



Post Graduate School  
Indian Agricultural Research Institute, New Delhi  
Examination for Admission to Ph.D. Programme 2013-2014

Discipline : Soil Science and Agricultural Chemistry

Discipline Code : 22

Roll No. 

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**Please Note:**

- (i) This question paper contains **12** pages. **Please check whether all the pages are printed in this set.** Report discrepancy, if any, **immediately** to the invigilator.
- (ii) **There shall be NEGATIVE marking for WRONG answers in the Multiple Choice type questions (No. 1 to 130) which carry one mark each. For every wrong answer 0.25 mark will be deducted.**

**PART – I (General Agriculture)**

**Multiple choice questions (No. 1 to 30). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

1. Who is the present Chairman of Protection of Plant Varieties and Farmers' Right Authority (PPV&FRA)?
  - a) Dr. R.R. Hanchinal
  - b) Dr. P.L. Gautam
  - c) Dr. S. Nagarajan
  - d) Dr. Swapan K. Datta
2. Which among the following is another name for vitamin B<sub>12</sub>?
  - a) Niacin
  - b) Pyridoxal phosphate
  - c) Cobalamin
  - d) Riboflavin
3. The largest share in India's farm export earning in the year 2011-12 was from
  - a) Basmati rice
  - b) Non-basmati rice
  - c) Sugar
  - d) Guar gum
4. The National Bureau of Agriculturally Important Insects was established by ICAR in \_\_\_\_\_, was earlier known as \_\_\_\_\_.
  - a) Bangalore; PDBC
  - b) New Delhi; National Pusa Collection
  - c) Ranchi; Indian Lac Research Institute
  - d) New Delhi; NCIPM
5. The most important sucking pests of cotton and rice are respectively
  - a) *Nilaparvata lugens* and *Aphis gossypii*
  - b) *Aphis gossypii* and *Thrips oryzae*
  - c) *Amrasca biguttula biguttula* and *Scirtothrips dorsalis*
  - d) *Thrips gossypii* and *Orseolia oryzae*
6. Which of the following microorganism causes fatal poisoning in canned fruits and vegetables?
  - a) *Aspergillus flavus*
  - b) *Penicillium digitatum*
  - c) *Clostridium botulinum*
  - d) *Rhizoctonia solani*
7. The cause of the great Bengal Famine was
  - a) Blast of rice
  - b) Brown spot of rice
  - c) Rust of wheat
  - d) Karnal bunt of wheat
8. Actinomycetes belong to
  - a) The fungi
  - b) Eukaryote
  - c) *Mycelia sterilia*
  - d) None of the above
9. A virus-free clone from a virus infected plant can be obtained by
  - a) Cotyledonary leaf culture
  - b) Axenic culture
  - c) Stem culture
  - d) Meristem tip culture
10. Which of the following is not an objective of the National Food Security Mission?
  - a) Sustainable increase in production of rice, wheat and pulses
  - b) Restoring soil fertility and productivity at individual farm level
  - c) Promoting use of bio-pesticides and organic fertilizers
  - d) Creation of employment opportunities

