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ENTRANCE EXAMINATIONS – 2019

(Ph.D. Admissions - January 2020 Session)

Ph.D. Plant Sciences

Time: 2 hours Maximum Marks: 70

HALL TICKET NO.

INSTRUCTIONS

Please read carefully before answering the questions:

1. Enter your Hall Ticket number both on the top of this page in the box provided and on the OMR answer sheet. Write your booklet code wherever applicable.

2. Answers are to be marked only on the **OMR answer sheet**, following the instructions provided there upon.

3. Hand over the OMR answer sheet at the end of the examination to the Invigilator.

4. The question paper contains **70** questions. **Part-A:** Question Nos. **1-35** and **Part-B:** Question Nos. **36-70** of multiple-choice printed in **14** pages, including this page. One OMR answer sheet is provided separately. **Please check**.

5. The marks obtained in **Part-A** will be used for resolving the tie issues.

6. Each question carries one mark. **There is negative marking. Each wrong answer carries -0.33 mark.**

7. Calculators and mobile phones are NOT allowed.

8. No additional sheets will be provided. Rough work can be done in the question paper itself or in the space provided at the end of the booklet.

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PART-A

1. In a UV estimation of RNA at 260 nm, 1 unit of absorbance corresponds to a concentration of:

   A) 20 µg RNA/ml
   B) 40 µg RNA/ml
   C) 60 µg RNA/ml
   D) 10 µg RNA/ml

2. Leghemoglobin in nitrogen-fixing nodules helps as:

   A) Cofactor for dinitrogenase enzyme
   B) Cofactor for dinitrogenase reductase enzyme
   C) Oxygen presenter for nitrogen-fixing enzyme complex
   D) Oxygen scavenger for nitrogen-fixing enzyme complex

3. A single plant cell with water potential value of -2 MPa is placed in a vessel of pure water. What will be the value of the water potential of the cell when it is fully turgid?

   A) -1 MPa
   B) -4 MPa
   C) 0 MPa
   D) +2 MPa

4. Assume that restriction digestion of Lambda DNA by HindIII enzyme produces 6 bands of sizes 23 kb, 10 kb, 6 kb, 5 kb, 4 kb, and 2 kb in an agarose gel electrophoresis (AGE) experiment. If the intensities of 2 kb and 6 kb bands on the AGE are equal to 10 and 30 nanograms of DNA respectively, what was the total amount of Lambda DNA loaded in the well at the start of AGE experiment?

   A) 150 ng
   B) 200 ng
   C) 250 ng
   D) 300 ng

5. What will be the reverse-complement sequence of the following sequence 5'-ACGCGCATCGTAAGTCA-3'?

   A) TGACTTACGATGCGCGT
   B) TGCGCGTAGCATTCAGT
   C) ACTGAATGCTACGCGCA
   D) ACGCGCATCGTAAGTCA

6. Which of the following statements is incorrect about gene conversion?

A) It involves a non-reciprocal sequence exchange between allelic genes
B) It occurs during meiosis when homologous recombination between heterozygotic sites results in a mismatch in base-pairing
C) It is initiated by double-strand break which is repaired by copying a homologous sequence
D) It results in Mendelian segregation of alleles (2:2) in germ cells

7. In one of the chromatography methods, the stationary phase consists of a support medium, on which the substrate is bound covalently in such a way that the reactive groups that are essential for binding of the target molecule are exposed. The following statement can be seen in which chromatography?

A) Gel exclusion chromatography
B) Ion exchange chromatography
C) Affinity chromatography
D) High-performance thin layer chromatography (HPTLC)

8. Researchers from several molecular biology laboratories are using 'Primer3' for different aspects of PCR. What is 'Primer3'?

A) Apart from forward and reverse primers, a third primer called Primer3 is used in PCR reaction to detect specific mutation in PCR product
B) Primer3 is the name of 3rd primer in specific PCR where researcher adds an adapter to the template and this Primer3 binds to adapter during PCR
C) Primer3 is the primer designing online tool
D) Primer3 is name of a dye which is used to label one of the PCR primers at a time

9. The genomic DNA extraction from mature plant tissue is difficult because plants have:

A) Very large amount of secondary metabolites and polysaccharides
B) Very large amount of DNA
C) Very large amount of proteins
D) Very large amount of RNA

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10. Why is it easier to manipulate plants by genetic engineering than animals? This is because:

A) No introns are found in plant genes
B) Availability of various vectors for transferring recombinant DNA into plant cells
C) A somatic plant cell can often give rise to a complete plant
D) Microinjection can be used to insert genes into plant cells

