

**QUESTION PAPER**  
**CSIR NET LIFE SCIENCES**

**June-2013**

21. Which one of the following non-covalent interactions between two non-bonded atoms A and B is most sensitive to the distance between them?
- (a) A and B are permanent dipoles and are involved in hydrogen bonding.  
(b) A and B are fully ionized and are involved in salt bridge formation.  
(c) A and B are uncharged and repel each other.  
(d) A and B are uncharged and attract each other.
22. Which statement best describes the pKa of amino groups in proteins?
- (a) pKa of  $\alpha$ -amino group is higher than the pKa of  $\epsilon$ -amino group.  
(b) pKa of  $\alpha$ -amino group is lower than the pKa of  $\epsilon$ -amino group.  
(c) pKa of  $\alpha$ -amino group is same as the pKa of  $\epsilon$ -amino group.  
(d) pKa of  $\alpha$ -amino group is higher than the pKa of guanidine side chain of arginine.
23. What is the effect of 2, 4-dinitrophenol on mitochondria?
- (a) Blocks ATP synthesis without inhibiting electron transport by dissipating the proton gradient.  
(b) Blocks electron transport and ATP synthesis by inhibiting ATP-ADP exchange across the inner mitochondrial membrane.  
(c) Blocks electron transport and proton pumping at complexes I, II and III.  
(d) Interacts directly with ATP synthase and inhibits its activity.
24. A protein has 30% alanine. If all the alanines are replaced by glycines,
- (a) helical content will increase.  
(b)  $\beta$ -sheet content will increase.  
(c) there will be no change in conformation.  
(d) the alanine-substituted protein will be less structured than the parent protein.
25. The gel to liquid crystalline transition temperature ( $T_m$ ) of phospholipids is dependent on the fatty acid composition. Considering this,  $T_m$  of
- (a) all the phospholipids will be identical.  
(b) DPPC will be lowest and DOPC will be highest  
(c) POPC and DOPC will be identical and lower than DMPC or DPPC.  
(d) DOPC will be lowest and DPPC will be highest
26. You have created a fusion between the *trp* operon, which encodes the enzymes for tryptophan biosynthesis, under the regulatory control of the *lac* operator. Under which of the following conditions will tryptophan synthase be induced in the strain that carries the chimeric operator fused operons?
- (a) Only when both lactose and glucose are absent.  
(b) Only when both lactose and glucose are present.  
(c) Only when lactose is absent and glucose is present.  
(d) Only when lactose is present and glucose is absent.
27. Which of the following pairs of subcellular compartments is likely to have same pH and electrolyte composition?
- (a) Cytosol and lysosomes. (b) Cytosol and mitochondrial inter membrane space.  
(c) Cytosol and endosome. (d) Mitochondrial matrix and inter membrane space.

28. Regarding microtubule assembly and disassembly during cell division, which will be the most appropriate answer?
- (a) Once formed, kinetochore microtubules depolymerize at the plus ends throughout mitosis.
  - (b) Once formed, kinetochore microtubules polymerize at the plus ends throughout mitosis.
  - (c) Kinetochore microtubules polymerize at their plus ends up to anaphase, at which point they begin to depolymerize.
  - (d) Kinetochore microtubules polymerize at their minus ends up to cytokinesis, at which point they depolymerize.
29. Origin of replication usually contains
- (a) GC rich sequences.
  - (b) both AT and GC rich sequences.
  - (c) no particular stretch of sequences.
  - (d) AT rich sequences.
30.  $\sigma$ -subunit of *E. coli* RNA polymerase DOES NOT
- (a) initiate transcription and fall off during elongation.
  - (b) increase affinity of the core enzyme to the promoter.
  - (c) binds to DNA, independent of the core enzyme.
  - (d) ensures specificity of transcription by interacting with the core enzyme.
31. The cap binding protein (eIF4E), which is involved in the global regulation of translation, is highly regulated in eukaryotic cells. In an experiment, a researcher transfected mammalian cells with (eIF4E) gene for its overexpression. Due to this, the cells will undergo
- (a) apoptosis.
  - (b) neoplastic transformation.
  - (c) no change.
  - (d) differentiation.
32. Bacteriophage T4 infects *E. coli* and injects its DNA inside the cell. The transcription of viral genes occurs in three stages: immediate early, early and late. All the promoters on viral genome are available, but the control takes place at the level of
- (a) promoter strength.
  - (b) modification of host RNA polymerase.
  - (c) synthesis of new polymerases.
  - (d) turn over rate of RNA synthesis.
33. Gram negative bacteria, *Klebsiella pneumoniae*, upon infecting humans, results in severe septic shock after a few hours of infection. Which of the following is not true for this type of infection?
- (a) Cell wall endotoxins cause overproduction of cytokines.
  - (b) Septic shock can be treated by anti-TNF  $\alpha$  antibodies.
  - (c) Recombinant bacterial proteins can be used for the treatment of septic shock.
  - (d) Recombinant TNF  $\alpha$  receptor antagonist can be used for the treatment of septic shock.
34. Which of the following is NOT associated with insulin action?
- (a) Increased glucose transport.
  - (b) Increased glycogen formation.
  - (c) Enhanced lipolysis in adipose tissue.
  - (d) Decreased rate of gluconeogenesis.
35. When adenoma is converted to metastatic adenocarcinoma, which of the following combination of proteins is almost certainly to be degraded?
- (a) Type IV collagen and laminin.
  - (b) Fibronectin and  $\beta_2$  integrin,
  - (c) Metalloprotease and serine protease.
  - (d) Elastin and selection.
36. Which of the following is considered to be a combined B- and T-cell deficiency?
- (a) Ataxia-telangiectasia
  - (b) Swiss type agammaglobulinemia
  - (c) Wiskott-Aldrich syndrome
  - (d) Bruton's agammaglobulinemia
37. The part of the embryo from which the ectoderm, mesoderm and endoderm are formed in chick is known as
- (a) primitive streak.
  - (b) hypoblast.
  - (c) epiblast.
  - (d) cytotrophoblast.

38. Which protein secreted by the amphibian organizer induces neural tissue formation by inhibiting Bone Morphogenetic Protein?  
(a)  $\beta$ -catenin. (b) Noggin. (c) Dickkopf. (d) Dishevelled.
39. The homologue of  $\beta$ -catenin in *Drosophila* is  
(a) Fushi tarazu (b) Engrailed.  
(c) Armadillo (d) Cubitus interruptus.
40. Which of the floral whorls is affected in *apetala 3/pistillata (ap3/pi)* mutants?  
(a) Sepals and petals. (b) Petals and stamens. (c) Stamens and carpels. (d) Sepals and stamens.
41. Which one of the following statements is **INCORRECT** about the role of oxidative pentose phosphate pathway in plant metabolism?  
(a) Generation of NADPH required to drive biosynthetic reactions.  
(b) Production of pentose phosphate for the synthesis of nucleic acids.  
(c) Formation of erythrose 4-phosphate for biosynthesis of aromatic amino acids.  
(d) Production of NADH to generate ATP.
42. During photosynthetic carbon reduction cycle in green leaves, net production of one molecule of glyceraldehyde 3-phosphate requires one of the following combinations of energy equivalents:  
(a) 9 NADPH and 6 ATP. (b) 3 NADPH and 9 ATP.  
(c) 2 NADPH and 3 ATP. (d) 6 NADPH and 9 ATP.
43. Which one of the following essential micronutrients is associated with urease enzyme found in higher plants?  
(a) Nickel. (b) Molybdenum. (c) Zinc. (d) Copper.
44. Plants are able to perceive light through various photoreceptors and downstream genes. Which one of the following genes is **NOT** involved in light perception?  
(a) *PIF3* (b) *NPR1* (c) *PHYE*. (d) *CRY3*
45. In the dark, rods show a large inward "dark" current which is suppressed by a flash of light. Which one of the following statements, explaining the effect of light, is true?  
(a) Sodium channels in the outer segment of rods are closed.  
(b) Cytoplasmic cGMP concentration increases.  
(c) Sodium channels in the inner segment of rods are closed  
(d) Transducin dissociates from beta-arrestin
46. Four groups of mice were studied for the factor required for mast cell generation: IL-3 deficient, GM-CSF deficient, G-CSF-deficient and erythropoietin-deficient. In which mice, mast cell generation is most likely to be deficient?  
(a) IL-3-deficient. (b) GM-CSF-deficient.  
(c) G-CSF deficient. (d) Erythropoietin-deficient.
47. What would be the outcome if the theca interna cells were destroyed in a Graafian follicle?  
(a) Immediate formation of corpus albicans.  
(b) Increased progesterone synthesis in the granulosa cells.  
(c) Decreased estrogen synthesis in the granulosa cells.  
(d) Formation of corpus hemorrhagicum.
48. The size of red blood cells (RBC) in venous blood is greater than that of arterial blood. This increased size of red blood cell in the venous blood is due to  
(a) the increased permeability of red blood cell (RBC) membrane.  
(b) the decreased osmotic pressure in plasma.  
(c) the increased osmotic pressure in RBC.  
(d) the dissociation of cytoskeletal proteins in RBC.

