Post Graduate School
Indian Agricultural Research Institute, New Delhi

Examination for Admission to Ph.D. Programme 2011-2012

Discipline : Soil Science and Agricultural Chemistry

Discipline Code : 21 Roll No.

Please Note:

(i) This question paper contains 13 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. Which of the following crops have been approved for commercial cultivation in India?
a) Bt cotton and Bt brinjal
b) Bt cotton and Golden Rice
c) Bt maize and Bt cotton
d) Bt cotton only

2. This year (2010-11) the expected food grain production in India is
a) 212 million tonnes
b) 220 million tonnes
c) 235 million tonnes
d) 250 million tonnes

3. The genome of which of the following crops is still not completely sequenced?
a) Rice
b) Soybean
c) Sorghum
d) Wheat

4. According to the Approach Paper to the 12th Five Year Plan, the basic objective of the 12th Plan is
a) Inclusive growth
b) Sustainable growth
c) Faster, more inclusive and sustainable growth
d) Inclusive and sustainable growth

5. To address the problems of sustainable and holistic development of rainfed areas, including appropriate farming and livelihood system approaches, the Government of India has set up the
a) National Rainfed Area Authority
b) National Watershed Development Project for Rainfed Areas
c) National Mission on Rainfed Areas
d) Command Area Development and Water Management Authority

6. Which of the following sub-schemes are not covered under the Rashtriya Krishi Vikas Yojana?
a) Extending the Green Revolution to eastern India
b) Development of 60,000 pulses and oilseeds villages in identified watersheds
c) National Mission on Saffron
d) National Mission on Bamboo

7. The minimum support price for the common variety of paddy announced by the Government of India for the year 2010-11 was
a) ₹ 1030
b) ₹ 1000
c) ₹ 980
d) ₹ 950

8. According to the Human Development Report 2010 of the United Nations, India's rank in terms of the human development index is
a) 119
b) 134
c) 169
d) 182

9. Which of the following does not apply to SRI method of paddy cultivation?
a) Reduced water application
b) Reduced plant density
c) Increased application of chemical fertilizers
d) Reduced age of seedlings

10. Which organic acid, often used as a preservative, occurs naturally in cranberries, prunes, cinnamon and cloves?
a) Citric acid
b) Benzoic acid
c) Tartaric acid
d) Lactic acid

11. Cotton belongs to the family
a) Cruciferae
b) Anacardiaceae
c) Malvaceae
d) Solanaceae

12. Photoperiodism is
a) Bending of shoot towards source of light
b) Effect of light/dark durations on physiological processes
c) Movement of chloroplast in cell in response to light
d) Effect of light on chlorophyll synthesis

13. Ergot disease is caused by which pathogen on which host?
a) *Claviceps purpurea* on rye
b) *Puccinia recondita* on wheat
c) *Drechlera sorokiniana* on wheat
d) *Albugo candida* on mustard

14. Rocks are the chief sources of parent materials over which soils are developed. Granite, an important rock, is classified as
a) Igneous rock
b) Metamorphic rock
c) Sedimentary rock
d) Hybrid rock

15. Which one of the following is a *Kharif* crop?
a) Pearl millet
b) Lentil
c) Mustard
d) Wheat

16. The coefficient of variation (C.V.) is calculated by the formula
a) (Mean/S.D.) × 100
b) (S.D./Mean) × 100
c) S.D./Mean
d) Mean/S.D.

17. Which of the following is commonly referred to as murlate of potash?
a) Potassium nitrate
b) Potassium chloride
c) Potassium sulphate
d) Potassium silicate

18. Inbred lines that have same genetic constitution but differ only at one locus are called
a) Multi lines
b) Monohybrid
c) Isogenic lines
d) Pure lines

19. For applying 100 kg of nitrogen, how much urea would one use?
a) 45 kg
b) 111 kg
c) 222 kg
d) 333 kg

20. The devastating impact of plant disease on human suffering and survival was first realized by epidemic of
a) Brown spot of rice in Bengal
b) Late blight of potato in USA
c) Late blight of potato in Europe
d) Rust of wheat in India

