(9)

Code No. Y-69

ENTRANCE EXAMINATION - 2020

Ph.D. Plant Sciences

Time: 2 hours | Maximum Marks: 70

HALL TICKET NO.

INSTRUCTIONS

Please read carefully before answering the questions:

1. Write your Hall Ticket Number in the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the space provided above.
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. No additional sheets will be provided. Rough work can be done in the question paper itself/space provided at the end of the booklet.
5. The question paper contains **70** questions. **Part-A**: Question Nos. **1-35** and **Part-B**: Questions Nos. **36-70** of multiple-choice printed in **15** pages, including this page. One OMR answer sheet is provided separately. **Please check.**
6. The marks obtained in **Part-A** will be used for resolving the tie cases.
7. Each question carries one mark.
8. Calculators and mobile phones are NOT allowed.

Part-A

1. Over expression of the gene encoding 5-enolpyruvyl shikimate 3-phosphate synthase in transgenic crop plants causes resistance to

A. 2,4-D B. dicamba C. glyphosate D. glufosinate

2. In CRISPR-Cas9 system, binding and cleavage of DNA by Cas9:gRNA require recognition of a short trinucleotide protospacer adjacent motif (PAM) in the target genome. The correct sequence of this PAM (5'-3') is ____.

A. NAA B. NGG C. NTT D. NCC

3. Consider the following statements about designing primers for PCR. Which of the statements are **correct**?

(i) The orientation of primer sequence should be 3' to 5' as it enables the synthesis in 5' to 3' direction

(ii) The forward and reverse primers should have similar melting temperatures as it enhances the specificity

(iii) Primers with melting temperatures above 65°C have a tendency for secondary annealing

(iv) The GC content of primer should be 20% or less as it enables easy melting and annealing

A. (i) and (ii) B. (ii) and (iii) C. (ii), (iii) and (iv) D. (iii) and (iv)

4. A foreign DNA was cloned into lacZ site of a plasmid that also contains ampicillin resistance gene. The plasmid was then transformed into *E. coli* and plated on two different media. How will you screen the positive colonies?

(i) Medium containing IPTG and X-gal but no ampicillin.
(ii) Medium containing IPTG, X-gal and ampicillin.

A. White colonies that grow on (i) but not on (ii) are positive
B. White colonies that grow on (ii) are positive
C. Blue colonies that grow on (i) but not on (ii) are positive
D. Blue colonies that grow on (ii) are positive

5. Consider the following reactions. The enzyme classes that catalyze these processes are:

(i) ethanol + NAD+ --> acetaldehyde + NADH + H+
(ii) glucose + ATP --> glucose-6-phosphate + ADP
(iii) glucose-6-phosphate <--> fructose-6-phosphate

A. oxidoreductase, transferase, and isomerase, respectively
B. dehydrogenase, phosphatase, and isomerase, respectively
C. hydrolase, transferase, and isomerase, respectively
D. kinase, phosphatase, and isomerase, respectively

6. A single molecule of DNA is amplified by PCR for 25 cycles. Theoretically, how many molecules of amplicon will be produced?

A. 11332210 B. 22443321
C. 33554432 D. 44665543

7. 'Metabolomics' is used to detect _____ in a biological system?

A. promoter sequences
B. a specific condition induced mRNA molecules
C. specific membrane proteins
D. low-molecular-weight molecules of below 1 kDa

8. Which of the following tool predicts subcellular localization of a protein?

A. TargetP B. Translate
C. ClustalW D. Dotlet

9. Which of the following enzymes is used for RACE (rapid amplification of cDNA ends) experiment?

A. T4 DNA ligase
B. restriction enzyme HindIII
C. specific membrane proteins
D. terminal deoxynucleotidyl transferase

10. Why EDTA (ethylene-diamine-tetraacetic acid) molecule is widely used in molecular biology experiments?

A. It directly degrades enzymes
B. It inhibits activities of various enzymes by chelating their essential cofactors
C. It can directly activate enzymes
D. It is a pH regulator

11. Principle of which of the following chromatography techniques is **not** dependent on affinity based purification?

A. Nickel column for 6xHis tag proteins
B. Antigen immobilized column for antibodies
C. Sephadex G50 column for desalting
D. Streptavidin column for biotinylated molecules

12. Proteins can be separated using two-dimensional electrophoresis performed under denaturing conditions based on which of the following characteristics?