49. A chromosome aberration leads to change in the order of genes in a genetic map but does not alter its linkage group. This is due to  
(a) translocation. (b) recombination. (c) transposition. (d) inversion.
50. The concept of recon was proposed by Seymour Benzer by studying recombination between  
(a) lysis mutants of bacteriophage T4.  
(b) white eye mutants of *Drosophila melanogaster*.  
(c) biochemical mutants of *Neurospora crassa*.  
(d) auxotrophic mutants of *Escherichia coli*.
51. Aspartic acid (Asp) is specified by the codon GAU and GAC. After mutation, Asp is changed to Alanine represented by GCX, where X may be A, U, C or G. The reversion of the mutation could only be done with reactive oxygen species. The nature of mutation is considered to be  
(a) transition. (b) transversion.  
(c) either transition or transversion. (d) depurination.
52. A cross is made between two plants with white flowers. All the F1 progeny had red coloured flower. This is because of  
(a) complementation. (b) recombination. (c) translocation. (d) reversion.
53. Cladistic classification is based on  
(a) sequential order in which branches arise from a phylogenetic tree.  
(b) the order of sequence divergence.  
(c) morphological features and skeleton of individuals.  
(d) cellular organization and cytoskeleton.
54. Tautonym is an informal taxonomic designation used for animals referring to  
(a) same name for genus and species. (b) same name for species and subspecies.  
(c) trinomial nomenclature. (d) the name of the author for the species.
55. A marine biologist dug up a small animal from the ocean floor. The animal was uniformly segmented with short, stiff appendages and soft, flexible skin. It had a complete digestive system and an open circulatory system but no exoskeleton. Based on this description, the animal appears to be a  
(a) lancelet. (b) roundworm. (c) mollusc. (d) crustacean.
56. Which of these programs is used to conserve a species facing extinction?  
(a) Captive breeding. (b) Natural resources.  
(c) Sustainable use. (d) Edge effects.
57. A grasshopper population is being assessed by capture-mark-release-recapture method. On the first day, 100 grasshoppers were captured from a given area in 1 hour time, marked and released. On the next day during recapture, 10 marked and 90 unmarked grasshoppers could be found in the same time period from same area. What will be the estimated population size in the given area?  
(a) 80. (b) 100. (c) 1,000. (d) 10,000.
58. Free-living nitrogen fixers can survive in different ecological niches. Identify the incorrect combination from the following list:  
(a) *Azotobacter* - acidic soil. (b) *Deraxia* - alkaline soil.  
(c) *Beijernckia* - acid soil. (d) *Frankia* - neutral soil.
59. A plot of soil contaminated with diesel oil was inoculated with oyster mushrooms. After 4 weeks, more than 95% of the polycyclic aromatic hydrocarbons had been reduced to non-toxic compounds. This process is called  
(a) phytoremediation. (b) chemoremediation.  
(c) mycoremediation. (d) zooremediation.

60. In pre-industrial period in England, peppered moths had light coloration which effectively camouflaged them against light coloured trees and lichens. During industrial revolution, many lichens died out and trees became blackened by soot from factories and interestingly, dark coloured moths were predominantly seen. This happened due to
- natural selection of dark coloured moths which were initially present in fewer numbers.
  - new mutation which arose due to environmental pollution.
  - macroevolution occurring due to environmental change.
  - natural selection of the camouflaging mechanism of the moths.
61. The speciation in which a population splits into two geographically isolated populations experience dissimilar selective pressure and genetic drift is known as
- sympatric speciation.
  - parapatric speciation.
  - peripatric speciation.
  - allopatric speciation.
62. Evolution of multi-gene family occurs by
- only gene duplication.
  - only unequal crossing-over.
  - random mutations.
  - both duplication and unequal crossing over.
63. One aims to find out the role of a gene product in macrophages by using a transgenic mouse expressing the genes under a promoter. Which of the following is the most appropriate promoter?
- Actin promoter.
  - MHC Class II promoter.
  - Mac-1/CD 11b promoter.
  - IL-2 promoter.
64. Which of the following genes was engineered in the "Flavr Savr" transgenic tomato variety?
- 1-Amino cyclopropane-1-carboxylic acid synthase.
  - 1-Amino cyclopropane-1-carboxylic acid oxidase.
  - Expansin.
  - Polygalacturonase.
65. For developing transgenic mice, embryonic stem cells are engineered to express the transgene. These cells are selected by
- novobiocin.
  - neomycin.
  - tetracycline.
  - penicillin.
66. Microbial leaching involves the process of dissolution of metals from ore breaking rocks using microorganisms. Which one of the following bacteria helps in leaching copper from its ore?
- Acidithiobacillus ferrooxidans*.
  - Pseudomonas putida*.
  - Deinococcus radiodurans*.
  - Rhodospseudomonas capsulate*.
67. Molar absorption coefficient of phenylalanine is  $200 \text{ M}^{-1}\text{cm}^{-1}$  at 257 nm. What concentration (g/L) of this amino acid will give an absorption of 1 in a cell of 0.5-cm path length at 257 nm?
- 3.30
  - 0.33
  - 1.65
  - 0.17
68. Which of the following atomic nuclei cannot be probed by nuclear magnetic resonance spectroscopy?
- $^1\text{H}$ .
  - $^{31}\text{P}$ .
  - $^{18}\text{O}$ .
  - $^{15}\text{N}$ .
69.  $t_{1/2}$  of an irreversible first order reaction,  $S \rightarrow P$  is 1 hour. The time (in hours) required to reach 75% completion is
- 1.5.
  - 2.0.
  - 2.5
  - 3.0.
70. In the case of monoclonal antibody production by hybridoma technology, myeloma cells used lack the enzyme hypoxanthine-guanine phosphoriboxyl transferase (HGPRT) such that fused cells can only survive when selected on hypoxanthine-aminopterin-thymidine (HAT). What is the role of aminopterin in this medium?
- To be used as cell cycle inhibitor of myeloma cells.
  - To block the pathway for nucleotide synthesis.
  - To facilitate fusion of myeloid B cells and antibody producing B cells.
  - To facilitate production of antibody producing B cells.

71. The amino acid alanine has high propensity to occur in helical conformation. The circular dichroism spectrum of an equimolar mixture of two 20-residue peptides, one composed of only L-alanine and the other only D-alanine is recorded in the region of 185-250 nm. Which one of the following will be observed?
- (a) No signal: as the chiroptical properties of the two peptides will cancel out.  
 (b) Bands with only negative ellipticity: as helix formed by the D-Ala peptide will be unstable.  
 (c) Bands with only positive ellipticity: as both the peptides will form right-handed helices.  
 (d) Bands with identical negative and positive ellipticity.
72. The following small peptide substrates are used for determining elastase activity and the following data have been recorded.

