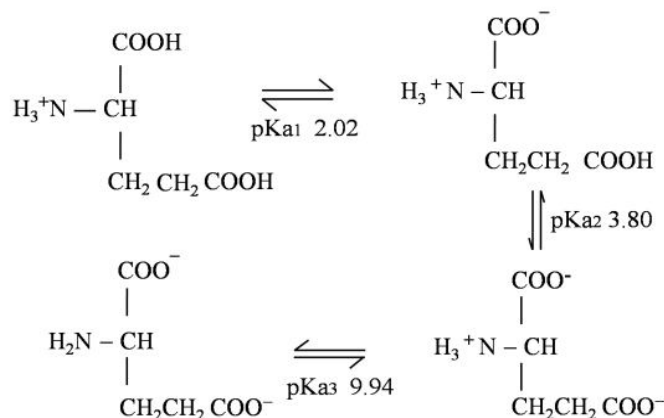


QUESTION PAPER

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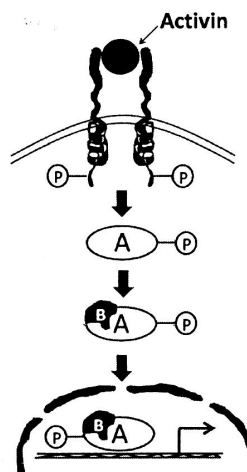
December-2016

21. Choose the most appropriate pH at which the net charge is zero for the molecule from the data shown below:



- (a) 2.02 (b) 2.91 (c) 5.98 (d) 6.87
22. Choose the correct statement about peptides in the Ramachandran plot.
- (a) Peptides that are unstructured will have all the backbone dihedral angles in the disallowed regions.
 (b) It is not possible to conclude whether a peptide adopts entirely helix or entirely beta sheet conformation.
 (c) The occurrence of beta turn conformation in a peptide can be deduced.
 (d) The sequence of a peptide can be deduced.
23. Equilibrium constant (K'_{eq}) of a reaction is a ratio of product to substrate concentrations. The relation between (K'_{eq}) and free energy change in a reaction ($\Delta G'$) is as follows $\Delta G' = -RT \ln K'_{eq}$
- Reaction A and Reaction B have K'_{eq} values of 10 and 100, respectively. Which of the following statements is correct with respect to $\Delta G'$?
- (a) $\Delta G'$ of A = $\Delta G'$ of B (b) $\Delta G'$ of A > $\Delta G'$ of B
 (c) $\Delta G'$ of B > $\Delta G'$ of A (d) $\Delta G'$ of A \approx $\Delta G'$ of B
24. Excess oxygen consumed after a vigorous exercise is
- (a) to pump out lactic acid from muscle.
 (b) to increase the concentration of lactic acid in muscle.
 (c) to reduce dissolved carbon dioxide in blood.
 (d) to make ATP for gluconeogenesis.
25. Which one of the following describes the primary function of flippases ?
- (a) Help in increasing lipid-protein interaction in the outer leaflet of the bilayer
 (b) Move certain phospholipids from one leaflet of the membrane to another
 (c) Localize more negatively charged membrane proteins in the lipid bilayer
 (d) cause uncoupling of v-SNARES and t-SNARES after fusion of incoming vesicle with target membrane

26. Mitotic cyclin-CDK activity peaks in M phase. This is because
 (a) Mitotic cyclin is synthesised only in M phase.
 (b) Threshold level of mitotic cyclin accumulates only in late G₂.
 (c) Cyclin subunit is activated by phosphorylation only in M phase.
 (d) The kinase subunit is activated by dephosphorylation only in M phase.
27. The gel to liquid crystalline phase transition temperature in phosphatidyl choline (PC) lipids composed of dioleoyl (DO), dipalmitoyl (DP), disteoyl (DS) and palmitoyl oleoyl (PO) fatty acids in increasing order will be
 (a) DOPC > DPPC > POPC > DSPC (b) DSPC > DPPC > POPC > DOPC
 (c) DPPC > DSPC > POPC > POPC (d) POPC > DPPC > DOPC > DSPC
28. Which of the following is NOT an example of transmembrane transport between different subcellular compartments ?
 (a) Transport from cytoplasm into the lumen of the endoplasmic reticulum
 (b) Transport from endoplasmic reticulum to the Golgi complex
 (c) Transport from stroma into thylakoid space
 (d) Transport from mitochondrial intermembrane space into the mitochondrial matrix
29. Which of the following are NOT transcribed by RNA polymerase II?
 (a) miRNA and some snRNA (b) miRNA and snoRNA
 (c) mRNA and snoRNA (d) tRNA and 5S rRNA
30. RNA editing, a post-transcriptional process, is achieved with the help of guide RNA (g-RNA). Which one of the following statements about the process is NOT true?
 (a) g-RNA dependent RNA editing happens in the kinetoplast DNA
 (b) g-RNA is involved in chemical modification of t-RNA
 (c) This process involves insertion or deletion of uridines
 (d) Sequences edited once may be re-edited using a second g-RNA
31. Telomerase, a RNA-protein complex which completes the replication of telomeres during DNA synthesis, is a specialised
 (a) RNA dependent DNA polymerase (b) DNA dependent DNA polymerase
 (c) DNA dependent RNA polymerase (d) RNA dependent RNA polymerase
32. Consider a short double-stranded linear DNA molecule of 10 complete turns with 10.5 bp/turn. The ends of the DNA molecule are sealed together to make a relaxed circle. This relaxed circle will have a linking number of
 (a) 105 (b) 20.5 (c) 10.0 (d) 10.5
33. In the following signalling cascade, which one of the following molecules is denoted by 'B'?



