

## Life Sciences

### Paper III

**Time Allowed : 2½ Hours]**

**[Maximum Marks : 150**

**Note :** This paper contains **Seventy Five (75)** multiple choice questions, each question carrying **Two (2)** marks. Attempt *All* questions.

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| <p>1. Thar desert stretches to Indian states like :</p> <p>(A) Rajasthan, Uttarakhand, Madhya Pradesh</p> <p>(B) Rajasthan, Haryana, NCR</p> <p>(C) Rajasthan, Andhra Pradesh, Jharkhand</p> <p>(D) Rajasthan, Punjab, Gujrat</p> <p>2. Which of the following sequences indicates trend in the evolution of thallus in algae ?</p> <p>(A) Unicellular → Heterotrichous → Colonial → Filamentous</p> <p>(B) Unicellular → Filamentous → Heterotrichous → Colonial</p> <p>(C) Unicellular → Colonial → Filamentous → Heterotrichous</p> <p>(D) Unicellular → Filamentous → Colonial → Heterotrichous</p> | <p>3. Dendrocronology deals with determination of age of a tree with :</p> <p>(1) Diffused porous wood</p> <p>(2) Ring porous wood</p> <p>(3) Heart ring porous wood</p> <p>(4) Sap wood</p> <p>(A) 1 and 3</p> <p>(B) 2 and 3</p> <p>(C) 1 and 4</p> <p>(D) 2 and 4</p> <p>4. The immediate products of meiosis in megaspore mother cell are :</p> <p>(A) Eggs</p> <p>(B) Megaspores</p> <p>(C) Embryo sacs</p> <p>(D) Female gametophytes</p> |
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5. 'Reserpine' a therapeutically active compound used for hypertension and epilepsy is obtained from :
- (A) Roots of *Rauwolfia serpentina*
- (B) Roots of *Glycyrrhiza glabra*
- (C) Leaves of *Podophyllum emodi*
- (D) Rhizome of *Dryopteris filixmas*
6. In plants first step in the synthesis of sulfur containing organic compounds is reduction of sulfate. Which of the following amino acids is synthesized in this process ?
- (A) Methionine
- (B) Cysteine
- (C) Glutamine
- (D) Glycine
7. *Lolium* is a long day plant, which of the following light treatments will result in flowering in this plant ?
- (A) Red—Far Red
- (B) Far Red—Red—Far Red
- (C) Far Red
- (D) Red—Far Red—Red
8. Allopolyploids eventually give rise to amphidiploids. These can be easily recognised by looking at their :
- (A) Morphological characters
- (B) Karyotype
- (C) Fertility characters
- (D) Meiotic analysis

9. In animal kingdom, there are animals who show true and false body segmentation. Animals characterized by the presence of coelom and segmentation of the body belong to the phylum :
- (A) Rotifera
  - (B) Annelida
  - (C) Platyhelminthes
  - (D) Echinodermata
10. During last few centuries, our earth has seen considerable extinction of fauna and flora. However, scientists came across some species, thought to have been extinct by chance. The living fossil *Latimeria chalumnae* is an example of :
- (A) Lung fish
  - (B) Placoderm
  - (C) Lobe-finned fish
  - (D) Xiphosuran
11. If gonadotropin releasing hormone was to be secreted in large amounts and at a constant rate rather than in a pulsatile manner, one of the following would happen :
- (A) Secretion of luteinising hormone would increase at first and then decrease
  - (B) Secretion of luteinising hormone would increase indefinitely
  - (C) Testosterone secretion in a male would be continuously high
  - (D) Oestradiol secretion in a female would be continuously high
12. Prevention of polyspermy of an egg predominantly contributed by a process is called :
- (A) Acrosome reaction
  - (B) Cortical granule breakdown
  - (C) Membrane receptor activation
  - (D) Inactivation of sperm