Substrate	$K_M$ (mM)	$K_{cat}$ ( $s^{-1}$ )
PAPA ↓ G	4.02	26
PAPA ↓ A	1.51	37
PAPA ↓ F	0.64	18

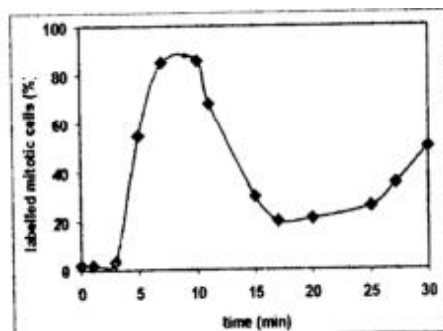
The arrow indicates the cleavage site. From the above observations, it appears that:

- (A) PAPAF is digested most rapidly.  
 (B) PAPAG is digested most rapidly.  
 (C) A hydrophobic residue at the C-terminus seems to be favored.  
 (D) A smaller residue at the C-terminus seems to be favored.  
 (E) Elastase always requires a smaller residue at the N-terminus of the cleavage site.

Which of the following is true?

- (a) (A), (C), (E)                      (b) (B), (D), (E)                      (c) (E) only                      (d) (D), (E) only
73. The apparent pH of a fluid is 7.45, where bicarbonate buffer is involved for maintaining its pH. Values of pKa of carbonic acid are 6.15 and 10.45. The molar ratio of [conjugate base]: [acid] is
- (a) 1 : 20                      (b) 20 : 1                      (c) 1 : 1000                      (d) 1000 : 1  
 (Hint : antilog 1.3 = 20.0 and antilog 10.3 = 1000)
74. A segment of B-DNA encodes an enzyme of molecular mass 50 kD. The estimated length of this segment in  $\mu\text{m}$  would be
- (a) 0.1547                      (b)  $0.1547 \times 10^3$                       (c) 0.4641                      (d)  $0.4641 \times 10^3$
75. In order to determine the primary structure of an octapeptide, amino acid composition was determined by acid hydrolysis (A). The intact oligopeptide was treated with carboxypeptidase (B), chymotrypsin (C), trypsin (D) and CNBr (E). The peptides were separated in each case and acid hydrolysis was carried out for B - E. Following results were obtained (the brackets represent mixtures of amino acids in each fragment):
- A. (2Ala, Arg, Lys, Met, Phe, 2Ser)                      B. (Ala, Arg, Lys, Met, Phe, 2Ser) and Ala  
 C. (Ala, Arg, Phe, Ser), (Ala, Lys, Met, Ser)                      D. (Ala, Arg), (Lys, Phe, Ser), (Ala, Met, Ser)  
 E. (Ala, Arg, Lys, Met, Phe, Ser), (Ala, Ser)
- Which one is the correct sequence of the presence of this protein upon oligopeptide?
- (a) Arg-Ala-Ser-Lys-Met-Phe-Ser-Ala                      (b) Arg-Ala-Ser-Lys-Phe-Met-Ser-Ala  
 (c) Ala-Arg-Ser-Phe-Lys-Met-Ser-Ala                      (d) Ala-Arg-Phe-Ser-Lys-Met-Ser-Ala

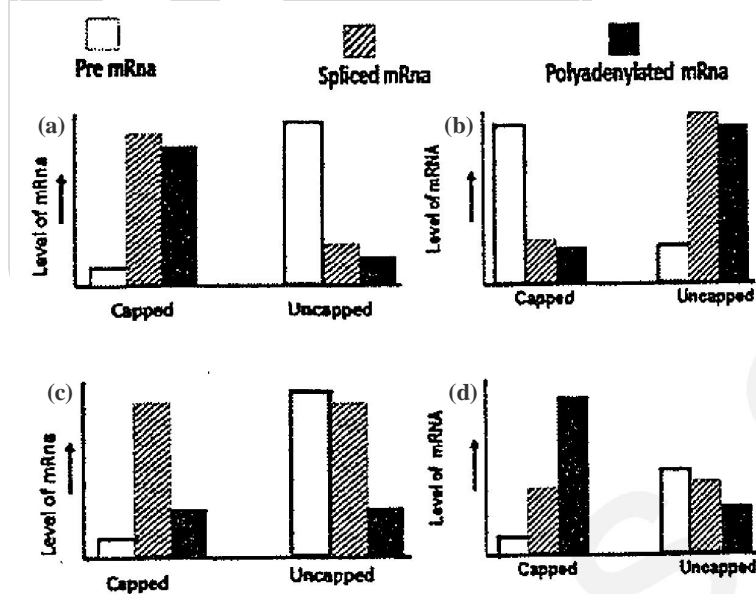
76. You are following the intracellular sorting of an integral plasma membrane protein in a living cell, in culture. You have decided to probe this protein by metabolic labeling technique with  $^{35}\text{S}$ -methionine (pulse-chase technique). After one cycle of division, the cells were treated with a potent inhibitor of protein biosynthesis and processed for subcellular fractionation. In which of the following fractions will you expect the immunoprecipitation with a specific antibody?
- (a) Only cytoplasm.  
(b) Only plasma membrane.  
(c) Both endoplasmic reticulum and plasma membrane.  
(d) Only secretory vesicles and endoplasmic reticulum.
77. The principal pathway for transport of lysosomal hydrolases from the trans Golgi network (pH 6.6) to the late endosomes (pH 6.0) and the recycling of M6P (mannose 6 phosphate) receptors back to the Golgi depends on the pH difference between those two compartments. From what you know about M6P receptor binding and recycling and the pathways for delivery of material to lysosomes, predict what would happen if the pH in late endosomes was raised to 6.6?
- (a) M6P will bind to hydrolases but will not release the hydrolases in the late endosomes.  
(b) M6P will bind to hydrolases and will release the hydrolases in the late endosomes.  
(c) At higher endosomal pH, the receptor would not release the hydrolase and could not be recycled back to the trans Golgi network.  
(d) M6P will be degraded at higher pH.
78. The diploid genome of a species comprises  $6.4 \times 10^9$  bp and fits into a nucleus that is  $6 \mu\text{m}$  in diameter. If base pairs occur at intervals of 0.34 nm along the DNA helix, what is the total length of DNA in a resting cell?
- (a) 3.0 m                      (b) 3.5 m                      (c) 2.2 m                      (d) 4.0 m
79. Phosphorylation of serines as well as methylation and acetylation of lysines in histone tails affect the stability of chromatin structure above the nucleosome level and have important consequences for gene expression. The resulting changes in charge are expected to affect the ability of the tails to interact with DNA because
- (a) DNA is negatively charged.  
(b) DNA-histone interaction is independent of net charge.  
(c) phosphorylation of serine increases DNA- histone interaction.  
(d) methylation and acetylation of lysine increases DNA-histone interaction.
80. Cells that grow and divide in a medium containing radioactive thymidine covalently incorporate the thymidine into their DNA during S phase. Consider a simple experiment in which cells are labelled by a brief (30 minutes) exposure to radioactive thymidine. The medium is then replaced with one containing unlabeled thymidine and the cells grow and divide for some additional time. At different time points after replacement of the medium, cells are examined under a microscope. Cells in mitosis are easy to recognize by their condensed chromosomes and the fraction of mitotic cells that have radioactive DNA can be estimated by autoradiography and plotted as a function of time after the thymidine labeling as in the figure below:



The rise and fall of the curve is because:

- (a) initial rise of the curve corresponds to cells that were just finishing DNA replication when radioactive thymidine was added (S phase).
- (b) the peak of the curve corresponds to cells in M phase.
- (c) the rise in curve after 20 min corresponds to cells in apoptotic phase.
- (d) the fall in curve after 10 min indicates the cells exiting M phase.

81. A rapidly growing bacterial species such as E coli exhibits a typical phase of growth cycle in liquid nutrient broth (lagphase → log phase → stationary phase → death phase). If a bacterial culture has starting density of  $10^3$  cells/ml has a lag time of 10 minutes and a generation time of 10 minutes, what will the cell density be at (cells/ml) 30 minutes? (a)  $6.0 \times 10^3$  (b)  $2.0 \times 10^3$  (c)  $3.0 \times 10^3$  (d)  $4.0 \times 10^3$
82. In order to study the role of telomeres in DNA replication, genetically engineered mice were prepared, where the gene for telomerase RNA was knocked out. When cells from these knock out mice were taken and cultured *in vitro*, they proliferated even after 100 cell divisions which is quite unlikely in the case of human cells. Which of the following is the correct reason?
- (a) Human and mice are fundamentally different with respect to their requirements for telomerase enzyme in the context of DNA replication.
  - (b) *In vitro*, mice DNA becomes circular due to end to end chromosome fusion and does not require telomerase for DNA end replication.
  - (c) Mice have very long stretch of telomere DNA sequence compared to that of human.
  - (d) *In vitro*, mice DNA replication does not require the removal of RNA primers.
83. You are working with an *in vitro* eukaryotic transcription system, which produced both capped and uncapped mRNAs. You incubated these mRNAs with mammalian cell nuclear extract and then quantified the different products as shown below. Which of the following graphs correctly represents the expected result?

