.0 m
- (d) 0.2 m

110. Which one of the following statements is correct about thickness of the capillary zone?

- (a) Thickness of the capillary zone varies directly with the pore size of soil.
- (b) Thickness of the capillary zone varies inversely with the pore size of soil.
- (c) Thickness of the capillary zone varies directly with the square root of pore size of soil.
- (d) Thickness of the capillary zone has no relationship with the pore size of soil.

111. If ρ_m is the density of mineral particles and ρ_d is the bulk density, then the porosity (α) of rock can be expressed as

(a) $\alpha = \frac{\rho_m + \rho_d}{\rho_m}$

(b) $\alpha = \frac{\rho_m}{\rho_m + \rho_d}$

(c) $\alpha = \frac{\rho_m}{\rho_m - \rho_d}$

(d) $\alpha = \frac{\rho_m - \rho_d}{\rho_m}$

112. Which one of the following is the unit of transmissivity?

- (a) m/day
- (b) m^2 /day
- (c) m^3 /day
- (d) $m \times \text{day}$

113. Which one of the following statements is correct regarding applicability of Darcy's law?

- (a) Darcy's law is applicable for turbulent flow in any medium.
- (b) Darcy's law is applicable for laminar flow in a saturated porous medium.
- (c) Darcy's law is applicable for both turbulent and laminar flows in any medium.
- (d) Darcy's law is applicable for any type of flow in any medium.

114. If grains in an aquifer material have same sorting, packing and fabric, then which one of the following relationships is correct about expected hydraulic conductivity of the aquifer material?

- (a) Gravel > Sand > Silt
- (b) Gravel > Sand < Silt
- (c) Gravel = Sand = Silt
- (d) Gravel < Sand < Silt

115. The Reynolds number of a fluid in a conduit is 12. If the velocity of flow is increased twice and the diameter of the conduit is reduced to one-third, what will be the new Reynolds number?
- (a) 12
 - (b) 72
 - (c) 8
 - (d) 4
116. In a groundwater sample, the concentrations of Ca and Mg are 100 ppm and 50 ppm respectively. What is the total hardness of this groundwater sample?
- (a) 150 ppm
 - (b) 250 ppm
 - (c) 435 ppm
 - (d) 455 ppm
117. In a groundwater sample, the concentrations of Na, Ca and Mg are 15, 12 and 6 equivalent per million (epm) respectively. What is the sodium adsorption ratio (SAR) value of this groundwater sample?
- (a) 33
 - (b) 5
 - (c) 21
 - (d) -3
118. The disease 'methemoglobinemia' in infants is caused due to excessive concentration of which one of the following constituents in water?
- (a) Chloride
 - (b) Iron
 - (c) Fluoride
 - (d) Nitrate
119. Artificial recharging of groundwater is generally done by digging pits or shafts in areas where the previous formations are
- (a) at shallow depth
 - (b) impermeable at all depths
 - (c) at greater depth
 - (d) absent
120. The general range of widths of ditch in ditch and furrow method of artificial recharge of groundwater is
- (a) 5 m to 10 m
 - (b) 0.3 m to 1.8 m
 - (c) 15 m to 20 m
 - (d) 30 m to 40 m

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