13. In amphibians, the embryonic gene expression does not begin during cleavage in early embryos. The maternal *mRNAs* are translated. Whereas at later stages, there is induction of embryonic gene expression. This phenomenon is called :
- (A) Maternal-paternal transition
  - (B) Midblastula transition
  - (C) Late embryonic switch
  - (D) Embryonic reprogramming
14. ....mimicry is exhibited by harmless colubrid snakes which resemble the poisonous snakes of the genus *Elaps* in having beautiful body colouration of alternating red and black bands.
- (A) Protective
  - (B) Müllerian
  - (C) Warning
  - (D) Batesian
15. A period of arrested development in the life cycle of some insect pests is known as :
- (A) Ecdysis
  - (B) Diastasis
  - (C) Diapause
  - (D) Pupa
16. Completion of the life cycle of the malarial parasite *Plasmodium* requires two hosts because :
- (A) After passing through the pre-erythrocytic and erythrocytic cycles in its human host, the parasite requires low ambient temperature for further development. Therefore it enters the second host, the mosquito.
  - (B) There are too many parasites in the human blood. Therefore, a transfer to the second host becomes necessary.
  - (C) The infected person starts taking medicines which prevents further development. Hence a transfer to a second host becomes necessary.
  - (D) The person develops resistance to the parasite by the time the erythrocytic cycle starts. Therefore another host is required.

17. Ability to taste phenylthiocarbamide (PTC) in human beings is controlled by a single gene, the tasters being either TT or Tt and non-tasters being tt. Suppose in a population of human beings, different genotypes are represented by ratio 0.50 TT : 0.20 Tt : 0.30 tt (The gene frequencies will be  $T = 0.60$ ,  $t = 0.40$ ). If population attains equilibrium, one would expect the genotypic ratios as :
- (A) 0.50 TT : 0.20 Tt : 0.30 tt  
(B) 0.36 TT : 0.48 Tt : 0.16 tt  
(C) 0.30 TT : 0.40 Tt : 0.30 tt  
(D) 0.40 TT : 0.40 Tt : 0.20 tt
18. Exposure of an organism to carcinogens often results in mutagenesis. This leads to alterations in important growth regulatory genes. Carcinogens are therefore identified by :
- (A) Ame's test  
(B) Commet assay  
(C) Complementation test  
(D) Fluctuation test
19. State which of the following statements is *correct* in case of population analysis
- (A) The rare allele is represented predominantly in heterozygotes particularly as it becomes rarer  
(B) The rare allele is always under selection  
(C) Equilibrium values in any population cannot be reached in a single generation of random mating  
(D) The maximum frequency of heterozygotes cannot exceed 0.75

20. The frequency with which spontaneous mutations arise in a normal diploid population is :
- (A)  $10^{-8}$
  - (B)  $10^{-2}$
  - (C)  $10^{-12}$
  - (D)  $10^{-3}$
21. Activation of formation of different kinds of microfilament like actin network and actin bundles (stress fibers) are caused by cell signalling mediated by a particular protein family member. Which of the following is involved in formation of stress fibers ?
- (A) cdc 42
  - (B) Rac
  - (C) Rho
  - (D) Both Rho and Rac
22. In mammals, sex is determined by presence or absence of y chromosome. The search for sex determining genes has led to identification of Hy, bkm, zfy as testes determining gene. Recently identified Sry gene, a putative sex determining gene has one of the following properties assigned :
- (A) DNA binding protein expressed in genital ridge at 8.5 pc
  - (B) Zn finger protein expressed in testes
  - (C) Homeo-domain protein in genital ridge
  - (D) Leads to sex transformation from males to females

23. During G<sub>2</sub> phase of cell cycle, cyclin B is synthesized and it forms a complex with CDK. This complex, called MPF, is crucial for the cells to enter mitosis. However, there is an extensive regulation of activity of MPF. There are kinases and phosphatases which take part in it.

For conversion of an inactive MPF to an active MPF that initiates mitosis, there are the following possibilities :

- (1) Phosphorylation of CDK by Weel kinase
- (2) Phosphorylation of CDK by CAK
- (3) Dephosphorylation of CDK inhibitory site by CDC 25
- (4) Dephosphorylation by PTEN

Which of the following is *correct* ?