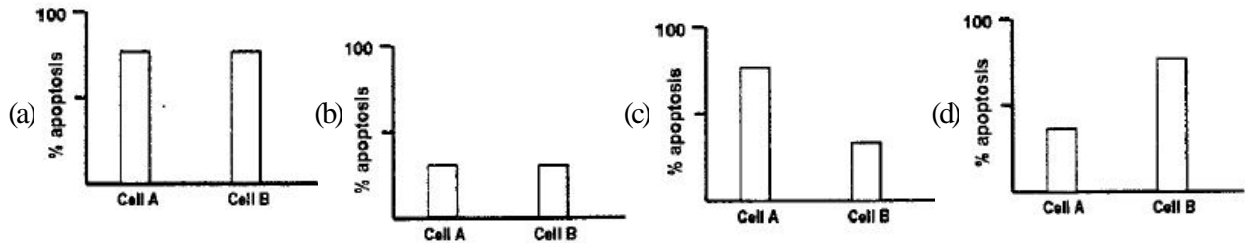


84. A non-enzymatic viral protein X was found to be inducing a cellular gene promoter activity. Although no *in vitro* DNA binding activity could be identified with X protein, it was found to be co-recruited on the cellular promoter along with a cellular transcription factor *in vivo*. Which one of the following statements seems to be the best interpretation of the above findings?
- (a) X is a DNA-binding protein.
  - (b) X physically interacts with the transcription factor.
  - (c) X modifies the chromatin for transcription activation.
  - (d) X is a chaperone.



85. During elongation step of protein synthesis, translocation moves the mRNA and the peptidyl t-RNA by one codon through the ribosome. Translocation in *E. coli* involves GTP and EF-G. However, *in vitro* translocation can take place independent of GTP and EF-G. Based on these observations, the following hypotheses can be made:
- (A) The molecular mechanism of translocation *in vitro* is completely different from that *in vivo*.  
(B) Translocation activity is independent of GTP hydrolysis.  
(C) Translocation activity is completely dependent on GTP and EF-G.  
(D) Translocation activity is inherent in ribosomes, however, the rate of translocation *in vivo* is enhanced significantly in presence of GTP and EF-G
- Which one of the following combinations is correct?
- (a) only (D)                      (b) (A) and (C)                      (c) (A) and (B)                      (d) (C) and (D)
86. DNA methylation plays an important role in transcription regulation in vertebrates. There is an inverse correlation between the level of DNA methylation in the vicinity of a gene and its transcription rate, whereas there is a direct correlation between histone acetylation and increased transcription,  $\beta$ -thalassemia is a common genetic impairment of hemoglobin  $\beta$ -chain synthesis in humans. If these patients can synthesize hemoglobin-F instead of hemoglobin  $\beta$ -chain in its place, they would be notably benefited. Administration of 5-azacytidine to  $\beta$ -thalassemia patients increases hemoglobin-F level in erythrocytes and thus benefit the patients. Which one of the following statements about 5-azacytidine is NOT correct?
- (a) Cells exposed to 5-azacytidine incorporate it into DNA in place of cytidine.  
(b) 5-azacytidine decreases DNA methylation.  
(c) 5-azacytidine promotes histone acetylation.  
(d) 5-azacytidine does not promote gene expression.
87. In cells having G protein coupled receptor, inhibition of protein kinase A by siRNA technology led to diminished transcription of androgen binding protein (ABP) and CREB protein. Addition of cAMP, which is a second messenger, will lead to
- (a) increased transcription of ABP.                      (b) increased phosphorylation of CREB protein.  
(c) no change in transcription level.                      (d) increased ATPase activity of  $G\alpha$  subunit.
88. Binding of a ligand to a cell-surface receptor activates an intracellular signal transduction pathway through the sequential activation of four protein kinases. In the human cell line A, these kinases are held in a signaling complex by a scaffolding 'protein whereas in another cell line B/these kinases are freely diffusible. Which one of the following possibilities do you think is NOT correct?
- (a) Speed of signal transduction will be higher in cell A.  
(b) Possibility of cross-linking with other signal transduction pathways will be lesser in cell A.  
(c) Possibility of signal amplification will be higher in cell A.  
(d) Potency of spreading signal through other signaling pathways will be higher in cell B.
89. Mouse erythroleukemia (MEL) cells are used as an *in vitro* cell culture model for understanding erythropoiesis. The cells are arrested at the stage of pro-erythroblast due to transformation. These cells could be induced by heme to differentiate further so as to synthesize hemoglobin. The most probable molecular mechanism for this could be that heme may suppress and/or downregulate an endogenous heme-regulated inhibitor (HRI) kinase, an inhibitor of globin synthesis. This downregulation in turn promotes differentiation. To validate this hypothesis which of the following approaches is NOT appropriate?
- (a) Transfect MEL cells with HRI kinase gene.  
(b) Knockdown HRI kinase gene in MEL cells.  
(c) Determine the rate of protein synthesis *in situ* as a function of differentiation.  
(d) Measure HRI kinase activity as a function of differentiation.

90. Cells undergo apoptosis by two distinct and inter-connected pathways: extrinsic and intrinsic. Extrinsic pathway is activated by extracellular ligand binding to cell surface death receptors. Whenever an apoptotic stimulus activates intrinsic pathway, the pro-apoptotic Bax and Bak proteins become activated and induce the release of cytochrome C from mitochondria leading to caspase cascade activation resulting in apoptosis. In cell A, cytochrome C is introduced by microinjection whereas in cell B, cytochrome C is introduced by microinjection but Bax and Bak are inactivated. What will be the most appropriate apoptotic response type in both cells



91. Dendritic cells (DC) from BALB/c mice were treated with IL-1<sub>0</sub> or with IFN- $\gamma$ . Similarly, dendritic cells from  $\beta$ 2-microglobulin-deficient mice were also treated with IL-1<sub>0</sub> or with IFN- $\gamma$ . These cells were co-cultured with CD8<sup>+</sup> T cells from hen egg lysozyme (HEL)-specific T cell receptor transgenic mice in presence of the HEL peptide. Five days later, CD8<sup>+</sup> T cells were assayed for target cell lysis. Which one of the following combinations will have the highest target cytotoxicity?

- (a) BC (BALB/c)<sup>IL-10</sup>  $\times$  CD8<sup>+</sup>T (b) DC (BALB/c)<sup>IFN- $\gamma$</sup>   $\times$  CD8<sup>+</sup>T  
(c) DC ( $\beta$ 2-microglobulin-deficient)<sup>IL-10</sup>  $\times$  CD8<sup>+</sup>T (d) DC ( $\beta$ 2-microglobulin-deficient)<sup>IFN- $\gamma$</sup>   $\times$  CD8<sup>+</sup>T

92. Polyspermy results when two or more sperms fertilize an egg. It is usually lethal since it results in blastomeres with different numbers and types of chromosomes. Many species therefore, have two blocks to polyspermy: the fast block and the slow block. In the case of sea urchins:

- A. the fast block is immediate and causes the egg membrane resting potential to rise which does not allow the sperm to fuse with the egg and is mediated by an influx of sodium ions.  
B. the fast block is immediate and causes the egg membrane resting potential to rise which does not allow the sperm to fuse with the egg and is mediated by an efflux of sodium ions.  
C. the slow block or cortical granule reaction is mediated by calcium ions  
D. the slow block or cortical granule reaction is mediated by potassium ions.

Which of the above statements are true?