	First Dimension	**Second Dimension**
A.	Subunit molecular weight	Density
B.	Density	Charge
C.	Isoelectric point	Subunit molecular weight
D.	Hydrophobicity	Subunit molecular weight

13. A traditional Northern blotting technique **cannot** be used to determine which of the following information?

A. the size of the mRNA species
B. the amino acid sequence of the protein coded by the mRNA species
C. the relative levels of the mRNA species in different tissues
D. the half-life of the mRNA species

14. Particular RNAs that are important for the development are located in the distinct regions of Arabidopsis embryo. This can be demonstrated by using

A. Western blotting
B. Northern blotting
C. *In situ* hybridization
D. *In vitro* translation

15. An α-helical structure of a protein in solution is best determined by

A. Fluorescence spectroscopy
B. UV-visible absorbance spectroscopy
C. Circular dichroism
D. Analytical ultracentrifugation

16. One of the techniques that can be used to show the fluidity of bio-membranes is

A. Phase-contrast microscopy
B. Fluorescence microscopy
C. Electron microscopy
D. Compound microscopy

17. The method for assessing the statistical significance of the positions of branches in a phylogenetic tree is called ____.

A. Bootstrapping
B. Scoring
C. Normalizing
D. Reappropriating

18. Three researchers (M, N, O) were identifying the proteins that interact with a transcription factor, TF. M performed gel filtration assay and identified that TF was found along with proteins α, β, γ, and δ. N performed co-immunoprecipitation experiments using TF-specific antibodies and identified α, β, and γ. O did yeast two-hybrid screen and identified only β. The below are the conclusions made to explain all the results. Which of these conclusions best explains the result?

(i) α, β, γ, and δ are in a complex with TF
(ii) TF directly interacts with β
(iii) Only α, β and γ are in complex with TF
(iv) δ is probably weakly associated with TF.

A. (i), (ii) and (iii)
B. (i), (ii) and (iv)
C. (i), (iii) and (iv)
D. (ii), (iii) and (iv)

19. In which of the following molecular biology techniques the term "driver" and "tester" is being used?

A. Microarray hybridization
B. Illumina genome analyser
C. Subtractive hybridization
D. Serial analysis of gene expression

20. After the outbreak of Coronavirus in Wuhan, China, several research groups have performed the complete genome sequencing of this virus strains collected from different geographical region of the world and submitted in NCBI database. One research scholar from University of Hyderabad wanted to compare genome sequences of all strains and prepare its dendrogram. Which of the following software/tool you will suggest him/her for preparing dendrogram?

A. KEGG
B. PHYLIP
C. FGENESH
D. Vgas

21. Which among the following indicate different types of DNA markers?

A. RFLP, AFLP, SSR
B. ddATP, ddGTP, ddCTP
C. BAC, PAC, YAC
D. BLAST, PFAM, GeneMark

22. In some of the plant molecular biology and functional genomics studies, few chemicals like Ethyl methanesulfonate (EMS) and Ethyl nitrosourea (ENU) are used. What are the functions of these chemicals?

A. EMS is chemical mutagen whereas ENU is fertilizer for plant growth
B. EMS is chemical mutagen whereas ENU is a dye which intercalates between nitrogenous bases of DNA
C. EMS is used for cleaning plant seeds whereas ENU is used for RNA purification
D. Both are chemical mutagens

23. In molecular cloning experiments, 1:3 and 1:6 vector-to-insert ratio is often recommended for sticky-end and blunt-end cloning ligation reactions, respectively. A student has been asked to carry out two separate *in silico* ligation reactions for sticky-end cloning and blunt-end cloning using a common vector (plasmid size: 12-kilobase). The amount plasmid DNA of this common vector to be taken in each reaction is 50-nanogram. If size of the insert to be used for sticky-end cloning is 8-kilobase, whereas the insert size for blunt-end cloning is 4-kilobase, calculate how much amount of each insert, for sticky-end and blunt-end cloning, respectively, would be required in each ligation reaction, keeping the vector-to-insert ratios same as recommended.