- (A) 1 and 2
- (B) 1 and 3
- (C) 2 and 3
- (D) 2 and 4

24. Lampbrush chromosomes in frog oocytes exhibit an index of amplification of :

- (A) rRNA
- (B) mRNA
- (C) tRNA
- (D) snoRNA

25. Principle of holocoenotic environment means :

- (A) Every factor affects every other factor in an ecosystem
- (B) Only one factor affects every other factor in an ecosystem
- (C) Only one factor affects only one other factor in an ecosystem
- (D) All the factors affect only one factor in an ecosystem

26. Last few years humans have seen rapid degradation of ecosystems. This has led global pressure on conservation of fauna and flora. In this direction the trees and shrubs are planted on all unused and fallow land to provide fuelwood, fodder etc. thereby reducing pressure on existing forests. For example, unused farmlands, community land, road and rail sides etc. are planted with suitable indigenous and/or exotic tree species. This is known as :

- (A) Forest plantations
- (B) Social forestry
- (C) Topiary
- (D) Conservation forestry

27. *Typha angustata* grows abundantly in/on :

- (A) Mountain plateaus
- (B) Wetlands
- (C) Grasslands
- (D) Arid deserts

28. A student examined two different groups of cells and made the following observations :

Trait	Cell I	Cell II
Cell wall	Present	Present
Ribosomes	Present	Present
Nucleus	Absent	Present
Ability to do photosynthesis	Present	Absent
Respiration	Present	Present

These observations support which of the following conclusions :

- (A) Cell I is more complex in its organisation than cell II
- (B) Cell I is a prokaryote
- (C) The ancestors of cell type II appeared earlier in the fossil record than the ancestor of cell I
- (D) Both cell I and II are plant cells



29. Viruses generally infect only one or a few particular species. This is called :

- (A) Host restriction
- (B) Host range
- (C) Cell specificity
- (D) Viral range

30. *E.coli* is used as a faecal pollution indicator. The water giving positive results for the presence of *E.coli* is declared non-potable or unfit for drinking. Which of the following is the most correct explanation for the above strategy ?

- (A) Faecal *E.coli* is extremely pathogenic
- (B) Presence of *E.coli* also means the presence of pathogens
- (C) *E.coli* and enteropathogens both enter water through faecal matter
- (D) *E.coli* grows much faster than most enteropathogens

31. The stimulation of microbial decomposition of recalcitrant compounds by the addition of microorganisms specific for its degradation is termed as :

- (A) Biostimulation
- (B) Bioaugmentation
- (C) Biotransformation
- (D) Bioconversion

32. Two statements I and II are given below :

Statement I : Some vaccines when administered protect the recipient from the specific infection for long periods.

Statement II : Antibodies induced by some antigens are stable enough to persist in body for long periods. Which of the following options is correct ?

- (A) Both the statements are incorrect
- (B) Both the statements are correct and statement II is the cause of statement I
- (C) Statement I is correct, but the statement II is incorrect
- (D) Statement II is correct, but statement I is incorrect

33. In a single substrate reaction, competitive inhibitor was added to examine the effect on  $K_m$  and  $V_{max}$ . Which of the following equations will be *correct* ?

$$(A) \frac{1}{V} = \frac{1}{V_{max}} \left[ 1 + \frac{[I]}{K_{ESI}} \right] + \frac{K_{ES}}{V_{max}} \left[ 1 + \frac{[I]}{K_{EI}} \right] + \frac{1}{[S]}$$

$$(B) \frac{1}{V} = \frac{1}{V_{max}} + \frac{K_{ES}}{V_{max}} \left[ 1 + \frac{[I]}{K_{EI}} \right] \frac{1}{[S]}$$

$$(C) \frac{1}{V} = \frac{1}{V_{max}} \left[ 1 + \frac{[I]}{K_{EI}} \right] + \frac{K_{ES}}{V_{max}} \left[ 1 + \frac{[I]}{K_{EI}} \right] + \frac{1}{[S]}$$

$$(D) \frac{1}{V} = \frac{1}{V_{max}} \left[ 1 + \frac{[I]}{K_{ESI}} \right] + \frac{K_{ES}}{V_{max}} \cdot \frac{1}{[S]}$$

34. Although pancreas is the site of storage of proteolytic enzymes, these enzymes do not act on pancreatic tissues because :

- (A) They are inactivated
- (B) They are not released from pancreas
- (C) They are in the form of proenzymes
- (D) Their substrate is absent in pancreas

35. A sigmoidal plot of substrate concentration *verses* velocity indicates :

- (A) Michaelis-Menten kinetics
- (B) Competitive inhibition
- (C) Non-competitive inhibition
- (D) Co-operative binding

36. The disaccharide that does *not* react with Benedict's reagent is :

- (A) Sucrose
- (B) Lactose
- (C) Maltose
- (D) Isomaltose

37. An amino acid contains no ionizable groups in its side chain (R). It is titrated from pH 0 to 14. Which of the following ionizable state is not observed during the entire titration in the pH range 0 to 14 ?