- (a) STAT 5 (b) SMAD 6 (c) GSK3 β (d) SMAD 4

34. The secondary antibodies routinely used for the detection of primary antibodies in western blotting experiment are
(a) anti- allotypic (b) Anti idiotypic (c) anti-isotypic (d) anti-paratypic
35. Which of the following events will NOT usually lead to transformation of a normal cell into a cancer cell?
(a) Gain of function of oncogenes
(b) Loss of function of tumor suppressors
(c) Gain of function of genes involved in nucleotide excision repair
(d) Loss of function of pro-apoptosis related genes
36. Which one of the following is a food borne toxin ?
(a) Tetanus toxin (b) Botulinum toxin
(c) Cholera toxin (d) Diptheria toxin
38. Certain proteins or mRNAs that are regionally localized within the unfertilized egg and regulate development are called
(a) gene regulators. (b) morphometric determinants .
(c) cytoplasmic determinants. (d) mosaic forming factors.
39. Cell to cell communication is important in development of an organism. The ability of cells to respond to a specific inductive signal is called
(a) Regional specificity of induction (b) Competence
(c) Juxtacrine signalling (d) Instructive interaction
40. Apical ectodermal ridge induction is essential tetrapod limb development. Which of the following is NOT essential for the formation of a functional limb?
(a) Tbx genes and Wnt (b) Androsterone
(c) Apoptotic gene (d) Fibroblast growth factor
41. Which one of the following best describes the symplast pathway of water flow from the epidermis to endodermis in a plant root?
(a) Water moves through cell walls and extracellular spaces without crossing any membrane
(b) Water travels across the root cortex via the plasmodesmata
(c) Water crosses the plasma membrane of each cell in its path twice, once on entering and once on exiting
(d) Transport across the tonoplast
42. The herbicide, dichlorophenyldimethylurea, is an inhibitor of
(a) shikimate pathway for biosynthesis of aromatic amino acids
(b) electron transport from P680 to P700
(c) branched chain amino acid pathway
(d) electron transport from P700 to ferredoxin
43. Which one of the following compounds is NOT a part of alkaloid class of secondary metabolites ?
(a) Lignin (b) Indole (c) Tropane (d) Pyrrolidine
44. Which one of the following plant derived signalling molecules induces hyphal branching of arbuscular mycorrhizal fungi, a phenomenon that is observed at the initial stages of colonization by these fungi?
(a) Salicylic acid (b) Abscisic acid (c) Strigolactones (d) Systemin
45. Serum has essentially the same composition as plasma EXCEPT that it lacks.
(a) Albumin (b) Stuart-Prover factor
(c) Antihemophilic factor (d) Hageman factor
46. Which one of the following does NOT occur due to stimulation of baroreceptors?
(a) Bradycardia (b) Hypotension (c) Venodilation (d) Vasoconstriction