21. The species of rice (*Oryza*) other than *O. sativa* that is cultivated is
a) *O. rufipugon*
b) *O. longisteminata*
c) *O. glaberrima*
d) *O. nivara*

22. The enzyme responsible for the fixation of CO_2 in mesophyll cells of C-4 plants is
a) Malic enzyme
b) Phosphoenol pyruvate carboxylase
c) Phosphoenol pyruvate carboxykinase
d) RuBP carboxylase

23. Which one of the following is a 'Vertisol'?
a) Black cotton soil
b) Red sandy loam soil
c) Sandy loam sodic soil
d) Submontane (Taral) soil

24. What is the most visible physical characteristic of cells in metaphase?
a) Elongated chromosomes
b) Nucleus visible but chromosomes not
c) Fragile double stranded loose chromosomes
d) Condensed paired chromosomes on the cell plate

25. All weather phenomena like rain, fog and mist occur in
a) Troposphere
b) Mesosphere
c) Ionosphere
d) Ozonosphere

26. Which of the following elements is common to all proteins and nucleic acids?
a) Sulphur
b) Magnesium
c) Nitrogen
d) Phosphorous

27. Silt has intermediate characteristics between
a) Sand and loam
b) Clay and loam
c) Loam and gravel
d) Sand and clay

28. Certified seed is produced from
a) Nucleus seed
b) Breeder seed
c) Foundation seed
d) Truthful seed

29. Seedless banana is an
a) Autotriploid
b) Autotetraploid
c) Allotriploid
d) Allotetraploid

30. Which one of the following is used to test the goodness-of-fit of a distribution?
a) Normal test
b) t-test
c) Chi-square test
d) F-test

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. As per Beer-Lambert's law, the relationship between optical density (OD) and transmittance (%T) of a coloured solution is given by
a) OD = log T
b) OD = log 2.0 - T
c) OD = 2.0 – log T
d) OD = log T - 2.0

32. The value of Avogardo's number is
a) 6.013×10^{19}
b) 6.023×10^{21}
c) 6.023×10^{-23}
d) 6.023×10^{23}

33. Which one is not a potash-bearing mineral?
a) Feldspar
b) Olivine
c) Muscovite
d) Biotite

34. The concentration of HPO_4^{2-} and $H_2PO_4^-$ ions in solution is equal at a pH of
a) 5.6
b) 6.5
c) 7.2
d) 8.2

35. According to Fick's law, diffusive flux of a nutrient is proportional to its
a) Thickness of the plane
b) Concentration gradient
c) Molecular weight of the gas
d) Atomic size of the gas

36. Two molecules that have the same chemical formula but are mirror images of each other are called
a) Enantiomers
b) Isomers
c) Isotopes
d) Mirrormers

37. The concept of nutrient mobility in soils was first proposed by
a) R.H. Bray
b) M.L. Jackson
c) E. Mitscherlich
d) E.W. Russell

38. Thermal diffusivity of a soil having thermal conductivity K and volumetric heat capacity C is given by
a) $\frac{K}{C}$
b) $\frac{C}{K}$
c) KC
a) $\frac{K}{\sqrt{C}}$

39. Which micronutrient is usually deficient in calcareous soils?
a) Mn
b) Mo
c) Cu
d) B

40. In the formation of organometallic complexes in soils, the metal ion acts as a/an
a) Ligand
b) Electron donor
c) Electron acceptor
d) Inert ion

41. The c-axis spacing of smectite group of silicate clays is
a) 0.66 nm
b) 0.72 nm
c) 1.01 nm
d) 1.40 nm

42. The hydraulic conductivity and differential water capacity of a soil are 10^{-3} cm sec^{-1} and 10^{-5} cm^{-1}, respectively. The soil water diffusivity is
a) 10^{-2} cm^2 sec^{-1}
b) 10^{-8} cm^2 sec^{-1}
c) 10^{2} cm^2 sec^{-1}
d) 10 cm^2 sec^{-1}

43. The saturation extract of a soil has EC 2.0 dS/m. What would be its osmotic potential (in bars)?
a) -0.18
b) -0.36
c) -0.72
d) -1.08