A. 100 ng for sticky-end and 200 ng for blunt-end
B. 50 ng for sticky-end and 100 ng for blunt-end
C. 100 ng for sticky-end and 100 ng for blunt-end
D. 200 ng for sticky-end and 100 ng for blunt-end

24. Match the items listed in "A" with the most relevant match listed in "B"

	A		**B**
a.	COBRA	i.	Taqman® probe
b.	SARS-CoV-2	ii	Protein-protein interaction
c.	Y2H	iii	FokI
d.	Genome-editing	iv	BstUI

A. a(iv), b(i), c(ii), d(iii)
B. a(iii), b(i), c(ii), d(iv)
C. a(iv), b(ii), c(i), d(iii)
D. a(iii), b(ii), c(i), d(iv)

25. Which of the answers is **true** for the given statements on Barnase-Barstar system expressed in a cell?

Statement 1: Barnase is a ribonuclease which when expressed is lethal to the cell. Barstar is a strong repressor gene that prevents barnase action.
Statement 2: If both of these genes are constitutively expressed in a cell, barnase action will be impaired and the lethal effect of its expression will be suppressed.

A. Statement 1 is incorrect whereas statement 2 is true.
B. Statement 1 is true whereas statement 2 is incorrect.
C. Both statements are true.
D. Both statements are incorrect.

26. How many unrooted trees are possible in a phylogenetic analysis, if the number of taxa taken in the analysis is two?

A. Zero B. One C. Two D. Four

27. Which of the following methods of the gene expression should be used in an experiment if one of the objectives of the study is also to have information on the expressed novel genes?

A. Northern blotting
B. Serial analysis of gene expression
C. Quantitative real-time PCR
D. Microarray

28. Which of the answers is **true** for the given statements on herbicide resistance in transgenic crops?

Statement 1: Glufosinate inhibits the activity of enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) of the shikimate pathway in plants.
Statement 2: An insensitive EPSPS allele is overexpressed to introduce herbicide tolerance trait in transgenic crops.

A. Statement 1 is incorrect whereas statement 2 is true.
B. Statement 1 is true whereas statement 2 is incorrect.
C. Both statements are true.
D. Both statements are incorrect.

29. The screening approach which is adopted to screen large sets of plant populations using DNA markers is to group segregating genotypes into resistant and susceptible classes. What are these classes known as:

A. Purelines
B. Inbreds
C. Bulks
D. Doubled haploids

30. Which one of the following DNA-based markers can be used to quantify the mRNA transcripts of a gene?

A. Mini satellite marker
B. Microsatellite marker
C. Single nucleotide polymorphism
D. Expressed sequence tag marker

31. A genetic approach wherein exogenous or modified deoxyribonucleic acid (DNA)-based vectors are randomly integrated into the recipient genome and the altered genes are screened using the known vector sequence as a probe is known as:

A. Insertional mutagenesis
B. Promoter trapping
C. Transposition
D. Chromosome landing

32. Snapdragon flowers exhibit codominance. When red flowered plants are crossed with white flowered plant, the possibility of an F2 offspring being homozygous is

A. 1/4
B. 1/2
C. 1/12
D. 3/4

33. Which of the following statements is **not true** about phenylmethylsulfonyl fluoride (PMSF)?

A. It binds covalently to the active site serine residue in trypsin and chymotrypsin
B. It has greater solubility and highest stability in aqueous solutions
C. Effective in most protein solutions at 0.1 to 1 mM final concentration
D. It inhibits mammalian acetylcholinesterase

34. Consider the following statements.

I. *In vitro* androgenesis is more commonly used for haploid production in different crop species than *in vitro* gynogenesis as it is more efficient and easy to culture
II. Haploid plants produced through *in vitro* gynogenesis are fertile and can set seeds
III. Chromosome doubling of haploid plants produced from pollen embryogenesis restores fertility and results in homozygous diploids
IV. Diploid plants produced through anther wall tissues in anther cultures are somatic diploids

Which of the following statements related to above are **correct**?