11. Agmarknet, a portal for the dissemination of agricultural marketing information, is a joint endeavour of
  - a) DMI and NIC
  - b) DMI and Ministry of Agriculture
  - c) NIC and Ministry of Agriculture
  - d) DMI and Directorate of Economics and Statistics
12. The share of agriculture and allied activities in India's GDP at constant prices in 2011-12 was
  - a) 14.1%
  - b) 14.7%
  - c) 15.6%
  - d) 17.0%
13. The average size of land holding in India according to Agricultural Census 2005-06 is
  - a) 0.38 ha
  - b) 1.23 ha
  - c) 1.49 ha
  - d) 1.70 ha
14. 'Farmers First' concept was proposed by
  - a) Paul Leagans
  - b) Neils Rolling
  - c) Robert Chamber
  - d) Indira Gandhi
15. In the year 2012, GM crops were cultivated in an area of
  - a) 150 million hectare in 18 countries
  - b) 170 million hectare in 28 countries
  - c) 200 million hectare in 18 countries
  - d) 1.70 million hectare in 28 countries
16. The broad-spectrum systematic herbicide glyphosate kills the weeds by inhibiting the biosynthesis of
  - a) Phenylalanine
  - b) Alanine
  - c) Glutamine
  - d) Cysteine
17. At harvest, the above ground straw (leaf, sheath and stem) weight and grain weight of paddy crop are 5.5 and 4.5 tonnes per hectare, respectively. What is the harvest index of paddy?
  - a) 45%
  - b) 50%
  - c) 55%
  - d) 100%
18. Crossing over between non-sister chromatids of homologous chromosomes takes place during
  - a) Leptotene
  - b) Pachytene
  - c) Diplotene
  - d) Zygotene
19. The term 'Heterosis' was coined by
  - a) G.H. Shull
  - b) W. Bateson
  - c) T.H. Morgan
  - d) E.M. East
20. When a transgenic plant is crossed with a non-transgenic, what would be the zygosity status of the  $F_1$  plant?
  - a) Homozygous
  - b) Heterozygous
  - c) Hemizygous
  - d) Nullizygous
21. The highest per capita consumption of flowers in the world is in
  - a) The USA
  - b) India
  - c) Switzerland
  - d) The Netherlands
22. Which of the following is a very rich source of betalain pigment?
  - a) Radish
  - b) Beet root
  - c) Carrot
  - d) Red cabbage
23. Dog ridge is
  - a) Salt tolerant rootstocks of mango
  - b) Salt tolerant rootstocks of guava
  - c) Salt tolerant rootstocks of grape
  - d) Salt tolerant rootstocks of citrus
24. Which of the following micronutrients are most widely deficient in Indian soils?
  - a) Zinc and boron
  - b) Zinc and iron
  - c) Zinc and manganese
  - d) Zinc and copper
25. Which of the following fertilizers is not produced in India?
  - a) DAP
  - b) Urea
  - c) Muriate of potash
  - d) TSP
26. What is the estimated extent of salt affected soils in India?
  - a) 5.42 mha
  - b) 7.42 mha
  - c) 11.42 mha
  - d) 17.42 mha
27. Which of the following is not a feature of watershed?
  - a) Hydrological unit
  - b) Biophysical unit
  - c) Socio-economic unit
  - d) Production unit

28. Correlation coefficient 'r' lies between  
 a) 0 and 1  
 b) -1 and 1  
 c) -1 and 0  
 d) 0 and  $\infty$
29. For the data 1, -2, 4, geometric mean is  
 a) 2  
 b) 4  
 c)  $-\frac{7}{3}$   
 d) -2
30. The relationship between Arithmetic mean (A), Harmonic mean (H) and Geometric mean (G) is  
 a)  $G^2=AH$   
 b)  $G=\sqrt{A+H}$   
 c)  $H^2=GA$   
 d)  $A^2=GH$

### **PART – II (Subject Paper)**

**Multiple choice questions (No. 31 to 130). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

31. Soils formed from which of the following rocks are more fertile?  
 a) Acid rocks  
 b) Basic rocks  
 c) Neutral rocks  
 d) Acid and neutral rocks
32. Dickite belongs to which group of minerals?  
 a) Kaolinite  
 b) Mica  
 c) Smectite  
 d) Amorphous
33. A silicate clay enriched subsurface horizon formed by illuviation is known as  
 a) Agric  
 b) Natric  
 c) Argillic  
 d) Oxic
34. Which of the following is the important determinant of the ligand exchange reaction?  
 a) CEC  
 b) AEC  
 c) pH  
 d) Ion size

35. Cation exchange capacity [ $\text{cmol}(p^+)\text{kg}^{-1}$ ] of laterite and lateritic soils in India is  
 a) <16  
 b) >20  
 c) 20-40  
 d) 40-45
36. According to the soil taxonomy, desert soils of India belong to which of the following order?  
 a) Vertisol  
 b) Spodosol  
 c) Inceptisol  
 d) Entisol
37. Rocks or soil debris accumulate at the foot of slope due to gravity is known as  
 a) Lacustrine  
 b) Alluvial  
 c) Fluvial  
 d) Colluvial
38. In Kjeldahl digestion of soil for N estimation,  $\text{K}_2\text{SO}_4$  is used to  
 a) Increase the temperature of digestion  
 b) Catalyses the reaction  
 c) Convert the  $\text{NH}_4^+$  to  $\text{NO}_3^-$   
 d) Break triple bond
39. In Kjeldahl digestion of soil for N estimation, which of the following reagent is used as catalyst?  
 a)  $\text{Na}_2\text{SO}_4$   
 b)  $\text{K}_2\text{SO}_4$   
 c)  $\text{CuSO}_4$   
 d)  $\text{CaSO}_4$
40. Soils form on volcanic ash belongs to which of the following order?  
 a) Gelisol  
 b) Andisol  
 c) Oxisol  
 d) Inceptisol
41. One of the dimensions of nano particles must be within  
 a) 1 nm  
 b) 100 nm  
 c) 1000 nm  
 d) 100 mm
42. Which of the following phyllosilicate is dominant in bentonite?  
 a) Montmorillonite  
 b) Kaolinite  
 c) Dickite  
 d) Illite