- (a) (A) and (C) (b) (A) and (D) (c) (B) and (C) (d) (B) and (D)

93. In an experiment, the cells that would normally become the middle segment of a *Drosophila* leg were removed from the leg forming area of the larva and were placed in the tip of the fly's antenna. Based on the "French flag" analogy for the operation of a gradient of positional information, which of the following statement is true?

- (a) The transplanted cells retain their committed status as leg cells, but respond to the positional information of their environment by becoming leg tip cells- i.e. claws.  
(b) The transplanted cells are determined as leg cells and therefore would form a complete limb instead of an antenna.  
(c) The transplanted cells would intermingle with the cells present in the new environment and develop accordingly to give rise to an antenna.  
(d) The transplanted cells retain their committed status as leg cells and would develop to form a chimeric

structure having proximal region made of antenna and the distal region ending in a complete leg.

94. Which of the inferences (A-D) given below would you draw from the following tissue transplantation experiments performed with the early and late gastrula stages of the newt?

	Host regions	Donor regions	Differentiation of donor tissue
	<b>EARLY GASTRULA</b>		
(i)	Prospective neurons	Prospective epidermis	Epidermis
(ii)	Prospective epidermis	Prospective neurons	Neuron
	<b>LATE GASTRULA</b>		
(i)	Prospective neurons	Prospective epidermis	Neuron
(ii)	Prospective epidermis	Prospective neurons	Epidermis

- A. Cells of early newt gastrula exhibit conditional development.  
 B. Cells of early newt gastrula exhibit autonomous development  
 C. Cells of late newt gastrula exhibit conditional development.  
 D. Cells of late gastrula exhibit autonomous development.

The correct inferences are:

- (a) (A) and (D)                      (b) (B) and (C)                      (c) (A) only                      (d) (D) only

95. Segmentation genes in *Drosophila* are divided into three groups (gap, pair rule and segment polarity) based on their mutant phenotype. Below are some of the major genes expressed in a sequential manner (with respect to the groups) affecting segmentation pattern.

- A. *hairy* → *paired* → *tailless* → *patched*  
 B. *hunchback* → *even-skipped* → *fushi tarazu* → *wingless*  
 C. *odd-skipped* → *giant* → *paired* → *wingless*  
 D. *tailless* → *hairy* → *fushi tarazu* → *gooseberry*

Which of the above sequence(s) of genes expressed from early to late embryo is/are correct?

- (a) (D) only                      (b) (A) and (B)                      (c) (C) and (B)                      (d) (B) and (D)

96. Human chorionic gonadotropin (hCG) is known to facilitate attachment of blastocyst to uterus. In women with mutation in hCG gene, biologically inactive hCG was formed but implantation occurred. When hCG was immune-neutralized in the uterus of normal woman, implantation failed. This suggests that for implantation in humans:

- (a) biologically active circulating hCG is not required.  
 (b) blastocyst can produce the required hCG, which helps locally in uterine attachment.  
 (c) trophoblastic cells do not require hCG for the invasion of uterus.  
 (d) extra-embryonic tissue is not responsible for the attachment of embryo to uterus

97. During reproductive development in plants:

- A. male and female gametes are produced as a result of two mitotic divisions after meiosis  
 B. vegetative cells in pollen contribute to pollen development  
 C. antipodal provide nourishment to developing embryo  
 D. Pollen tube ruptures and releases both the male gametes in one of the degenerated synergids

Which of the above statement are true?

- (a) A and B                      (b) B and D                      (c) B and C                      (d) A and D

98. During fertilization “in mammals, sperm-egg interaction is mediated by zona pellucida (ZP) membrane proteins and their receptors present in sperm membrane. ZP3 has been identified to be the principle ZP protein whose post-translational modification is important for sperm - egg interaction. In a competitive inhibition assay the sperm is saturated with either active ZP3 or its modified forms, before studying sperm-egg-interaction. Which of the following experiments will NOT inhibit sperm-egg-interaction
- Saturate sperm with ZP3 protein prior to use.
  - Deglycosylate the ZP3 protein and use it for saturation of sperm.
  - Phosphorylate the ZP3 protein and use it for saturation of sperm.
  - Dephosphorylate the ZP3 protein and use it for saturation of sperm.
99. If an *Arabidopsis* plant, mutated in lycopene biosynthetic pathway is grown in sunny tropical climate in the presence of oxygen:
- it would accumulate higher biomass due to higher rate of photosynthesis.
  - there will not be any influence of this mutation on the rate of photosynthesis and plant growth.
  - it would show reduced biomass due to photo oxidative damage.
  - the leaves would be bluish purple in color because of higher accumulation of xanthophylls.
100. According to the current model of alternative oxidase regulation, the following factors cause induction of alternative oxidase:
- significant increase in the ubiquitin pool in the cytosol.
  - presence of  $\alpha$ -keto acids (like pyruvate and glyoxylate).
  - cold stress.
  - increase in cytosolic ATP concentration.
- Which one of the following combinations of above statements is true?
- A and D
  - B and C
  - A and B
  - A and C
101. The oxidative pentose phosphate pathway provides the reducing equivalents for nitrite reduction in plastids (leucoplasts) of non-green tissues. Which one of the following statements would be correct for the above mentioned pathway?
- Glutamate synthesized from  $\text{NH}_4^+$  is translocated from cytosol to leucoplast.
  - $\alpha$ -ketoglutarate is translocated from cytosol to leucoplast.
  - Glucose-6-phosphate is translocated and moves from leucoplast to cytosol.
  - Triose phosphate is translocated from cytosol to leucoplast.
102. Perception of blue light in plants causes
- inhibition of cell elongation and stimulation of stomatal opening.
  - stimulation of cell elongation and inhibition of stomatal opening.
  - inhibition of stomatal opening.
  - inhibition of cell elongation.
103. Following are few statements regarding water potential of soil.
- The osmotic potential ( $\psi_s$ ) of soil water is generally negligible, except in saline soils.
  - The osmotic potential ( $\psi_s$ ) of saline soil is always more than zero.
  - In dry soils the hydrostatic pressure ( $\psi_p$ ) of soil water potential is always positive.
  - Gravitational potential ( $\psi_g$ ) of soil water is always proportional to height of the tree.
- Which one of the following combinations of above statements is true?
- A and C
  - B and D
  - C and B
  - D and A

- 104.** Which one of the following pairs of precursor amino acid and alkaloid is correct?  
(a) 'Ornithine aspartate-nicotine' and tryptophan -quinine'  
(b) 'Ornithine-nicotine' and 'tyrosine-morphine'  
(c) 'Tyrosine-quinine' and 'tryptophan-morphine'  
(d) 'Ornithine-quinine' and 'ornithine aspartate - nicotine'
- 105.** Typical morphological defects are routinely used in genetic screens to identify novel genes in signal transduction pathways. Which one of the following morphology has been used to decipher the ethylene signaling pathways?  
(a) Light grown morphology of seedling. (b) Triple response morphology of seedling.  
(c) Dark grown morphology of seedling. (d) Morphology of true leaves.
- 106.** In bone marrow, stem cells are committed to different lineages. Factors that stimulate the colonies of these different lineages are interleukin-3 (multi-CSF), granulocyte- macrophage colony stimulating factor (GM-CSF) and granulocyte or macrophage colony stimulating factor (G-CSF or M-CSF). In a mouse deficient in GM-CSF, the number of hematopoietic cells will be altered. Which one of the following is correct?  
(a) Mast cells will be normal in number while granulocytes and macrophages will be deficient in number.  
(b) Granulocytes count will be normal but not of macrophages.  
(c) Macrophage number will remain unaltered.  
(d) Mice will be deficient in all the three cell types.
- 107.** An individual was suffering from digestive complications. It was observed that the individual had dehydrated gastrointestinal tract. When an advanced investigation was done, the person was found to have defects in the following:  
A. cystic fibrosis transmembrane conductance regulator protein.  
B. glucose transporter protein.  
C.  $\text{Na}^+/\text{K}^+$ ATPase.  
D.  $\text{Ca}^{2+}$ ATPase.  
Which of the above could be the cause for such a digestive disorder?  
(a) (A) only (b) (B) and (C) (c) (C) and (D) (d) (D) only
- 108.** The action potential was recorded intracellularly from a squid giant axon bathed in two types of fluid such as sea water and artificial sea water having lower concentration of sodium ions while maintaining the same osmotic pressure with choline chloride. The nature of action potential was different in the two bathing fluids. Which of the following results is most likely? ( )  
(a) The resting transmembrane potential was not changed but the amplitude of action potential was increased with lower sodium concentration in the bathing fluid.  
(b) The amplitude of action potential was gradually decreased with reduction of sodium concentration in bathing fluid but the duration of action potential was prolonged.  
(c) The resting transmembrane potential was decreased and the amplitude of action potential was also decreased with lower sodium concentration in the bathing fluid.  
(d) The amplitude of action potential was not changed with reduction of sodium concentration in the bathing fluid but the duration of action potential was prolonged.
- 109.** Three forms of dextrans namely neutral, polyanionic and polycationic having different molecular radii were injected separately in three groups of rats. The concentrations of dextrans in glomerular filtrate were measured to determine the filterability of the dextrans. The possible outcomes could be as follows:  
A. The dextrans having smaller diameter have greater filterability than larger dextrans.  
B. Neutral dextrans were filtered more than polycationic and polyanionic dextrans. C.  
Polycationic dextrans were filtered more than neutral and polyanionic dextrans.  
D. Polyanionic dextrans were filtered more than neutral and polycationic dextrans.  
Which one of the following combinations is correct?  
(a) (A) only (b) (B) only (c) (A) and (C) (d) (B) and (D)