44. By increasing the electrolytic concentration, the thickness of diffuse double layer
a) Increases
b) Decreases
c) Remains unaffected
d) Depends on pH

45. If the nitrate formation in a soil were independent of the amount of ammoniacal-N, in that case the reaction would be considered as
a) Zero order
b) First order
c) Second order
d) Either first or second order

46. The first N fertilizer manufactured in India was
a) Ammonium chloride
b) Ammonium sulphate
c) Urea
d) CAN

47. Which one is a major component of organic P in soils?
a) Nucleic acids
b) Phospholipids
c) Inositol phosphate
d) ATP

48. Which position at the layer silicate has the maximum specificity for K^+ ion?
a) e-position
b) p-position
c) i-position
d) Both e- and p- positions

49. Which micronutrient is fixed on the same sites of the soil colloids as is phosphate?
a) Boron
b) Copper
c) Zinc
d) Molybdenum

50. Which micronutrient is most strongly bound to organic matter?
a) Fe
b) Cu
c) Zn
d) B

51. The pH of a calcareous soil in equilibrium with atmospheric CO_2 is
a) 6.8
b) 7.5
c) 8.2
d) 8.5

52. The molarity of concentrated H_2SO_4 (AR grade) is
a) 10 M
b) 12 M
c) 16 M
d) 18 M

53. Division of the factors of soil formation into active and passive groups was proposed by
a) H. Jenny
b) C.F. Marbut
c) J.S. Joffe
d) V.V. Dokuchaiev

54. Which one is not a pedogenic process?
a) Humification
b) Calcification
c) Laterization
d) Ferruginization

55. A subsoil layer of high bulk density which is brittle when moist and very hard when dry, is known as
a) Fragipan
b) Duripan
c) Durinodes
d) Plinthite

56. Ultisols are comparable with Alfisols except for having
a) High base saturation of the exchange complex
b) Low base saturation of the exchange complex
c) Uniform soil profile
d) High water table

57. Total number of agro-ecological sub-regions (AESR) in India delineated by NBSS&LUP is
a) 21
b) 42
c) 60
d) 76

58. In total N determination of a soil sample by Kjeldahl method, salicylic acid is added before digestion to include
a) NH_4-N
b) NO_3-N
c) Amide-N
d) Protein-N

59. Land area having definite boundary and contributing runoff to a single point is known as
a) Watershed
b) Catchment area
c) Command area
d) A field unit

60. Moisture content at wilting point is highest in
a) Clay loam
b) Silty clay loam
c) Loam
d) Sandy loam

61. Darcy's law is applicable under unsaturated conditions if hydraulic conductivity is expressed as a function of
a) Porosity
b) Hydraulic gradient
c) Hydraulic head
d) Water content

62. Capillary fringe in soil refers to
a) Height of water rise in a capillary
b) Saturated zone above the water table
c) Water in capillary pores
d) Depth of water table

63. Dehydrogenase activity is a good index of biological activity of soil because it plays role in
a) Carbon metabolism
b) Respiration
c) Synthesis of cell macromolecules
d) Cell division

64. Association of two microorganisms in which one is benefitted while other remains unaffected is known as
a) Commensalism
b) Protocooperation
c) Ammensalism
d) Competition

65. Which group of microorganisms is most active at the terminal stage of composting?
a) Actinomycetes
b) Bacteria
c) Fungi
d) Protozoa

66. The presence of 'Hartig net' is a characteristic of
a) Endomycorrhizae
b) Ectomycorrhizae
c) Arbuscular mycorrhizae
d) Ericoid mycorrhizae

67. In Soil Taxonomy, great groups are defined largely by
a) Soil forming processes
b) Presence or absence of diagnostic horizons
c) Thermal regime
d) Moisture regime

68. Rhizosphere is dominated by
a) Gram positive spore forming bacteria
b) Gram negative spore forming bacteria
c) Gram negative non-spore forming bacteria
d) Gram positive non-spore forming bacteria

69. The toxicity of oxygen for strict anaerobe is due to the production of
a) Hydroxyl radical
b) Superoxide radical
c) Hydrogen peroxide
d) Cyanide