43. Which of the following mineral is not a polymorph?  
 a) Quartz  
 b) Tridymite  
 c) Cristobalite  
 d) Leucite
44. Which of the following minerals is likely to be chemically weathered most easily?  
 a) K-feldspar  
 b) Olivine  
 c) Quartz  
 d) Hornblende
45. The amount of charge reaching to the central cation  $\text{Na}^+$  from an anion in a cubic coordination is  
 a)  $-\frac{1}{8}$   
 b)  $-\frac{1}{6}$   
 c)  $+\frac{1}{8}$   
 d)  $+\frac{1}{6}$
46. Thermodynamically a chemical system is said to attain equilibrium at  
 a) Minimum entropy  
 b) Minimum enthalpy  
 c) Minimum free energy  
 d) Minimum internal energy
47. Ligand adsorption of P by soil results in  
 a) Increase of CEC  
 b) Increase of AEC  
 c) Decrease of pH  
 d) Increase specific surface area
48. Which of the following remain constant for an equilibrated ion in the soil system?  
 a) Electrochemical potential  
 b) Chemical potential  
 c) Activity  
 d) Electric potential
49. Linear portion of Q/I curve of K represents  
 a) K adsorbed on planar, relatively high energy sites  
 b) K adsorbed on planar, relatively low energy sites  
 c) K fixed at geometrically selective adsorption sites  
 d) Non-exchangeable K
50. Solution A has pH of 3 and solution B has pH of 5. The active acidity of solution A is how many times greater than that of solution B?  
 a) 2 times  
 b) 10 times  
 c) 20 times  
 d) 100 times
51. Which of the following soils has higher buffering capacity and lower activity ratio of potassium?  
 a) Kaolinite dominant soil  
 b) Smectite dominant soil  
 c) Sandy soil  
 d) Red soil
52. In trioctahedral arrangement of phyllosilicate minerals, three octahedral positions are filled by which of the following cation?  
 a)  $\text{Si}^{4+}$   
 b)  $\text{Al}^{3+}$   
 c)  $\text{Mg}^{2+}$   
 d)  $\text{Fe}^{3+}$
53. If 'k' is intrinsic permeability and 'f' is fluidity then hydraulic conductivity is given by  
 a) kf  
 b) k/f  
 c)  $\sqrt{kf}$   
 d)  $\sqrt{\frac{k}{f}}$
54. Oxidation reduction potential of typical soil systems is  
 a) Not affected by pH  
 b) Equal at pH 5 and 7  
 c) Higher at pH 5 than 7  
 d) Lower at pH 5 than 7
55. Organism most tolerant to soil moisture stress is  
 a) Fungi  
 b) Protozoa  
 c) Bacteria  
 d) Actinomycetes
56. In leguminous crops, *Rhizobium* enters root hair dissolving cell wall by  
 a) Cellulase  
 b) Chitinase  
 c) Pectinase  
 d) Lignolytic enzyme
57. Which one of the following fertilizers has zero equivalent acidity?  
 a) Ammonium sulphate  
 b) Ammonium nitrate  
 c) Anhydrous ammonia  
 d) Calcium ammonium nitrate
58. Ligand exchange is not distinguished from anion exchange based on which of the following characteristics?  
 a) Release of  $\text{OH}^-$  in solution  
 b) High degree of specificity toward particular anion  
 c) A change in the measured surface charge to a more negative value  
 d) Desorption is much faster than adsorption