A. Statements I, II and III are correct
B. Statements I, II and IV are correct
C. Statements I, III and IV are correct
D. Statements II, III and IV are correct

35. Hairy root cultures for secondary metabolite production are induced by transforming plant cells with

A. Virus
B. *Agrobacterium tumefaciens*
C. *Bacillus thuringiensis*
D. *Agrobacterium rhizogenes*

Part-B

36. Which of the following transcription factor families is plant-specific?

A. AP2 B. bZIP
C. MYB D. WRKY

37. In tRNA, Ψ (Psi) -arm is named for the presence of ____.

A. amino-pseudopurine B. pyrimidinediol
C. uracil-pseudouridine D. dioxypyrimidine

38. Which of the following statements about protein structure is/are **correct**?

(i) Hydrophobic amino acid side chains are buried inside globular proteins
(ii) Beta-sheets are stabilised by hydrogen bonds between parallel or antiparallel strands
(iii) Amino acids in coils have an undefined, random position
(iv) Protein secondary and tertiary structure can be changed by high salt concentration

A. (i) and (ii) B. (i) only
C. (iii) and (iv) D. (iii) only

39. Match the **correct** hormonal combination (I) with the response of explant (II) on MS media.

I	II
a. High auxin to cytokinin ratio	(i) Root initiation
b. Low auxin to cytokinin ratio	(ii) Shoot elongation
c. Auxin alone	(iii) Callus initiation
d. Cytokinin alone	(iv) Shoot regeneration

A. a(ii), b(iii), c(iv), d(i) B. a(iii), b(iv), c(i), d(ii)
C. a(iv), b(i), c(ii), d(iii) D. a(iv), b(iii), c(i), d(ii)

40. Which of the following is an example of polyterpene?

A. Secondary wood B. Natural rubber
C. Menthol D. Vincristine

41. Antibiotics 'beta-lactams' inhibit bacterial growth by inhibiting _____.

A. cell wall synthesis B. protein synthesis
C. cell membrane potential D. Nucleic acid biosynthesis

42. _____ is a molecular chaperone.

A. Chlorophyll binding protein located in chloroplasts
B. Binding immunoglobulin protein (BiP) located in the ER
C. Limonene synthase located in leucoplasts
D. Polysomal complex located in cytosol

43. The Shine-Delgarno sequence is a sequence that is referred to _____

A. 5'-end of 16S ribosomal RNA
B. 3'-end of bacterial mRNA downstream of the stop codon
C. 5'-end of bacterial mRNA, upstream of the start codon
D. 3'-end of 28S ribosomal RNA

44. Each cycle of β-oxidation can produce?

A. 1 FAD, 1 NAD+, and 2 CO2 molecules
B. 1 FADH2, 1 NAD+, and 1 acetyl-CoA
C. 1 FADH2, 1 NADH, and 1 acetyl-CoA
D. 1 FADH2, 1 NADH, and 2 CO_2 molecules

45. The zymogen trypsinogen is converted to active trypsin by

A. binding of a crucial metal ion
B. reduction of a disulphide bond
C. proteolytic cleavage
D. phosphorylation of an active site residue

46. The eukaryotic photosynthesis originated *via*—

A. Endosymbiosis of Cyanobacteria
B. Endosymbiosis of Purple Bacteria
C. Endosymbiosis of Archaea Bacteria
D. From Algae

47. The plant hormone auxin mediates changes in plant growth rate due to

A. increased extensibility of the walls of the affected cells
B. loss of turgor pressure in the affected cells
C. cytoskeletal rearrangements in the affected cells
D. enlargement of vacuoles in the affected cells

48. An upstream activating sequence in a single gene gets deleted and the mutation is expected to be

A. lethal B. *cis*-dominant C. *trans*-dominant D. silent

49. Identify the **correct** matches

i. Mycoplasmas – Obligate parasites
ii. Mycobacteria – Facultative parasites
iii. Chlamydiae – Facultative parasites
iv. Rickettsia – Facultative parasites

A. i, ii B. iii. iv C. ii, iii D. i. iv

50. Endoreduplication means ___.

A. splitting up of endoplasmic reticulum (ER) to form rough and smooth ER
B. recurrent DNA replication without consequent mitosis and cytokinesis
C. mobilization of DNA into ER and replication of DNA in the ER
D. replication of DNA in the nuclei and endocytosis of one copy to another organelle

51. Compared to C3 photosynthesis, the C4 process involves the role of five specific enzymes, namely, CaH, PEPC, PPDK, NADP-MDH, and NADP/P-ME. A researcher analyzed the rice genome and found that rice encodes 2, 6, 2, 9, and 6 genes, respectively, for these enzymes. The rationale provided on the presence of these enzymes in a C3 genome are given below. Which of the below is/are **correct**?