70. The specificity between legume host and *Rhizobium* spp. is governed by
a) Flavonoids
b) Tryptophan
c) Polysaccharides
d) Indole acetic acid

71. The potassium activity ratio (AR_e^K) is expressed as
a) $\frac{{}^aK}{\sqrt{({}^aCa + {}^aMg)}}$
b) $\frac{{}^aK}{\frac{\sqrt{({}^aCa + {}^aMg)}}{2}}$
c) $\frac{{}^aK}{({}^aCa + {}^aMg)}$
d) $\frac{{}^aK}{\frac{({}^aCa + {}^aMg)}{2}}$

72. The size of micro-watershed is
a) 10,000 - 20,000 ha
b) 1,000 - 10,000 ha
c) 100 - 1,000 ha
d) 10 - 100 ha

73. Some microorganisms produce organic ligands to chelate iron in the soil and make it available to the plants. These organic ligands are known as
a) Porphyrins
b) Siderophores
c) Chromophores
d) Ferrodoxins

74. Soil-test-based fertilizer recommendation for targeted yield of crops was first introduced in India by
a) J.S. Kanwar
b) N.P. Datta
c) B. Ramamoorthy
d) R.V. Tamhane

75. In absorption measurements, minimum error occurs at the transmittance of
a) 10%
b) 25%
c) 36.8%
d) 50%

76. TDR is a method of monitoring
a) Soil wetness
b) Vapour pressure
c) Salt concentration
d) Solar radiation

77. Which one is not a process of chemical weathering?
a) Hydration
b) Hydrolysis
c) Precipitation
d) Carbonation

78. In the Jenny's factors of soil formation, factor 'b' refers to
a) Biological factor
b) Biochemical factor
c) Base-exchange
d) Biosphere

79. Sediments deposited in fresh water lakes are called
a) Delta
b) Aeolian
c) Lacustrine
d) Outwash

80. The number of diagnostic surface horizons (epipedons) included in Soil Taxonomy is
a) 6
b) 9
c) 12
d) 15

81. 'Argillic' horizon is rich in
a) Fe and Al-oxides
b) Sodium
c) $CaCO_3$
d) Silicate clay

82. Phosphate-fixation is minimum at soil pH between
a) 8 and 9
b) 7 and 8
c) 6 and 7
d) 5 and 6

83. The DTPA-TEA-$CaCl_2$ extractant is designed to prevent excessive dissolution of
a) $CaSO_4$
b) CaO
c) $MgCl_2$
d) $CaCO_3$

84. Intensity of blue colour in phosphorus determination is measured at a wavelength of
a) 420 nm
b) 470 nm
c) 540 nm
d) 660 nm

85. Chlorite are the minerals belonging to
a) Tectosilicates
b) Cyclosilicates
c) Inoslicates
d) Phyllosilicates

86. Montmorillonite minerals have external surface area (m^2/g) of
a) 80-150
b) 150-180
c) 180-250
d) 250-300

87. Which of the following is not a slow-release fertilizer?
a) N-serve
b) LCU
c) SCU
d) NCCU

88. Capillary porosity is given by the formula
a) 1-Field capacity
b) Field capacity × Bulk density
c) Field capacity × Particle density
d) $\left(1 - \frac{\text{Bulk density}}{\text{Field capacity}}\right) \times 100$

89. Azomethine-H is used in determination of
a) Molybdenum
b) Sulphur
c) Boron
d) Calcium

90. The journal "Communications in Soil Science and Plant Analysis" is published by
a) Elsevier
b) Kluwer
c) CSIRO
d) Francis and Taylor

91. Measured concentration of an ion is usually not equal to the actual concentration in soil due to
a) Complexation and ion-pair formation
b) Delayed equilibrium
c) Inefficiency of measuring device
d) Non-ideal pK values

92. The first compound formed on urea hydrolysis is
a) Ammonium carbonate
b) Ammonium carbamate
c) Anhydrous ammonia
d) Ammonium hydroxide