59. Permissible limit of RSC ( $\text{me L}^{-1}$ ) in irrigation water up to which gypsum application is not recommended
- 2.5
  - 3.5
  - 4.5
  - 5.5
60. Which of the following is P solubilizing bacteria?
- Pseudomonas striata*
  - Nitrosomonas*
  - Thiobacillus ferrooxidans*
  - Fusarium oxysporum*
61. Ionic potential is maximum in case of
- Cs
  - Li
  - K
  - Na
62. Methanogenesis in waterlogged soil takes place at Eh of
- < -200 mV
  - 200-300 mV
  - 300-400 mV
  - > 400 mV
63. Most of the boron is absorbed by plants in the form of
- B
  - $\text{H}_3\text{BO}_3$
  - $\text{H}_2\text{BO}_3^-$
  - $\text{BO}_3^{3-}$
64. Ligand adsorption of a weak acid on oxide surface will be maximum when
- pH is greater than pK value of the acid
  - Acid anion and undissociated acid are present in equal amounts
  - Undissociated acid is 10% of dissociated acid
  - pH is less than pK value of the acid
65. Who proposed the term 'functional or metabolic nutrient' in plant nutrition?
- D.J. Nicholas
  - Arnon
  - Stout
  - Arnon and Stout
66. What is the main basis of distinction between mollic and umbric epipedon?
- Organic matter
  - Base saturation
  - pH
  - CEC
67. The microorganism predominant in flooded rice soils is
- Bacteria
  - Fungi
  - Actinomycetes
  - Protozoa
68. Nitrogen reduction in symbiotic systems takes place at
- Nodules surface
  - Membrane envelop
  - Bacteroids
  - Cytochrome
69. A soil which has pH <8.5, ESP <15 and EC >4  $\text{dS m}^{-1}$  at 25°C in saturated condition is called
- Saline-alkali
  - Saline
  - Alkali
  - Normal
70. One molecule of  $\text{K}_2\text{Cr}_2\text{O}_7$  when react with  $\text{H}_2\text{SO}_4$  gives three atoms of oxygen, the equivalent weight of  $\text{K}_2\text{Cr}_2\text{O}_7$  is
- $1/3^{\text{rd}}$  of molecular weight
  - $1/4^{\text{th}}$  of molecular weight
  - $1/6^{\text{th}}$  of molecular weight
  - $1/12^{\text{th}}$  of molecular weight
71. Among the prominent greenhouse gases, the one whose emission is almost entirely dependent on soil related process are
- Methane
  - Carbon dioxide
  - Chlorofluoro carbon
  - Nitrous oxide
72. The type of weathering needing water for chemical reaction is called
- Hydration
  - Hydrolysis
  - Dissolution
  - Oxidation
73. pH of Morgan's reagent is
- 3.8
  - 4.8
  - 5.8
  - 6.8
74. In water erosion if rill is too big to be crossed by farm equipment, it is called
- Sheet erosion
  - Plate erosion
  - Gully erosion
  - Big rill erosion

75. Vermiculite is similar to illite except vermiculite has
- A higher CEC
  - A lower CEC
  - Not an expansive layer
  - K-bridge between the layers
76. Process of podzolization takes place in
- Warm humid climate
  - Arid climate
  - Cold humid climate
  - Semi-arid climate
77. Minimum percentage of water soluble phosphate (as  $P_2O_5$ ) in DAP is
- 22.5
  - 32.5
  - 42.5
  - 52.5
78. The total pore space is more in
- Sandy soil
  - Silty loam soil
  - Loam soil
  - Clay loam soil
79. Hydrogen bonding results in the interlayer of
- Muscovite
  - Montmorillonite
  - Pyrophyllite
  - Kaolinite
80. Cell wall thickening in root apical meristem occurs due to deficiency of
- Zn
  - Mo
  - B
  - Mn
81. Karl Fischer reagent used in the chemical method of determination of moisture in fertilizers contains
- Pyridine
  - Pyrimidine
  - Phthalic acid
  - Phenolphthalein
82. Basic slag is produced when
- Iron ore is converted to pig iron
  - Pig iron is converted to steel
  - Steel is converted to an alloy
  - Any of the above
83. Isomorphous substitution of  $Al^{3+}$  for some  $Mg^{2+}$  ions in the dioctahedral sheet accounts for most of the negative charge in
- Illite
  - Smectite
  - Allophane
  - Hemetite
84. When phenolphthalein is added to an acid solution the solution becomes
- Yellow
  - Colourless
  - Blue
  - Pink
85. The concept of leaching requirement was developed by
- W.R. Gardner
  - L.A. Richards
  - L.D. Baver
  - D. Kirkham
86. Which of the following combination of minerals is most abundant in the silt and sand fractions of soils?
- Quartz and iron-oxide minerals
  - Quartz and calcite
  - Feldspars and mica
  - Quartz and feldspars
87. The 'Bangalore method' of composting is characterised by
- Initial aerobic phase followed by anaerobic phase
  - Continuous aerobic phase
  - Initial anaerobic followed by aerobic phase
  - Continuous anaerobic phase
88. *Bradyrhizobium* sp. is suitable for
- Groundnut
  - Soybean
  - Cowpea
  - Alfalfa
89. Size of K ion is similar to that of
- $Na^+$
  - $Zn^{2+}$
  - $NH_4^+$
  - $Mg^{2+}$
90. Which of the following has the highest weatherability?
- Biotite
  - Apatite
  - Garnet
  - Zircon
91. Non-exchangeable acidity is not associated with
- Weak acid groups on humus
  - Organically complexed Al
  - Al-hydroxy cations strongly retained at mineral surfaces
  - Easily dissociating acid groups on humus