- (A)  ${}^+\text{NH}_3 - \underset{\text{R}}{\text{CH}} - \text{COO}^-$
- (B)  ${}^+\text{NH}_3 - \underset{\text{R}}{\text{CH}} - \text{COOH}$
- (C)  $\text{NH}_2 - \underset{\text{R}}{\text{CH}} - \text{COO}^-$
- (D)  $\text{NH}_2 - \underset{\text{R}}{\text{CH}} - \text{COOH}$

38. Which of the following sugar pucker favours Z-conformation of DNA ?

- (A) 2'-OH steric hindrance
- (B) Anti-G and C 2'-endosugar
- (C) Syn G and C 3'-endosugar
- (D) G 4 - DNA quartet

39. The sequence in which the following electron carriers are organised in electron transport chain is :

- (A) Ubiquinone, cytochrome  $a + a_3$ , NADH dehydrogenase
- (B) Cytochrome  $a + a_3$ , ubiquinone, NADH dehydrogenase
- (C) NADH dehydrogenase, ubiquinone, cytochrome  $a + a_3$
- (D) NADH dehydrogenase, cytochrome  $a + a_3$ , ubiquinone

40. Maple syrup disease is a result of genetic defect in metabolism of :
- (A) Sulphur containing amino acids
  - (B) Branched chain amino acids
  - (C) Aromatic amino acids
  - (D) Dicarboxylic amino acids
41. Which of the following tissues utilize ketone body acetoacetate as a source of energy during prolonged starvation ?
- (A) Brain
  - (B) Liver
  - (C) Skeletal muscle
  - (D) Lung
42. The tertiary structure of proteins is stabilized by various interactions. Which is the weakest interaction of the following ?
- (A) Hydrogen bond
  - (B) Hydrophobic interactions
  - (C) van der Waals interactions
  - (D) Covalent bond
43. Hibernating animals can maintain their body temperature during hibernation period. This is made possible by :
- (A) Maintaining the BMR at low level
  - (B) Coupling oxidative phosphorylation to ATP synthesis
  - (C) Uncoupling oxidative phosphorylation from ATP synthesis
  - (D) Catabolising muscle proteins

44. There are many compounds that are known to be inhibitors of mitochondrial electron transport chain (ETC). Which of the following is *not* an inhibitor of ETC ?
- (A) Rotenone
  - (B) Antimycin A
  - (C) Sodium azide
  - (D) Dinitrophenol
45. Coding strand in ds-DNA is :
- (A) identical in sequence to transcribed RNA
  - (B) complementary in sequence to transcribed RNA
  - (C) identical to sense strand of DNA
  - (D) identical in sequence to ORF alone
46. Gene density in eukaryotic organisms is consistently lower and more variable than in prokaryotes. Compared to lower eukaryotes like the yeast *S. cerevisiae* ( 500 genes/ Mb), the human genome has 50 fold lower gene density. The eukaryotic genes are also much larger in size. This is because :
- (A) eukaryotic genome has high proportion of repeats and satellite DNAs and genes have introns
  - (B) eukaryotic genome is diploid and has to cross over; also genes are polycistronic
  - (C) Prokaryotic genome has more non-coding DNA and interrupted genes
  - (D) eukaryotic genome has telomeres and centromeres and genes are clustered as families