- 110.** A novel enzyme was identified in humans. The following approaches are available to identify the chromosome on which the gene encoding the enzyme is present:
- (A) Suppress the activity of enzyme by RNAi.  
 (B) Identify polymorphism in the population and carry out pedigree analysis to study its inheritance.  
 (C) Purify the enzyme, decipher its amino acid sequence, predict its DNA sequence and search for its presence in the available human genome sequence.  
 (D) Create chromosome addition lines by making somatic hybrids between human and mouse cells, identify lines showing the enzyme activity and the human chromosome present in it.
- Which of the above approaches can be used?
- (a) (A) or (B)                      (b) (B) or (C)                      (c) (C) or (D)                      (d) (A) or (C)
- 111.** In an experiment on transposition in an eukaryotic system, an intron was cloned within a transposable element and allowed to transpose from a plasmid to genomic DNA. The intron was found to be absent in the transposable element in its new location. It is
- (a) not a case of transposition.                      (b) a case of replicative mode of transposition.  
 (c) a case of conservative mode of transposition.                      (d) a retroposon.
- 112.** In a plant species, a segregating line (one that contains both homozygotes and heterozygotes at a locus) can be made homozygous by repeated selfing for several generations. What is the level of remaining heterozygosity after three generations of selfing, if the level of heterozygosity in generation '0' is denoted as 1?
- (a) 0.5                      (b) 0.25                      (c) 0.125                      (d) 0.0625
- 113.** Given below is the result of a complementation test for six independent mutants (1 to 6).

1	2	3	4	5	6	
0	+	0	+	+	0	1
	0	+	+	+	+	2
		0	+	+	0	3
			0	0	+	4
				0	+	5
					0	6

'+' represents complementation; '0' represents non-complementation Based on the above, which one of the following conclusions is correct?

- (a) The mutations can be ordered in a single cistron as 1 -3-5-2-4-6.  
 (b) All mutations belong to a single cistron, but their order cannot be determined.  
 (c) There are three cistrons, mutations 1, 3 and 6 represent one cistron, 4 and 5 represent the second cistron and 2 represents the third cistron.  
 (d) There are three linkage groups, mutations 1, 3 and 6 represent linkage group A, 4 and 5 represent linkage group B, and 6 represents linkage group C.
- 114.** In a hospital three babies were mixed up. The blood group of the babies were A, B and AB. In order to identify the parents of the babies, the blood groups of the parents were determined. The results obtained were:
- Parent set 1 - A and AB Parent set 2 - AB and O  
 Parent set 3 - B and AB
- Which of the following conclusions can be definitively made?
- (a) The baby with blood group A is the child of the parent set 2  
 (b) The baby with blood group AB is the child of the parent set 1  
 (c) The baby with blood group B is the child of the parent set 3  
 (d) The parentage of none of the babies can be determined from the given information.

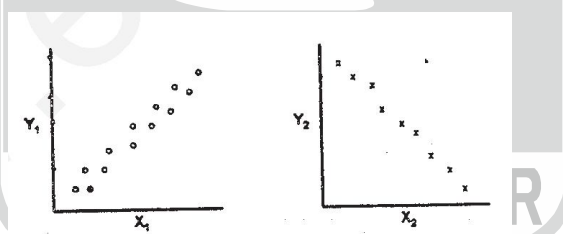
115. There are two mutant plants. One shows taller phenotype than wild type, whereas the other has the same height as the wild type. When these two mutations were brought in together by genetic crosses, the double mutant displayed even taller phenotype than the tall mutant plants. This genetic interaction is called
- (a) antagonistic interaction. (b) additive interaction.  
(c) synergistic interaction. (d) suppressive interaction.

116. The following table gives vascular tissue characteristics of four divisions of Tracheophyta.

Divisions		Vascular tissue characteristics	
A.	Psilophyta	i.	Well-developed tracheid and pits in lateral wall
B.	Lycopodiophyta	ii.	Tracheids
C.	Sphenophyta	iii.	Tracheids, vessels and well-developed phloem
D.	Pteridophyta	iv.	Primitive tracheids and pits in lateral wall

Identify the correct combinations:

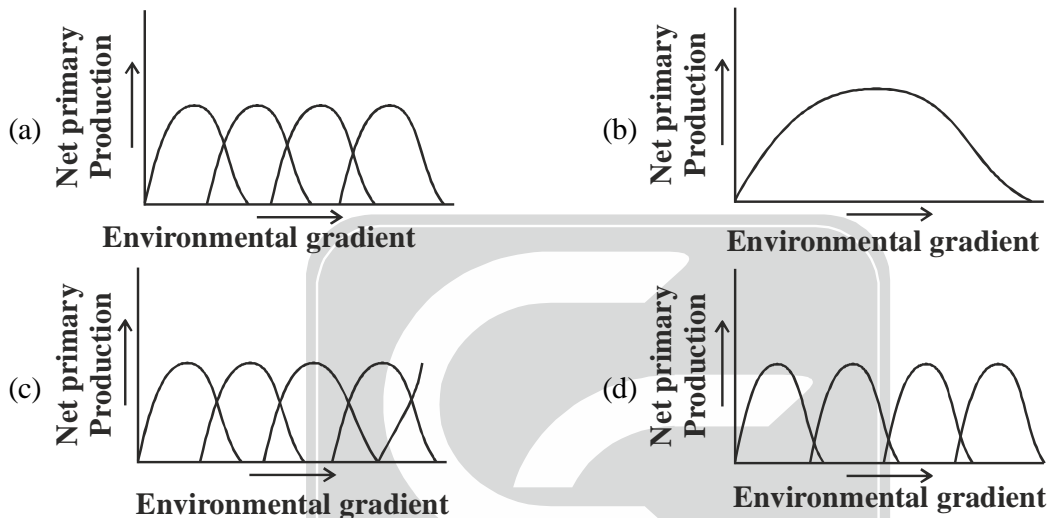
1. (A) - i, (B) - ii, (C) - iii, (D) - iv (b) (A) - ii, (B) - i, (C) - iv, (D) - iii  
(c) (A) - iv, (B) - iii, (C) - ii, (D) - i (d) (A) - iii, (B) - iv, (C) - i, (D) - ii
117. Which of the following is NOT an advantage to seed-based reproduction?
- (a) Reserve food material is provided for the developing embryo.  
(b) Seed coat protects the embryo and allows it to remain dormant until favourable environmental conditions are available.  
(c) The amount of energy spent per female gametophyte is less than that spent on making a spore.  
(d) The female gametophyte remains on the sporophyte which provides protection and nourishment.
118. In a study of sexual isolation in a species of salamander, scientists brought together males and females from different populations and from the same population. They observed the frequency of mating and calculated a sexual isolation index. One graph shows the relationship between mating frequency and genetic distance, and the other shows the relationship between sexual isolation index and geographic isolation.