92. Black colour of Vertisol is due to the presence of
- Organic matter
  - Titanium
  - Selenium
  - Montmorillonite clay
93. For tobacco crop, the preferred potassic fertilizer is
- Potassium nitrate
  - Potassium chloride
  - Potassium sulphate
  - Potassium iodate
94. Red soils are predominant in
- Tamil Nadu and Karnataka
  - Assam and Tripura
  - Gujarat and Maharashtra
  - Kerala and West Bengal
95. The potential difference between the fixed part and freely mobile portion of the diffuse double layer is known as
- Stream potential
  - Matric potential
  - Zeta potential
  - Ionic potential
96. In the octahedral sheet of a crystal unit of silicate clays, Al octahedra are bound together by
- Shared oxygen atoms
  - OH-H bond
  - H-bond
  - OH-bond
97. Chemical formula of potassium feldspar is
- $\text{KAISi}_5\text{O}_8$
  - $\text{KAISiO}_3$
  - $\text{KAISi}_3\text{O}_8$
  - $\text{KAISi}_3\text{O}_6$
98. Which of the following elements cannot be determined by a flame photometer?
- Sodium
  - Potassium
  - Calcium
  - Zinc
99. "Lattice hole" theory of potassium fixation was proposed by
- F.E. Bear
  - M.L. Jackson
  - Page and Bayer
  - McLean
100. Principal mineral constituent of rock phosphate is
- Crandallite
  - Apatite
  - Phlogopite
  - Struvite
101. A subsurface horizon that is cemented mostly by silica is known as
- Duripan
  - Fragipan
  - Placic
  - Glossic
102. Measurement of soil-moisture by TDR is based on
- Neutron scattering
  - Dielectric constant of water
  - Electrical resistance of soil
  - Viscosity of water
103. Hydrolysis of urea in saline soils yields
- Amides
  - Ammonium carbamate
  - Uric acids
  - Hydroxylamine
104. Initially, micas lose their structural  $\text{K}^+$  rapidly in the weathering solution through which of the following?
- Cation exchange
  - Dissolution
  - Hydrolysis
  - Desorption
105. The function of leghaemoglobin found in the root nodules of legumes is
- Inhibition of nitrogenase activity
  - Regulation of  $\text{CO}_2$  supply to the nodule
  - Regulation of  $\text{O}_2$  supply to the nodule
  - Inactivating the ATP
106. Soil structure is more stable when the dominant clay mineral is
- Montmorillonite
  - Illite
  - Chlorite
  - Kaolinite
107. High zeta potential of a clay colloidal system represents the state of
- Low swelling
  - High swelling
  - Low viscosity
  - Low plasticity
108. In soil taxonomy, diagnostic horizons are used to differentiate
- Order
  - Sub-order
  - Great group
  - Series
109. Which of the following is the correct weathering sequence of mica?
- Biotite → chlorite → vermiculite → smectite
  - Chlorite → biotite → vermiculite → smectite
  - Vermiculite → chlorite → biotite → smectite
  - Biotite → chlorite → smectite → vermiculite