11. What happens when the seeds or plant DNA is treated with Ethyl methane sulfonate?

A) In both the cases, the plant DNA is methylated
B) In both the cases, the plant DNA becomes resistant to restriction endonucleases
C) It is a chemical mutagen and converts the DNA sequence from C/G to T/A
D) This is a type of detergent which is used for disinfecting plant seeds and also used in purification of DNA sample

12. Which of the following regarding epigenetic inheritance is false?

A) It does not involve changes in DNA sequence
B) It involves functionally relevant modifications to the genome such as histone modification
C) Epigenetic changes are not preserved when cells divide
D) DNA methylation is epigenetic event

13. A mixture containing the following compounds is passed through a column in a gel filtration chromatography, which excludes all proteins of MW 150,000 and higher. If protein A MW = 30,000, protein B MW = 220,000, protein C MW: 90,000, protein D MW: 50,000 and protein E MW: 250,000 are present, what will be the order of elution of these proteins?

A) Protein E, Protein B, Protein C, Protein D, Protein A
B) Protein E + Protein B, Protein C, Protein D, Protein A
C) Protein A, Protein D, Protein C, Protein B, Protein E
D) Protein E + Protein B, Protein A, Protein D, Protein C

14. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:

A) Tryptophan, aspartate or cysteine
B) Asparagine, serine or threonine
C) Glycine, alanine or aspartate
D) Aspartate or glutamate

15. Star activity of a restriction endonuclease refers to _____

A) Improved activity of a restriction endonuclease enzyme
B) Restriction endonuclease showing an additional function of ligase activity
C) Restriction endonuclease showing an additional function of polymerase activity
D) Restriction endonucleases cleaving at noncanonical sites

16. *Neurospora crassa*, which produces ordered tetrads is a widely chosen organism for mapping the gene with respect to centromere. Considering a gene which is linked to centromere in this organism, if four types of double crossovers between the centromere and gene are equally frequent, what proportion of asci formed from double crossing over will show second-division segregation pattern?

A) 12.5%
B) 25%
C) 50%
D) 100%

17. To construct unidirectional (3′-5′) deletions using double stranded DNA as a template, this modifying enzyme is used in the laboratory:

A) Exonuclease VII
B) Exo III nuclease
C) λ Exo
D) T7 gene 6 Exonuclease

18. Which of the following function(s) as glycosyl donor/carrier for N-linked glycosylation of proteins, occurs in lumen of endoplasmic reticulum?

A) Heparan Sulfate Proteoglycans (HSPG)
B) Dolichol phosphosugars
C) Glycated Hemoglobin
D) Glycated Albumin

19. A reaction mixture of 500 ml containing 5 mM Tris-HCl buffer pH 7.5, 0.2 mM $MgCl_2$ and 0.01% NaCl has to be prepared using the stock solutions of concentration, 1 M Tris HCl of pH 7.5; 100 mM $MgCl_2$ and 1.0% NaCl solution. The volumes of the stocks should be mixed as:

A) 2.5 ml of Tris-HCl, 1.0 ml of $MgCl_2$ and 5.0 ml of NaCl in 491.5 ml of H_2O
B) 2.5 ml of Tris-HCl, 0.5 ml of $MgCl_2$ and 2.5 ml of NaCl in 494.5 ml of H_2O
C) 2.5 ml of Tris-HCl, 1.0 ml of $MgCl_2$ and 0.5 ml of NaCl in 496.0 ml of H_2O
D) 2.5 ml of Tris-HCl, 2.5 ml of $MgCl_2$ and 5.0 ml of NaCl in 490.0 ml of H_2O

20. Match the following using the codes given below:

1. Lauric acid	(a) Hexadecanoic acid
2. Myristic acid	(b) Dodecanoic acid
3. Palmitic acid	(c) Octadecanoic acid
4. Stearic acid	(d) Tetradecanoic acid

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

21. Which of the following statements about hydrolytic damage to DNA is <u>incorrect</u>?

A) It causes cleavage of glycosidic bonds resulting in loss of bases
B) Cytosines are often deaminated to give thymines
C) It causes amino groups to be stripped from bases
D) Loss of purine bases occurs at much faster rate than loss of pyrimidine bases

22. Different types of steles are found in *Lycopodium*. One among them consists of central xylem core with radiating ribs or a star shaped appearance surrounded by phloem and is known as:

A) Actinostele
B) Plectostele
C) Mixed protostele
D) Mixed plectostele

23. Match the following using the codes given below:

1. Pantothenic acid	(a) 5'-Deoxyadenosyl cobalamin
2. Vitamin-B_{12}	(b) Pyridoxal phosphate
3. Vitamin-B_6	(c) Coenzyme-A
4. Vitamin-B_2	(d) FAD