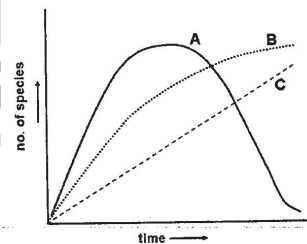
Choose the appropriate terms for of  $X_1$ ,  $Y_1$ ,  $X_2$  and  $Y_2$  in the figures, above.

- (a)  $X_1$  = Geographic distance,  $Y_1$  = Sexual isolation index;  $X_2$  = Genetic distance,  $Y_2$  = mating frequency  
(b)  $X_1$  = Geographic distance;  $Y_1$  = mating frequency;  $X_2$  = Genetic distance,  $Y_2$  = Sexual isolation index  
(c)  $X_1$  = Genetic distance;  $Y_1$  = mating frequency;  $X_2$  = Sexual isolation index;  $Y_2$  = Geographic distance  
(d)  $X_1$  = Genetic distance;  $Y_1$  = Geographic distance;  $X_2$  = Sexual isolation index;  $Y_2$  = mating frequency
119. As per the International Code of Botanical Nomenclature, 2006 (Vienna Code), which of the following is a Nothospecies? (
- (a) *Polypodium vulgare* subsp. *prionodes* (Asch.) Rothm.  
(b) *Polypogon monspeliensis* (L.) Desf.  
(c) *Agrostis stolonifera* L.  
(d) *Agrostis stolonifera* L.  $\times$  *Polypogon monspeliensis* (L.) Desf.
120. Which of the following groups have only two wings?
- (a) Honey bee, beetle, ant (b) Butterfly, housefly, fruitfly  
(c) Dragonfly, butterfly, fruitfly (d) Housefly, fruitfly, mosquito

- 121.** India has currently 17 biosphere reserves representing different ecosystems. These conservation areas significantly differ from the conventional protected areas of the country. Identify the correct combination of attributes (A to G) that best explains the concept of biosphere reserve.
- (A) Conservation, (B) Education,  
 (C) Human habitation allowed, (D) Human habitation not allowed,  
 (E) Strong legal back-up, (F) No supporting act,  
 (G) Research.
- (a) (A), (B), (C), (F), (G) (b) (A), (B), (D), (F), (G)  
 (c) (A), (B), (C), (E), (G) (d) (A), (B), (E), (G)
- 122.** Followings are the niche characteristics of the constituent species and resource partitioning pattern in different ecosystems. Which of these would lead to competitive exclusion of species?



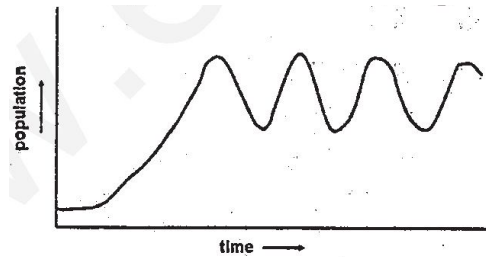
- 123.** Environmental conditions can influence accumulation of species in successional communities. Curves representing changes in forest species over time are given in the figure below. Which of the following keys is correct for the curves?



- 1 A = xeric, B = mesic, C = intermediate      2 A = intermediate, B = xeric, C = mesic  
 3 A = intermediate, B = mesic, C = xeric      4 A = mesic, B = intermediate, C = xeric
- 124.** A plant with blue-coloured flowers was observed to attract a large number of pollinators. However, these flowers were not producing any nectar. Which of the following can be a logical explanation to the observation?
- (A) There could be another species in the vicinity that has blue flowers and is rich in nectar.  
 (b) There is no other species with blue flowers in the vicinity so pollinators are compelled to visit this species.  
 (c) Pollinators may not have blue-colour vision.  
 (d) Pollinators may be able to see only blue colour.

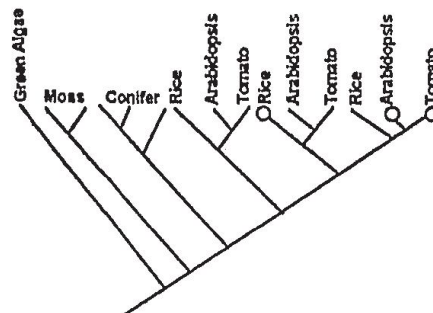


125. Three islands have identical habitat characteristics. On first island rodent species A is present at a density  $325/\text{km}^2$ . Second island has only species B at a density of  $179/\text{km}^2$ . On the third island, both A and B co-exist with densities  $297/\text{km}^2$  and  $150/\text{km}^2$ , respectively. Which of the following can be inferred from this?
- The two species do not compete with each other.
  - The intra-specific competition is more intense than inter-specific competition.
  - The inter-specific competition is more intense than intra-specific competition.
  - The inter and intra species competition are of the same intensity.
126. A few males and females of a species were introduced to a new island. Their population was monitored over several generations and followed a pattern shown in the figure:



Which of the characteristics of the species does NOT explain the pattern?

- Skewed sex ratio (more females than males)
  - Large litter size
  - Delayed sexual maturity
  - Effects of intra-uterine development on fecundity
127. Plasmids are self replicating small circular DNA elements in bacterial cells that can be said to have a stable symbiotic existence with the host cell. They often carry genes useful to the host. Which of the following is a potential threat to the evolution and stability of the symbiotic coexistence?
- 'Copy-up' mutations that increase the rate of plasmid replication per host cell cycle.
  - Reversible integration of plasmid DNA into the host DNA
  - Transfer of plasmids to new cells by conjugation
  - Spontaneous curing of plasmids in a small proportion of host cells.
128. Complex eukaryotic cells may have evolved from simpler prokaryotic cells because complexity of organization increases the
- growth rate.
  - efficiency of energy utilization.
  - tolerance to starvation.
  - ability to attain larger size.
129. *Knox* genes code transcriptional factor important for the regulation of indeterminate growth in plant shoots. These genes also regulate patterns of development of plant organs such as leaves and flowers. The figure represents a phylogenetic tree of the multigene family in some land plants. The circles represents the genes that act to maintain shoot apical meristem (equivalent to stem cells). Orthologues are genes that duplicate due to speciation and paralogues are genes that duplicate within a species.



From the figure, the following inferences were made.

- (A) Multiple gene duplication occurred in vascular plants.

- (B) Gene duplications may have enabled shoot diversification in vascular plants.  
(C) Shoot apical meristems are regulated by orthologous genes in vascular plants.  
(D) Shoot apical meristems are regulated by paralogous genes in vascular plants.

Which of the following represents a combination of correct inferences?

- (a) (A), (B) and (D)      (b) (A), (B) and (C)      (c) (B) and (C) only      (d) (B) and (D) only

- 130.** In an experiment that has continued for more than 50 years, corn has been propagated by breeding only form plants with the high amount of oil in the seeds. The average oil content is now much greater than any of the plants in the original population

The following hypotheses were proposed as explanations for this observation.

- (i) Mutations occurred that increased the oil content in seeds.  
(ii) Plants with high oil content were stimulated to produce offspring with more oil in their seeds.  
(iii) The breeding led to increased frequency of alleles at multiple loci, so that new combinations of genes for even higher oil content were formed.

Which of the following represents a combination of correct statements ?

- (a) (i) and (ii) only      (b) (i) and (iii) only      (c) (ii) and (iii) only      (d) (i), (ii) and (iii)

- 131.** The Galapagos finches were an important clue to Darwin's thinking about the origin of species. These finches are believed to have descended from a single ancestral species that colonized the Galapagos archipelago, America, over a short period of time. The Galapagos finches differ in their beak shape and size. Different species feed on seeds that vary in size and hardness. Which of the following is the most likely explanation for these patterns?

- (a) The finches represent an example of directional trend in beak size from small to big.  
(b) Beak shapes changed in response to different seed types and these changes were inherited by subsequent generations.  
(c) The ancestral finch already had all the beak variations and different lineages formed that were specialized to eat different seed types.  
(d) The finches represent an example of adaptive radiation in which beak variation was generated by mutation followed by selection by different seed types.