110. Identify the volcanic rock among the following
- Rhyolite
  - Granite
  - Sylvinite
  - Gabbro
111. The presence of Vermiculite in soil indicates the potential problem of
- K fixation
  - P fixation
  - Acidity
  - Ammonia volatilization
112. Diagnostic horizon of a soil to be classified as Inceptisol is
- Cambic
  - Oxic
  - Spodic
  - Argillic
113. E4/E6 ratio of humate solution decreases with more
- Dilution
  - Salt content
  - Aromatic component
  - Aliphatic component
114. For chloride determination in plant samples, titration with standard silver nitrate solution is carried out at pH
- 5.6
  - 6.0
  - 7.0
  - 8.2
115. Devarda's alloy contains
- Cu Mn Zn
  - Cu Zn Al
  - Cu Mn Al
  - Cu Mg Al
116. Rain drop splash and surface flow cause
- Splash erosion
  - Gully erosion
  - Rill erosion
  - Sheet erosion
117. Which one is the correct form of Nernst equation?
- $$E_h = E_h^{\circ} - \frac{0.059}{n} \log \frac{(\text{oxidized molecule})}{(\text{reduced molecule})(H^+)^m}$$
  - $$E_h = E_h^{\circ} + \frac{0.059}{n} \log \frac{(\text{oxidized molecule})}{(\text{reduced molecule})(H^+)^m}$$
  - $$E_h = E_h^{\circ} - \frac{0.059}{n} \log \frac{(\text{oxidized molecule})}{(\text{reduced molecule})(H^+)^m}$$
  - $$E_h = E_h^{\circ} - \frac{0.059}{n} \log \frac{(\text{reduced molecule})}{(\text{oxidized molecule})(H^+)^m}$$
118. Two elements which are associated with biological nitrogen fixation are
- Fe & Mo
  - Fe & Co
  - Mo & B
  - Co & Zn
119. Phosphate solubilization from inorganic sources by soil microorganisms is mainly through production of
- Carbonic acid
  - Volatile fatty acids
  - Organic acids
  - Microbial enzymes
120. Langmuir isotherm often describes successfully which one of the following?
- Chemisorption
  - Physical sorption
  - Multilayer adsorption
  - Multilayer physical adsorption
121. Stokes' law applies to the settling of spheres in
- Stationary liquid and constant temperature
  - Stationary liquid and variable temperature
  - Mobile liquid and constant temperature
  - Mobile liquid and variable temperature
122. Soil calcium carbonate loses CO<sub>2</sub> to form calcium oxide at
- 105 °C
  - 105-500 °C
  - 350 °C
  - ≥770 °C
123. Molar masses of humus normally range between
- 20,000 - 1,00,000 g/mol
  - 5,000 - 10,000 g/mol
  - 500 - 1,000 g/mol
  - 100 - 200 g/mol
124. Graphite furnace atomic absorption spectrophotometry uses maximum temperature up to
- 500 °C
  - 1000 °C
  - 2000 °C
  - 3000 °C
125. There is an improvement in detection unit of graphite furnace AAS over flame AAS by a factor of up to
- 1000
  - 100
  - 50
  - 10



126. Target pH value of liming is usually

- a) 5.5 - 6.5
- b) 5.0 - 5.5
- c) 4.5 - 5.5
- d) 4.5 - 5.0

127. Which of the following species is dominant in solution at soil pH value of 4.0?

- a)  $Al^{3+}$
- b)  $Al(OH)^{2+}$
- c)  $Al(OH)_2^+$
- d)  $Al(OH)_3$

128. The process which operates in hydromorphic soils is known as

- a) Gleying
- b) Drying
- c) Vetting
- d) Waterlogging

129. Most important metal ions responsible for the binding of phosphates in soils are

- a) Al, Fe and Ca
- b) Al, Fe and K
- c) Fe, Ca and Mg
- d) Al, Fe and Zn

130. Micas may have isomorphous substitution

- a) Predominantly in tetrahedral layer
- b) Predominantly in octahedral layer
- c) In both the layers equally
- d) In octahedral layer only

**Matching type questions (No. 131 to 140); all questions carry equal marks. Choose the correct answer (a, b, c, d or e) for each sub-question (i, ii, iii, iv and v) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

131.