(i) The identified genes could be pseudogenes having no function

(ii) The genes could be in a transcriptionally inactive state

(iii) The genes might have evolved to perform different functions

(iv) The genes might have got nonsense mutations

A. (i) and (iv) B. (iv) only

C. (ii) and (iii) D. (iii) only

52. The below reasons are proposed for preferring floral characters over vegetative characters for the classification of angiosperms. Identify the **correct** statement(s).

(i) Reproductive axis shows a large degree of prominent variations
(ii) Floral characters show less variations than vegetative traits
(iii) Shape of flower is diagnostic feature in many families
(iv) It is convenient to study floral features than vegetative characters

A. (i) only B. (i) and (iii)
C. (ii) only D. (ii) and (iv)

53. A genus with a single species is called ____.

A. Atypic
B. Monotypic
C. Solotypic
D. Neotypic

54. A locus that explains a fraction of the genetic variance of a gene expression phenotype is called

A. eQTL
B. gQTL
C. mQTL
D. pQTL

55. Bread wheat (*Triticum aestivum*) is used for preparing bread and roti, and durum wheat (T. durum) is used in pasta. Consider the following comparative statements. Which of the below is/are **correct**?

(i) *T. aestivum* is a hexaploid whereas *T. durum* is a tetraploid
(ii) *T. durum* was originated in ancient Egypt and *T. aestivum* in Indus Valley
(iii) *T. aestivum* has an additional 'C' genome that is absent in *T. durum*
(iv) *T. durum* served as an ancestor for the evolution of *T. aestivum*

A. (i) only
B. (ii) and (iv)
C. (i) and (iv)
D. (i), (ii) and (iv)

56. Match the NCBI database (I) with its correct description (II).

I	II
a. PubMed	(i) Annotated collection of DNA sequences
b. SRA	(ii) Gene expression profiles of sequence data
c. GenBank	(iii) Database of citations and abstracts
d. GEO	(iv) Next generation sequencing data

A. a(iii), b(ii), c(iv), d(i)
B. a(iii), b(i), c(iv), d(ii)
C. a(ii), b(iii), c(i), d(iv)
D. a(iii), b(iv), c(i), d(ii)

57. The correct grading of the below taxa in the descending order of Linnaean hierarchy is ____.

(i) Class (ii) Kingdom (iii) Phylum (iv) Order (v) Genus (vi) Family (vii) Species

A. (ii), (iii), (iv), (vi), (i), (v), (vii)
B. (vii), (v), (i), (vi), (iv), (iii), (ii)
C. (ii), (iii), (i), (iv), (vi), (v), (vii)
D. (vii), (v), (vi), (iv), (i), (iii), (ii)

58. The secondary metabolites are mainly synthesized through which of the following pathways?

A. Shikimate pathway
B. C3 pathway
C. C4 pathway
D. β-oxidation pathway

59. What is the approximate genome size of Covid-19?

A. 30 Kb
B. 30 Mb
C. 3 Kb
D. 3 Mb

60. Which of the following are the names of plant disease resistance genes?

A. *Cy3 & Cy5*
B. *Hm1 & RPS2*
C. *GENIE & Xq28*
D. *Bcl-2 & BRCA1*

61. Identify the **correct** statements with respect to pedigree characteristics of X-linked dominant trait in human beings and choose the **right** options

I. Affected sons must have an affected mother
II. Affected daughters must have either an affected mother or an affected father
III. Affected mothers (if heterozygous) will pass the trait on to all their sons and not daughters
IV. Affected fathers will pass the trait on to all their daughters

A. Statements I, II and III are correct
B. Statements I, II and IV are correct
C. Statements I, III and IV are correct
D. Statements II, III and IV are correct