47. Non-homologous nucleotide sequences in two DNA molecules could be visualised using :
- (A) Heteroduplex technique
  - (B) Fluorescent *in-situ* hybridisation
  - (C) Immunoblotting technique
  - (D) Southern blotting and hybridisation
48. RNA type C tumor viruses are negative strand viruses and amplify copy number of their genome by using an enzyme encoded by them, which is :
- (A) RNA replicase
  - (B) RNA polymerase
  - (C) RNA dependent DNA polymerase
  - (D) RNA helicase
49. In an experiment to determine genetic code, synthetic RNA molecules with different composition of A and C nucleotide were used, viz. (A) poly (AC) (5 : 1) and (B) poly (AC) (1 : 5). Lysine was incorporated in case of A with very high frequency and proline in case of B. Lysine incorporation was least in B. The codon assignment could be concluded as :
- (A) AAA lysine; CCC proline
  - (B) AAC lysine; CCA proline
  - (C) ACA lysine; CAC proline
  - (D) CAA lysine; ACC proline
50. Eukaryotic RNAs (transcripts) are much longer than the final mRNAs. Splicing is a characteristic feature of eukaryotic processing. This process involves :
- (A) ribozymes and lariat formation
  - (B) heteroduplex formation
  - (C) end joining complexes and rRNA
  - (D) adaptor RNA and micro RNA

51. In an *ipozya* situation of a lac operon, where  $\beta$ -galactosidase is generally inducible by lactose, diploids were created in a transduction experiment. In an / situation which of the following statements is valid ?

- (A) beta galactosidase will be constitutively expressed
- (B) beta galactosidase will not be constitutively expressed
- (C) beta galactosidase will not be expressed
- (D) beta galactosidase will not be synthesised due to catabolite repression

52. Which of the following is *not* a feature of transcription factors ?

- (A) glycosylation domain
- (B) zinc finger motif
- (C) helix-turn-helix
- (D) leucine zipper

53. For precise quantification of differential gene expression at mRNA level for a gene 'X' which of the following methods will be used ?

- (A) Western blot
- (B) Real time PCR
- (C) RT-PCR
- (D) Northern blot

54. Modified nucleotides provide additional level of information over and above genetic code. They influence genotype-phenotype correlation. This is due to the ability of such modified nucleotides to influence :

- (A) DNA protein interactions and DNA conformations
- (B) DNA bending, promoter stability and rate of transcription
- (C) RNA splicing and termination of transcription
- (D) RNA editing, transcription and protein folding

55. Cancer is said to be a multistep process. Oncogenes and antioncogenes are involved in the process of carcinogenesis. The reason for cancer phenotype is :

- (A) Oncogenes acquire a dominant activating mutation while antioncogenes get inactivated
- (B) Oncogenes are activated and duplicated and translocated
- (C) Oncogene is inactivated and antioncogene is activated
- (D) Loss of heterozygosity for oncogenes

56. If a woman desires to conceive after the age of 35, she needs genetic counselling. This is particularly required because of incidence of.....in the babies born to such mothers.

- (A) Klinefelters syndrome
- (B) Still birth
- (C) Down's syndrome
- (D) Abortion



57. CI 857 is a mutation in lambda phage wherein the repressor protein is temperature sensitive and gets inactivated at 45°C. Which of the following is *true* for this mutant of  $\lambda$  phage ?

- (A) This mutant will not produce plaques in plate assay on *E.coli* host at 37°C or 45°C
- (B) Mutant will produce plaques at 37°C but not at 45°C
- (C) Mutant will produce turbid plaques at 37°C and clear plaques at 45°C
- (D) Mutant will produce clear plaques at 37°C and turbid plaques at 45°C

58. Chromosome walking technique relies on :

- (A) Genomic libraries
- (B) cDNA libraries
- (C) RFLP
- (D) Real time PCR

59. During natural transformation in bacteria, a fragment of single strand enters recipient cell. Upon its interaction with recipient, a structure that results is termed as :

- (A) Merozygote
- (B) Exogenote
- (C) Endogenote
- (D) Zygote

60. Given genome size of an organism is  $4 \times 10^5$  bP and its G + C content is 50%. Complete digestion of this genomic DNA by Bam H1 (GG AT CC) will yield an average fragment size of :
- (A) 1.5 kb  
 (B) 4 kb  
 (C) 2 kb  
 (D) 10 kb
61. DNA foot-printing technique is useful in :
- (A) Detection of genomic variations  
 (B) Detection of predisposition of genetic diseases  
 (C) Detection of protein-DNA interactions  
 (D) Prenatal sex determination
62. Transgenic animals can be utilised to produce recombinant therapeutic proteins such as insulin and growth hormones. In order to produce genetically identical individuals which can be used for generation of animal farms for biopharming the following strategies can be utilised.
- (A) embryo transfer  
 (B) artificial insemination  
 (C) *in-vitro* fertilisation  
 (D) Cloning of animals
63. In barley plants cross was carried out between *Hordeum vulgare* and *H. bulbosum*. Immature embryos were cultured *in-vitro* on M. S. medium to overcome natural abortion. 35% of the embryos grown *in-vitro* showed development of haploid plants with *Vulgare* genome. This phenomenon has occurred due to :
- (A) distant hybridization  
 (B) genotypic variation  
 (C) somaclonal variation  
 (D) phenotypic variation