93. Uniform chlorosis of the youngest growth is a symptom of
a) K deficiency
b) S deficiency
c) Mg deficiency
d) Fe deficiency

94. In the universal soil loss equation, factor 'S' stands for
a) Slope-length
b) Slope gradient
c) Soil texture
d) Soil erodibility

95. The volumetric heat capacity of a wet soil (C_v) is expressed by
a) $C_v = \rho_b (1+\theta_m) c_p$
b) $C_v = \rho_b (1-\theta_m) c_p$
c) $C_v = \rho_b (\theta_m-1) c_p$
d) $C_v = \frac{(1-\theta_m)}{\rho_b} . c_p$

where,
c_p = heat capacity of soil on mass basis
θ_m = soil water content on mass basis
ρ_b = bulk density

96. The process of bringing bulk soil sample to the desired quantity is called
a) Reduction
b) Minimization
c) Quartering
d) Partitioning

97. Double rings infiltrometer is used for
a) Maximizing the vertical and horizontal flows
b) Reducing the vertical flow
c) Reducing the upward flow
d) Minimizing the horizontal flow

98. Which one is not a resource conservation technology (RCT)?
a) Zero tillage
b) Puddling
c) Laser leveling
d) Bed planting

99. *Aspergillus awamori* is a
a) K-mobilizer
b) Organic matter decomposer
c) S-oxidizer
d) P-solubilizer

100. In India, the work on 'biogas' was first carried out by
a) J.N. Mukherjee
b) S.V. Desai
c) N.P. Datta
d) N.N. Goswami

101. Real-time N management refers to
a) N supply as per plant demand
b) N supply as per soil test
c) N supply as per fertilizer schedule
d) N supply at different growth stages

102. 'cfu' is a unit for measuring
a) Soil pollution
b) Metal contamination
c) Soil quality
d) Microbial population

103. Conventional deficiency thresholds (mg/kg soil) of Zn and Fe for Indian soils are
a) 0.2 and 2.0
b) 0.6 and 4.5
c) 1.0 and 2.0
d) 3.0 and 6.0

104. The correct order of preference of anions for positive sites is
a) $Cl^- > PO_4^{3-} > SO_4^{2-}$
b) $Cl^- > SO_4^{2-} > PO_4^{3-}$
c) $PO_4^{3-} > SO_4^{2-} > Cl^-$
d) $SO_4^{2-} > PO_4^{3-} > Cl^-$

105. Acid sulphate soils are formed mainly due to
a) Reduction of sulphates
b) Oxidation of sulphides
c) Evolution of hydrogen sulphide
d) Rice cultivation using ammonium sulphate

106. 29.5 mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 mL of 0.1 M NaOH solution for complete neutralization. The percentage of nitrogen in the compound is
a) 23.7
b) 29.5
c) 47.4
d) 59.0

107. Find out the most appropriate order of organic soil nitrogen in order of their ease of mineralization:
a) Urea > amino acids > proteins > nucleic acids > amino sugars > humified N
b) Urea > amino sugars > proteins > amino acids > humified N > nucleic acids
c) Urea > nucleic acids > proteins > amino acids > humified N > amino sugars
d) Urea > amino acids > nucleic acids > humified N > proteins > amino sugars

108. The numerical notation 2.5 YR 5/6 indicates equivalent soil colour name as
a) Yellow
b) Yellow red
c) Red
d) Red yellow

109. If total soil water potential at a point A in soil is -150 cm and at point B is -200 cm, then
a) Water will flow from point A to B
b) Water will flow from point B to A
c) There will be no flow of water between points A & B
d) More information is needed to draw conclusion on direction of flow of water

110. Number of recognised land capability classes given by Soil Conservation Service of USA is
a) IV
b) VI
c) VIII
d) X

111. *Rhizobium japonicum* fixes N in symbiotic relationship with
a) Pea group
b) Lupin group
c) Soybean group
d) Phaseolus group

112. If 2 mL of 1N $K_2Cr_2O_7$ solution was consumed for oxidation of organic C present in 1 gram of a soil, the organic matter percentage of the soil is
a) 0.3
b) 0.6
c) 1.0
d) 1.5