- |  |                    |
|--|--------------------|
| i) Phosphate potential                               | a) Cate and Nelson |
| ii) Equilibrium phosphate potential                  | b) Ramamoorthy     |
| iii) Critical nutrient concept of available nutrient | c) Fried and Dean  |
| iv) Law of minimum                                   | d) Schofield       |
| v) A-value   | e) Liebig          |

132.

- |                            |                        |
|----------------------------|------------------------|
| i) Precipitation indicator | a) Starch              |
| ii) Redox indicator        | b) Murexide            |
| iii) Self indicator        | c) $KMnO_4$            |
| iv) Metal ion indicator    | d) Orthophenanthroline |
| v) Adsorption indicator    | e) Ferric alum         |

133.

- |               |              |
|---------------|--------------|
| i) Hornblende | a) $SiO_4$   |
| ii) Olivine   | b) $SiO_3$   |
| iii) Feldspar | c) $SiO_2$   |
| iv) Pyroxene  | d) $Si_2O_5$ |
| v) Mica       | e) $Si_2O_3$ |

134.

- |                            |                           |
|----------------------------|---------------------------|
| i) Hydraulic conductivity  | a) Stokes' law            |
| ii) Thermal conductivity   | b) Fourier law            |
| iii) Diffusion coefficient | c) Fick's law             |
| iv) Terminal velocity      | d) Intrinsic permeability |
| v) Sorptivity              | e) Infiltration           |

135.

- |                     |                        |
|---------------------|------------------------|
| i) P solubilization | a) <i>Gigaspora</i>    |
| ii) S oxidation     | b) <i>Thiobacillus</i> |
| iii) Vermi compost  | c) <i>Pseudomonas</i>  |
| iv) VAM             | d) <i>Azotobacter</i>  |
| v) Diazotroph       | e) <i>Eisenia</i>      |

136.

- |         |                    |
|---------|--------------------|
| i) Fe   | a) 10-300          |
| ii) Mn  | b) 2-100           |
| iii) Zn | c) 0.2-5           |
| iv) Cu  | d) 10,000-1,00,000 |
| v) Mo   | e) 20-4,000        |

137.

- |                             |               |
|-----------------------------|---------------|
| i) Urease inhibitor         | a) Nitrapyrin |
| ii) Nitrification inhibitor | b) Gypsum     |
| iii) Sequester              | c) Krillium   |
| iv) Soil conditioner        | d) EDTA       |
| v) Soil amendment           | e) DCD        |

138.

- |                        |              |
|------------------------|--------------|
| i) Permafrost          | a) Spodosols |
| ii) Slickensides       | b) Andosols  |
| iii) Low bases         | c) Vertisols |
| iv) Amorphous material | d) Gelisols  |
| v) Albic horizon       | e) Ultisols  |

139.

- |                             |                                  |
|-----------------------------|----------------------------------|
| i) Procter moisture content | a) Turbulent flow                |
| ii) Laplace equation        | b) Soil structure                |
| iii) Reynold Number         | c) Soil compaction               |
| iv) MWD                     | d) Short-wave reflectivity       |
| v) Albedo                   | e) Air-water interface curvature |

140.

- |                     |                                |
|---------------------|--------------------------------|
| i) Ratio law        | a) Variable charge surface     |
| ii) Bragg's law     | b) Selectivity coefficient     |
| iii) ZPC            | c) Donnan membrane equilibrium |
| iv) Osmo-regulation | d) X-ray diffraction           |
| v) Gapon equation   | e) Salt-tolerance of crops     |

**Short questions (No. 141 to 146); each question carries FIVE marks. Write answers, including computation / mathematical calculations if any, in the space provided for each question on the question paper itself.**

141. A soil contains 3% organic matter. If the C:N ratio of organic matter is 10:1, calculate the percentage of C and N in soil.

142. Compare the working principles of ICP-AES and ICP-MS.

143. A soil has CEC of 20 cmol<sub>c</sub>/kg of which 60% is satisfied by exchangeable H+Al. Calculate the amount of lime (g CaCO<sub>3</sub>/kg soil), required to neutralize the exchangeable acidity.

144. Describe the reasons for mutual antagonism between Cu and Mo in plants and cattle. Describe N and S interaction in soil and plant.

145. Describe the reasons for changing availability of P and Mo in soil with change in soil pH.

146. Write the generally recommended doses of Zn, Fe, Mn and B for soil and foliar applications.