- 132.** In order to demonstrate that the long tails of males attracted females in a bird species, experimenters captured and cut the tails of 'n' number of males and monitored the number of females mated by each male. They had two types of controls in the experiment.

- (i) 'n' males that were not captured  
(ii) 'n' males that were captured, had their tails cut and then stitched back to attain the original size.

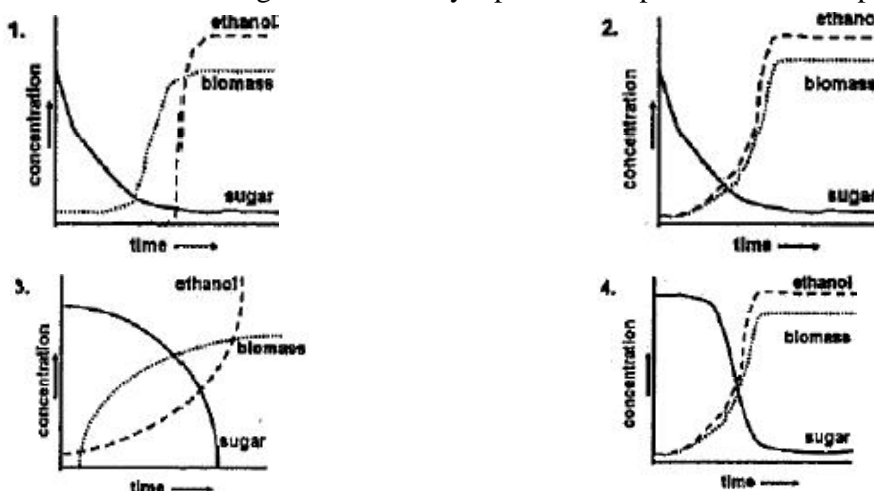
The males with cut tails mated with a significantly smaller number of females than both the controls.

Which of the following alternative explanations is NOT ruled out by the experiment?

- (a) The stress of cutting tails affected the performance of males.  
(b) The time wasted in the capture reduced mating opportunities of males.  
(c) Females avoided any deviation from normal.  
(d) Females chose males randomly.



137. Which of the following curves correctly represents the process of ethanol production by yeast ?



138. Inbreeding for 5 generations led to production of homozygous transgenic mice. However, these homozygous males or females were infertile. Which of the following approach is most preferable and economical to obtain heterozygous transgenic animals continuously?

- More transgenic founder (1<sup>st</sup> animal) should be generated.
- Crossing (breeding) of transgenic mice with wild type mice in earlier generations should be done for continued production of transgenic heterozygous offspring.
- Inbreeding should be avoided after 5<sup>th</sup> generation.
- Homozygous transgenic mice should be mated with wild type mice for continued production of transgenic heterozygous offspring.

139. Following are few statements for regeneration of plants from explants/tissues.

- Cytokinin is required for shoot development.
- Auxin is required for shoot development.
- Auxin to cytokinin ratio is very important.
- Jasmonic acid is required for both root and shoot development.

Which of the following combinations of above statements is true?

- (A) and (C)
- (B) and (D)
- (A) and (D)
- (B) and (C)

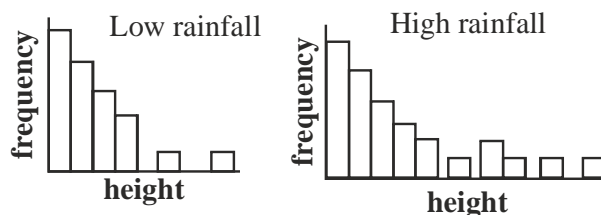
140. A set of neonatal mice are divided into four groups. Group 1 neonates were not primed with any antigen. Group 2 neonates were primed with KLH. Group 3 neonates were primed with KLH but thymectomized. Group 4 neonates were KLH-primed, thymectomized, but reconstituted with KLH- specific CD4<sup>+</sup> T cells. All these mice, when grown adult, were challenged with KLH and the anti-KLH IgG antibody was measured in sera. Which of the following is the correct order of magnitude of antibody response? [ $>$  = greater than,  $\geq$  = greater than or equal to]

- Group 1  $>$  Group 2  $>$  Group 3  $>$  Group 4
- Group 2  $>$  Group 1  $>$  Group 3  $\geq$  Group 4
- Group 2  $>$  Group 3  $>$  Group 1  $>$  Group 4
- Group 4  $>$  Group 1  $>$  Group 2  $\geq$  Group 3

141. Choose the correct sequence of events in a next generation sequencing technology-based whole genome sequencing project.

- DNA extraction  $\rightarrow$  shearing  $\rightarrow$  library preparation  $\rightarrow$  sequencing  $\rightarrow$  assembly  $\rightarrow$  finishing  $\rightarrow$  annotation  $\rightarrow$  submission to Genbank.
- DNA extraction  $\rightarrow$  library preparation  $\rightarrow$  sequencing  $\rightarrow$  assembly  $\rightarrow$  annotation  $\rightarrow$  finishing  $\rightarrow$  submission to Genbank.
- DNA extraction  $\rightarrow$  shearing  $\rightarrow$  adapter ligation  $\rightarrow$  library amplification  $\rightarrow$  sequencing  $\rightarrow$  assembly  $\rightarrow$  finishing  $\rightarrow$  annotation  $\rightarrow$  submission to Genbank.
- DNA extraction  $\rightarrow$  adapter ligation  $\rightarrow$  library amplification  $\rightarrow$  shearing  $\rightarrow$  sequencing  $\rightarrow$  finishing  $\rightarrow$  assembly  $\rightarrow$  annotation  $\rightarrow$  submission to Genbank.

142. An investigator discovers a new receptor for a known ligand and wanted to identify the binding partner of the receptor i.e. its co-receptor. The anti-receptor antibody is not available but anti GFP-antibody is available. Which one of the following strategies is most likely to identify the co-receptor?
- The GFP-receptor fusion protein is expressed in a cell line and analyzed by LC-MS/MS.
  - The GFP-receptor fusion protein is expressed in a cell line and the cells positive for GFP were sorted out, lysed and run on a polyacrylamide gel.
  - The GFP-receptor protein is coated on ELISA plate, followed by ELISA with anti- GFP antibody..
  - The receptor is cloned as a fusion protein of GFP and expressed in stimulated cells. The immunoprecipitated complex obtained by anti-GFP antibody was analyzed by LC- MS/MS.
143. The frequency distribution of tree heights in two forest areas with different annual rainfall are given



Which of the following statistical analysis will you choose to test whether rainfall has an effect on tree heights?

- $t$  test for comparison of means.
  - A non-parametric comparison of the two groups
  - Correlation analysis of rainfall and mean tree heights.
  - Regression of tree heights on rainfall.
144. Two species of plants were sampled in 32' quadrats in a forest. The mean and variance for the occurrence of species 1 were 16.2 and 48 and species 2 were 3.6 and 3.2 respectively. Which of the following statements about the distribution of the two species in these quadrats is supported by these findings?
- Both species are distributed randomly.
  - Species 1 is distributed randomly and species 2 is clustered.
  - Species 1 is clustered and species 2 is distributed randomly.
  - Both species are clustered.
145. Poly-L-lysine exists in pure  $\alpha$ -helix,  $\beta$ -sheet and random coiled conformation depending upon the solvent conditions. The values of mean residue ellipticity at 220 nm ( $[\theta]_{220}$ ) are -35,700, -13,800 and +3,900 deg  $\text{cm}^2 \text{dmol}^{-1}$  for  $\alpha$ -helix,  $\beta$ -sheet and random coil conformations of this polypeptide, respectively. The polypeptide exists in  $\alpha$ -helix conformation at pH 10.8 and 25°C. Addition of urea leads to a two state transition between  $\alpha$ -helix and random coil conformation. It has been observed that  $[\theta]_{222}$  of the polypeptide is -14800 deg  $\text{cm}^2 \text{dmol}^{-1}$  in the presence of 6M urea. The percentage of the polypeptide in  $\alpha$ -helix conformation is:
- 37
  - 41
  - 47
  - 50

==== end =====