113. Eriochrome Black-T is used for determination of
a) Lime requirement
b) Gypsum requirement
c) Organic-C
d) Boron determination

114. The correct sequence which shows decreasing order of C/N ratio is
a) Prokaryotes > earth worm > matured soil > *Sesbania sesban* > wheat straw > saw dust
b) Matured soil > prokaryotes > earth worm > *Sesbania sesban* > wheat straw > saw dust
c) Prokaryotes > *Sesbania sesban* > earth worm > matured soil > saw dust > wheat straw
d) Saw dust > wheat straw > *Sesbania sesban* > matured soil > earth worm > prokaryotes

115. Anion exchange capacity is highest in
a) Vermiculite
b) Montmorillonite
c) Kaolinite
d) Illite

116. DRIS approach was given by
a) Bray
b) Beaufils
c) Jackson
d) Nemeth

117. Amount of micronutrients required by various crops can be arranged in an order:
a) Fe > Mn > Zn > Cu > Mo
b) Mn > Zn > Fe > Cu > Mo
c) Fe > Zn > Mn > Cu > Mo
d) Mo > Cu > Zn > Mn > Fe

118. Mitscherlich related the potential yield of a crop to the amount of a given nutrient with the following equation:

Log (A-Y) = log A – Cb

In the equation 'b' denotes
a) Proportionality constant
b) Potential yield
c) Amount of given form of nutrient present in the soil
d) Growth factor specific to a crop when all other factors are not limiting

119. Prokaryotes in soil include the following groups of organisms
a) Fungi, Actinomycetes, Bacteria, Algae
b) Bacteria, Archaea, Actinomycetes, BGA
c) Protozoa, Bacteria, Fungi, Archaea
d) Algae, Protozoa, Fungi, Bacteria

120. Which one of the following organisms is an obligate chemoautotroph?
a) *Frankia*
b) *Nitrosomonas*
c) *Rhizobium*
d) *Anabaena*

121. Efficiency of nitrogenous fertilizer is dependent on various factors like water, fertilizers and presence of other agronomic management practices. To calculate the 'Apparent Nitrogen Recovery' (ANR) in relation to crop yield, the correct approach is

a) $ANR=\frac{(\text{uptake of N from fertilizer N} - \text{Uptake of N from control})}{\text{Amount of N applied}}\times 100$

b) $ANR=\frac{(\text{uptake of N from fertilizer N} - \text{Uptake of N from control})}{\text{Uptake of N from control}}\times 100$

c) $ANR=\frac{(\text{uptake of N from fertilizer N} - \text{Uptake of N from control})}{\text{Uptake of N from fertilizer N}}\times 100$

d) $ANR=\frac{(\text{Grain yield in N fertilized plot} - \text{Grain yield in control plot})}{\text{Amount of N applied}}\times 100$

122. In nitrification, the oxidation state of N changes from
a) -3 to +3
b) +3 to -5
c) -3 to +5
d) +3 to –3

123. Suppose that 100 kg of green manure containing 40% C and 2% N is decomposed by bacteria with C to N ratio of 5:1 and C assimilation efficacy of 5%. What will be the quantity of N mineralized or immobilized from the addition of green manure?
a) 0.4 kg N immobilized
b) 1.6 kg N mineralized
c) 2 kg N immobilized
d) 2 kg N mineralized

124. 'BIOLOG' is used for determining
a) Genetic fingerprints of soil microorganisms
b) Taxonomic changes of soil microorganisms
c) Metabolic fingerprints of soil bacteria
d) All of the above

125. Soil that contains 10^3 bacterial cells per gram is treated with organic matter. Bacteria in the soil can double every 4 hours. The number of bacterial cells after 36 hours will be
a) 4×10^6
b) 5.12×10^5
c) 8.2×10^5
d) 9×10^3

126. There are number of fundamental assumptions upon which the validity of Stokes' law is based. Which one of the assumptions given below is not correct?
a) The particles must be large in comparison to liquid molecules.
b) Particles must not be rigid and smooth.
c) There must be no slipping between the particle and the liquid.
d) The velocity of the fall must not exceed a certain critical value so that the viscosity of the liquid remains the only resistance to the fall of the particles.