64. For cloning hybridomas, the cells need to be distributed through serial dilutions to the extent of a single cell deposited in a well in the 96-well cell culture plates. To ensure that such a cell grows and propagates the following is required :
- (A) grow them with addition of growth factors
  - (B) grow them in the presence of high serum concentration
  - (C) plate them on a feeder-layer of uv-irradiated fibroblast cells
  - (D) grow them along with myeloma cells
65. Release of  $\text{Ca}^{++}$  from the ER in a fertilised egg is triggered by :
- (A) Map kinase pathway
  - (B) Inositol triphosphate ( $\text{IP}_3$ ) pathway
  - (C) Wnt signalling pathway
  - (D) C-AMP-dependent signalling pathway
66. Suppose the  $\text{Na}^+$  concentration outside a cell is 100 mM and inside it is 10 mM. The lactose concentration on both sides of the membrane is 10 mM. If there is an integral membrane protein for the symport of  $\text{Na}^+$  and lactose, which of the following results would you expect ?
- (A) No change, as ATP hydrolysis would be necessary to transport lactose
  - (B)  $\text{Na}^+$  will enter but lactose concentration will not change because it is at equilibrium
  - (C)  $\text{Na}^+$  will enter and lactose will leave the cell
  - (D) Both lactose and  $\text{Na}^+$  will enter the cell

67. The most suitable ligand for purification of glycoproteins from a given mixture of proteins is :
- (A) Heparin
  - (B) Concanavalin A
  - (C) Avidin
  - (D) 5'-AMP
68. Which of the following microscopic techniques is useful to observe three-dimensional structure of the cell ?
- (A) SEM
  - (B) Light microscopy
  - (C) Fluorescence microscopy
  - (D) TEM
69. You have been asked to measure DNA synthesis, which radioisotope is of better choice ?
- (A)  $^3\text{H}$  Thymidine
  - (B)  $^{32}\text{P}$
  - (C)  $^{14}\text{C}$  ATP
  - (D)  $^{15}\text{N}$  cytosine
70. DNA sequence determination classically involves sequencing by synthesis or degradation which is used in Sanger or Maxam Gilbert method. In the NGS (next generation sequencing) which of the following methods is used ?
- (A) Radioactivity
  - (B) Fluorescence
  - (C) Luminiscence
  - (D) Electrical conductance
71. Which of the following molecules has the highest molar extinction coefficient ?
- (A) GFP
  - (B) Fluorescein
  - (C) Rhodamine
  - (D) Chlorophyll

72. Leukemia or blood cancer is uncontrolled proliferation of an abnormal clone of hematopoietic cells. The diagnosis is generally based on detection of abnormal cells in blood and bone marrow. One of the most powerful confirmatory approach is immunophenotyping of the cells. The immunophenotyping analysis can be carried out by :
- (A) Enzyme linked immunosorbant assay
  - (B) Radioimmunoassay
  - (C) Flow cytometry
  - (D) Immunoprecipitation
73. In a HPLC separation of a sample, it is suspected that two known molecules could be present in a single peak. How can you verify this ?
- (A) Changing the elution gradient
  - (B) Increasing the run time
  - (C) Spiking with suspected molecules
  - (D) Changing the mobile phase
74. Which of the following enzymatic reaction produces chromogenic product ?
- (A) Phosphatase using para-nitrophenyl phosphate
  - (B)  $\beta$ -galactosidase using X-gal
  - (C) Cytochrome oxidase with cytochrome C
  - (D) Alcohol dehydrogenase with ethanol
75. The resemblance between groups and within groups of relatives can be determined by applying which test ?
- (A) Correlation
  - (B) Covariances
  - (C) ANOVA
  - (D) Regression

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**ROUGH WORK**