62. Which of the following sequence of lipids are abundant in chloroplasts?

A. DGDG, MGDG, PG and SQDG
B. MGDG, DGDG, SQDG and PG
C. DGDG, MGDG, SQDG and PG
D. MGDG, DGDG, PG and SQDG

63. *Aphelenchoides besseyi* is plant pathogen which causes rice white tip, spring dwarf, and strawberry crimp disease. This pathogen is a

A. bacteria
B. fungi
C. virus
D. nematode

64. In an organism, the phenotype of the offspring is determined by the genotype of the mother. This can be explained by

A. Maternal inheritance
B. Genome imprinting
C. Genetic maternal effect
D. Epigenetic inheritance

65. In this question, a statement is given, followed by two conclusions. Select the **right** answer.

Statement: Under optimal conditions, C4 crop species can assimilate CO_2 at rates two to three times greater than that of C3 species.

Assumption 1: Rubisco is present in the leaf bundle sheath cells of C4 plants where concentration of CO_2 may reach to several fold higher than that in C3 plants.

Assumption 2: Unlike C4 plants, photosynthesis of C3 plants is not inhibited by O_2 and they have a very low CO_2 compensation point.

A. Only assumption 1 is practical
B. Only assumption 2 is practical
C. Both assumptions are practical
D. Neither assumption 1 nor assumption 2 is practical

66. Mapping of polygenes is usually carried through mating/hybridization between plants of diverse nature followed by screening of the segregating populations through molecular markers is known as:

A. Quantitative trait loci analysis
B. Qualitative trait analysis
C. Monosomic analysis
D. Regression analysis

67. Which of the following genes is **not** closely associated with the action or production of the plant hormone gibberellin?

A. *Reduced height1*
B. *Semi-dwarf 1*
C. *Shatterproof 4*
D. *Submergence 1*

68. Match the plant hormones listed in "A" with the associated receptors listed in "B".

	A		B
a.	Auxin	i.	PYR/PYL/RCAR
b.	Abscisic acid	ii	CRE1
c.	Ethylene	iii	TIR1
d.	Cytokinin	iv	ERS1

A. a(i), b(ii), c(iii), d(iv)
B. a(ii), b(iii), c(iv), d(i)
C. a(ii), b(iv), c(i), d(iii)
D. a(iii), b(i), c(iv), d(ii)

69. Read the following statement and reason carefully with regard to photolithoautrophic life forms and identify the **correct** answer

Statement: These are life forms which derive energy from light, inorganic chemicals as electron donors and carbon sources.

Reason: This type of growth mode is common only among bacteria which use light as source of energy, H_2O as inorganic electron donor and can fix CO_2.

A. Both statement and reason are correct and the reason explains the statement.

B. Only the statement is correct and the reason is incomplete explanation of the statement.

C. Both statement and reason are incorrect

D. Statement is incorrect and reason is correct explanation of photolithoautrophic life forms.

70. Which of the following chromosomal changes is **not** responsible for the position-effect/variegation effect of a gene?

A. Transposition

B. Translocation

C. Inversion

D. Polyploidization

------//END//------

University of Hyderabad
Entrance Examinations – 2020

School/Department/Centre : Department of Plant Sciences, School of Life Sciences
Course/Subject : Ph.D. Plant Sciences

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	C	26	A	51	D	76	
2	B	27	B	52	C	77	
3	B	28	A	53	B	78	
4	B	29	C	54	A	79	
5	A	30	D	55	C	80	
6	C	31	A	56	D	81	
7	D	32	B	57	C	82	
8	A	33	B	58	A	83	
9	D	34	C	59	A	84	
10	B	35	D	60	B	85	
11	C	36	A	61	B	86	
12	C	37	C	62	D	87	
13	B	38	D	63	D	88	
14	C	39	B	64	C	89	
15	C	40	B	65	A	90	
16	B	41	A	66	A	91	
17	A	42	B	67	C	92	
18	B	43	C	68	D	93	
19	C	44	C	69	B	94	
20	B	45	C	70	D	95	
21	A	46	A	71		96	
22	D	47	A	72		97	
23	C	48	B	73		98	
24	A	49	A	74		99	
25	C	50	B	75		100	

Note/Remarks : --

Signature 26/09/2020
School/Department/Centre

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