127. Which one of the following minerals would weather most rapidly?
a) Muscovite
b) Albite
c) Quartz
d) Microline

128. Which of the following processes explains the formation of secondary crystalline colloids from the mica and feldspars present in the parent rock?
a) Hydrolysis
b) Solution
c) Coagulation
d) Carbonation

129. The crystal units of montmorillonite are held together by
a) O – O linkages
b) O – H linkages
c) H bonding
d) K^+ ions

130. Carbon-14 (^{14}C) is used for C dating. What is the half life of ^{14}C?
a) 8370 years
b) 5730 years
c) 1620 years
d) 13 years

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) Karl Fisher reagent	a) P determination
ii) EBT indicator	b) Available N estimation
iii) Ascorbic acid	c) Available Mo estimation
iv) Alkaline permanganate	d) Moisture determination in urea
v) Grigg's reagent	e) Ca estimation

132.

i) Production of H_2 as feedstock	a) Solvay's process
ii) Single superphosphate	b) Froth floatation
iii) Ammonium chloride	c) Haber-Bosch
iv) Beneficiation of rockphosphate	d) Steam reforming
v) Ammonia synthesis	e) EID (Parry) Ltd.

133.

i) Phospholipid fatty acids	a) Phosphatase
ii) Phenyl mercuric acetate	b) Dehydrogenase
iii) Fumigation extraction	c) Biodiversity
iv) Tri-phenyl tetrazolium chloride	d) Microbial biomass-C
v) P-nitrophenol	e) Urease inhibitor

134.

i) Deflorination	a) Potassic fertilizers
ii) Floatation	b) Nitrogenous fertilizers
iii) Anti-caking	c) Biochar
iv) LCC	d) Conditioners
v) Pyrolysis	e) Phosphatic fertilizers

135.

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

136.

i) Infrared thermometer	a) Wind velocity
ii) Psychrometer	b) Reflectance
iii) Spectro-radiometer	c) Stable isotopes
iv) Anemometer	d) Canopy temperature
v) Mass spectrometer	e) Relative humidity

137.

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

138.

i) Environmental Soil Physics	a) C.E. Marshall
ii) Physical Chemistry and Mineralogy of Soil	b) D. Hillel
iii) Soil Conditions and Plant Growth	c) W.L. Lindsay
iv) Soil Fertility : Theory and Practice	d) E.W. Russell
v) Chemical Equilibria in Soils	e) J.S. Kanwar

139.

i) Truog's reagent	a) pH 7.3
ii) Egner's reagent	b) pH 8.5
iii) Morgan's reagent	c) pH 4.8
iv) Olsen's reagent	d) pH 3.0
v) DTPA reagent	e) pH 3.8

140.

i) Photoautrophs	a) Energy from sunlight, C from CO_2
ii) Chemoautotrophs	b) Exist as free living organisms but fix N_2
iii) Anaerobes	c) Energy from sunlight, C from organic matter
iv) Non-symbiotic N_2 fixers	d) Can use chemical species other than free oxygen as electron acceptors
v) Photoheterotrophs	e) Energy from oxidation of inorganic substances, C from CO_2

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. "Soil health deterioration is the major second generation problem of Green Revolution". Substantiate the statement with appropriate reasons.

142. Give the working principles of flame photometry and atomic absorption spectrophotometry and explain the basic difference between these two techniques.

143. "Irrespective of the original pH, pH of the soil upon prolonged waterlogging tends to stabilize near neutrality". Support your answer by taking an example of acidic Ultisol and sodic Alfisol.

144. "Natural vegetation promotes below ground biodiversity". Briefly describe.

145. Enumerate the soil-related conditions congenial for occurrence of *Akiochi* disease in rice. What measures will you suggest for the alleviation of the same?

146. Define lime requirement and lime potential. Calcium chloride ($CaCl_2$) contains 53% calcium. Express this on an equivalent calcium oxide. Can calcium chloride be used as a liming agent? Give reasons in support of your answer.