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

24. During tandem mass spectrometry of peptides, which of the following does not occur?

A) Collision induced dissociation
B) Breakage across the peptide bond
C) Production of a series of b and y ions
D) Cleavage of the signal peptide

25. The effect of pollen genotype on the developing maternal tissues of seed or fruit of recipient genotype, usually associated with a single recessive gene is known as:

A) Metaxenia
B) Hypoxia
C) Anorexia
D) Hypoxemia

26. Homologous genes within a single species that diverged by gene duplication are:

A) Homeologs
B) Orthologs
C) Xenologs
D) Paralogs

27. Labelling of DNA at the 5' ends can be performed by using:

A) T4 polynucleotide kinase
B) Klenow fragment
C) *Taq* DNA polymerase
D) Terminal transferase

28. The short tandem repetitive DNA sequence could be developed into a molecular marker to screen several genotypes to analyze variation among them. Which one among the following markers, suits best to the above described conditions?

A) Single nucleotide polymorphism (SNP)
B) Random amplified polymorphic DNA (RAPD)
C) Sequence characterized amplified region (SCAR)
D) Minisatellite

29. Promoter regions are nucleotide sequences that:

A) Are involved in the initiation of transcription
B) Are involved in transcription termination
C) Contain the code for a mRNA molecule
D) Are important to the translation process

30. A three-point test cross in *Drosophila melanogaster* yields a frequency of recombination of 0.2 in "region 1", a frequency of recombination of 0.3 in "region 2" and an interference value of 0.3. Among 1000 total progeny, how many should be recombinants in both regions (double crossovers)?

A) 48
B) 152
C) 252
D) 548

31. Two genes A and B that are present in a specific chromosomal region are linked. There is no crossover in 60% of the cells undergoing meiosis, whereas 20% of the cells have a single crossover, and 20% of the cells have a double crossover. The frequency of genetic recombination between the two genes A and B is:

A) 15
B) 20
C) 30
D) 40

32. Which of the following term is not associated with the CRISPR genome editing technology?

A) CrRNA (Clustered Regularly Interspaced Short Palindromic Repeats [CRISPR] RNA)
B) gRNA (guide RNA)
C) PAM (Protospacer Adjacent Motif)
D) TALE (Transcription Activator-Like Effectors)

33. In *Escherichia coli*, the inability of the *lac* repressor to bind to an inducer would result in:

A) Constitutive synthesis of β-galactosidase
B) No substantial synthesis of β-galactosidase
C) Synthesis of inactive β-galactosidase
D) Inducible synthesis of β-galactosidase

34. Which of the following vectors is derived from F-factor of *E. coli*?

A) Bacterial artificial chromosome (BAC)
B) P1-derived artificial chromosome (PAC)
C) Yeast artificial chromosome (YAC)
D) Cosmid

35. Which one of the following is not a catalytic mechanism in enzymatic reactions?

A) Acid-Base reactions
B) Covalent reactions
C) Metal ion mediated reactions
D) Preferential binding of the enzyme to the product

PART-B

36. Which of the following pairs of post-translational modifications, can each cause a mass change of 80 Da in a protein?

A) Phosphorylation and sulfation
B) Sulfation and nitrosylation
C) Acetylation and sumoylation
D) Hydroxylation and phosphorylation

37. The practice of growing plants in nutrient enriched water without soil is called:

A) Aeroponics
B) Hydroponics
C) Japonics
D) Cryptonics

38. Ammonia oxidation to nitrate depends on the following two bacteria:

A) *Nitrosomonas-Nitrosospira*
B) *Azospirillum-Pseudomonas*
C) *Nitrobacter-Nitrococcus*
D) *Nitrosospira-Nitrococcus*

39. Death of protoplasm is a pre-requisite for a vital function like:

A) Transport of sap
B) Transport of food
C) Absorption of water
D) Gaseous exchange

40. Light dependant proton gradient occurs in:

A) Peroxisomes
B) Golgi complexes
C) Chloroplast
D) Mitochondria

41. Which of the following degrades ubiquitinated-proteins?

A) Lysosome
B) Proteosome
C) Calpain
D) Trypsin

42. Which of the following elements is required for the perception of ethylene by its receptors?

A) Nickel
B) Copper
C) Potassium
D) Iron

43. In sphingomyelin, two hydrocarbon chains are bound to _____

A) Selenocysteine
B) Serine
C) Glycerol
D) Threonine

44. Which amino acids participate in Kinase enzyme activity:

A) Ser, Tyr and Phe
B) Ser, Thr and Tyr
C) Ser, Ala and Thr
D) Thr, Thy and Phe

45. The plant hormone derived from degradation of carotenoid is:

A) Auxin
B) Kinetin
C) Abscisic acid
D) Salicylic acid

46. N-acetyl glucosamine (NAG) and N-acetyl muramic acid (NAM) are two important chemical constituents of the cell wall of:

A) Algae
B) Fungi
C) Bacteria
D) Plants

47. Vinblastine, Vincristine and Leucocrostine are anti-cancerous drugs isolated from this plant species:

A) *Eclipta alba*
B) *Catharanthus roseus*
C) *Ocimum sanctum*
D) *Sida cardifolia*

48. Denaturation of proteins comprises the disruption and possible destruction of:

A) Secondary and tertiary structure
B) Only secondary structure
C) Peptide bond
D) Primary structure

49. Enzymes of oxidative phosphorylation are present in:

A) Grana
B) $F_0 - F_1$ particles
C) Ribosomes
D) Endoplasmic reticulum

50. Which of the following agents mediate oxidative cleavage of disulphide bonds?

A) β-mercaptoethanol
B) Dithiothreitol
C) Performic acid
D) Dithioerythritol

51. Identify the mismatch among the following:

A) *Bifidobacterium* – produces acetic acid
B) *Frankia* – fixes nitrogen
C) *E. coli* – Methyl red positive
D) *Enterobacter* – H_2S positive

52. The site of synthesis of matrix polysaccharides of pectin, component of cell walls in plant cells is _____.

A) Mitochondria
B) Chloroplasts
C) Golgi apparatus
D) Vacuole

53. What is the source of energy that drives the ascent of water in tall trees?

A) Solar energy
B) Gravitational pull
C) Root pressure
D) Osmotic potential

54. Which of the following is <u>not</u> a transition element which is involved in plant photosynthesis?

A) Copper
B) Iron
C) Zinc
D) Magnesium

55. Which of the following element is the most immobile in soil?

A) Calcium
B) Phosphorus
C) Potassium
D) Magnesium

56. Vanillin from *Vanilla fragrans*, used as a food flavouring agent is chemically a:

A) Protein
B) Alkaloid
C) Phenolic compound
D) Carbohydrate

57. Which ribonuclease specifically hydrolyses RNA after guanyl residue?

A) Ribonuclease A
B) Ribonuclease H
C) Ribonuclease T1
D) Ribonuclease T7

58. In a competitive inhibition, the reaction would be:

A) V_{max} unchanged and K_m, changes
B) V_{max} decreases and K_m unchanged
C) Both V_{max} and K_m, decrease
D) Both V_{max} and K_m, increase

59. Lysosomal lumenal targeted enzymes are recognized in Golgi due to the presence of:

A) Mannose-6-phosphate
B) Sulfhydryl group
C) Acetylated N-terminal amino acid
D) Glucose residues

60. One of the following is <u>not</u> a property of facilitated diffusion:

A) Mediated by a membrane protein
B) Competitive inhibition
C) Transport of ions
D) Requirement of metabolic energy

61. A cycle in which plasmogamy, karyogamy and meiosis (haploidization) takes place typically <u>not</u> at a specified point of time in the life of an organism. This phenomenon is called as:

A) Asexual life cycle
B) Parasexual cycle
C) Parthenogenic cycle
D) Heteromistic cycle

62. Which of the following treatments will <u>not</u> result in sterilization?

A) Autoclaving
B) Boiling for 20 minutes
C) Flaming a loop
D) Pasteurization

63. The dwarf pea mutant used by Mendel for genetic analysis was defective in biosynthesis of:

A) Gibberellic acid
B) Polyamine
C) Indole acetic acid
D) Brassinosteroid

64. Antibiotics of 'aminoglycosides' target to inhibit bacterial _____

A) Nucleic acid synthesis
B) Protein synthesis
C) Cell wall biosynthesis
D) Cell division

65. A long term biological interaction in which members of one species gains or benefits, while the other species neither benefits nor gets harmed is called:

A) Parasitism
B) Mutualism
C) Commensalism
D) Inquilinism

66. In gas chromatography, the basis for separation of the components of the volatile material is the difference in:

A) Partition coefficients
B) Conductivity
C) Molarity
D) Molecular weight

67. Lichens are composite organisms that arise from algae and multiple species of fungi. The habitats at which the lichens are growing are indicators of the presence of:

A) Mercury
B) NO_2
C) SO_2
D) CO

68. Which among the following support myxotrophic growth of microorganisms?

A) Acetate + CO_2
B) Acetate + glucose
C) Glucose + H_2S
D) CO_2 + H_2S

69. From one glucose molecule how many acetyl CoA molecules can be generated:

A) 4
B) 6
C) 8
D) 2

70. A culture of bacterial cells started with 8 cells and ended with 512 cells. How many generations did the cells undergo to produce that many numbers of cells?

A) 5
B) 6
C) 7
D) 8