47. Vasopressin secretion does NOT increase with
(a) exercise (b) an increase in extracellular fluid volume
(c) standing (d) vomiting
48. Which type of cells located in gastric glands is responsible for the release of histamine?
(a) Mucous neck cells (b) Enterochromaffin-like cells
(c) Chief cells (d) Parietal cells
49. If non-disjunction occurs in meiosis I, which of the following scenario is most likely to occur?
(a) Two gametes will be $n + 1$ and two will be $n - 1$
(b) One gamete will be $n + 1$, two will be 'n' and one will be $n - 1$
(c) Two gametes will be normal and two will be $n - 1$
(d) Two gametes will be normal and two will be $n + 1$
50. Which of the following mutagens is most likely to result in a single amino acid change in a gene product?
(a) Acriding organge (b) X-rays
(c) Ethylmethane sulphate (EMS) (d) Ethidium bromide
51. Maternal inheritance of coiling of shell in snail (*Limmaea peregra*) is well established. The dextral coiling depends on dominant allele D and sinistral coiling depends upon recessive allele d. A female F1 progeny of dextral (Dd) type is crossed with a male sinistral snail. What will be the ratio of heterozygous : homozygous individuals in its F2 progeny ?
(a) 3 : 1 (b) 1 : 1 (c) 1 : 3 (d) 1 : 2 : 1
52. Which of the following is true for cells harbouring F' plasmid?
(a) Their F plasmid is non-functional
(b) They exhibit increased rates of transfer of all chromosomal genes
(c) They are merodiploids
(d) They fail to survive as the chromosomal origin of replication is inactivated
53. An alga having chlorophyll a, floridean starch as storage product and lacking flagellate cells belongs to the class
(a) Phaeophycease (b) Chlorophycease (c) Rhodophyceae (d) Xanthophyceae
54. Which of the following is NOT true for monocots?
(a) Sieve tube members with companion cells (b) Vasculature atactostelic
(c) Triloculate pollen (d) Vascular cambium absent
55. Individuals occupying a particular habitat and adapted to it phenotypically but not genotypically are known as
(a) Ecophenes (b) Ecotypes (c) Ecospecies (d) Coenospecies
56. Which one of the following statements supports the concept of trade-off in the evolution of life history traits?
(a) Level of parental care and clutch size are positively correlated
(b) Animals maturing early tend to live longer
(c) An increase in seed size is usually associated with a decrease in seed number
(d) Allocation of higher energy for reproduction leads to higher population growth
57. A plot of dN/dt as a function of population density yields a
(a) rectangular hyperbola (b) negative exponential curve
(c) positive rectilinear curve (d) bell-shaped curve
58. For a species having logistic growth, if $K = 20,000$ and $r = 0.15$, the maximum sustainable yield will be
(a) 450 (b) 1500 (c) 3000 (d) 6000
59. Which of the following is a correct ranking of ecosystems based on the root: shoot ratio of plants ?
(a) Tropical wet forest > Tropical dry forest > Temperate grassland > Tropical grassland
(b) Temperate grassland > Tropical grassland > Tropical wet forest > Tropical dry forest
(c) Tropical dry forest > Tropical wet forest > Tropical grassland > Temperate grassland
(d) Temperate grassland > Tropical grassland > Tropical dry forest > Tropical wet forest

60. Which of the following periods is known as “Age of Fishes” ?
(a) Devonian (b) Jurassic (c) Cambrian (d) Carboniferous
61. Which of the following NOT an assumption of the Hard-Weinberg model ?
(a) Population mates at random with respect to the locus in question
(b) Selection is not acting on the locus in question
(c) One allele is dominant and the other is recessive at this locus
(d) The population is effectively infinite in size
62. Which of the following geological periods is characterized by the first appearance of mammals ?
(a) Tertiary (b) Cretaceous (c) Permian (d) Triassic
63. In which of the following mating systems there is likely to be NOT conflict of interest over reproductive success between the sexes ?
(a) Polyandry (b) Monogamy (c) Promiscuity (d) Polygamy
64. Which one of the following analytical techniques does NOT involve an optical measurement?
(a) ELISA (b) Microarray
(c) Flow cytometry (d) Differential Scanning Calorimetry
65. Which genes have been introduced in Bollgard II cotton to get resistance against cotton bollworm, tobacco budworm and pink bollworm?
(a) *cry1Ab + cry1Ac* (b) *cry1Ac + cry2Ab* (c) *cry1Ab + cry2Ab* (d) *cry9C + cry2Ab*
66. Different leads are used to record ECG of humans. Which one of the following is NOT unipolar leads ?
(a) Augmented limb leads (b) V_1 and V_2 leads
(c) Standard limb leads (d) VR and VL leads
67. The presence and distribution of specific mRNAs within a cell can be detected by
(a) Northern blot analysis (b) RNase protection assay
(c) *in situ* hybridization (d) real-time PCR
68. The tetanus vaccine given to humans in the case of a deep cut is a
(a) DNA vaccine (b) recombinant vector vaccine
(c) subunit vaccine (d) toxoid vaccine
69. The electrotherapy ionization spectrum of a mixture of two peptides show peaks with m/z values 301, 401, 501 and 601. The molecular weights of the peptides are
(a) 1200 and 1250 (b) 1200 and 1500 (c) 1350 and 1500 (d) 1250 and 1350
70. An optical measurement of a protein is taken both before and after digestion of the protein by a protease. In which of the following spectroscopic measurements the signal change, i.e., before vs after protease treatment, could be the maximum ?
(a) Absorbance at 280 nm (b) Circular dichroism
(c) Absorbance at 340 nm (d) Fluorescence value
71. From the following statements,
A. Hydrogen, Deuterium and Tritium differ in the number of protons.
B. Hydrogen, Deuterium and Tritium differ in the number of neutrons.
C. Both Deuterium and Tritium are radioactive and decay to Hydrogen and Deuterium, respectively.
D. Tritium is radioactive and decays to Helium.
E. Carbon-14 decays to Nitrogen-14
F. Carbon-14 decays to Carbon-13
pick the combination with ALL correct statements.
(a) A, B and F (b) B, D and E (c) A, C and D (d) C, E and F

72. From the following statements,
- For a reaction to occur spontaneously the free energy change must be negative.
 - The interaction between two nitrogen molecules in the gaseous state is predominantly electrostatic.
 - By knowing bond energies, it is possible to deduce whether the bond is covalent bond or hydrogen bond.
 - Hydrophobic interactions are not important in a folded globular protein.
- pick the combination with ALL WRONG statements.

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

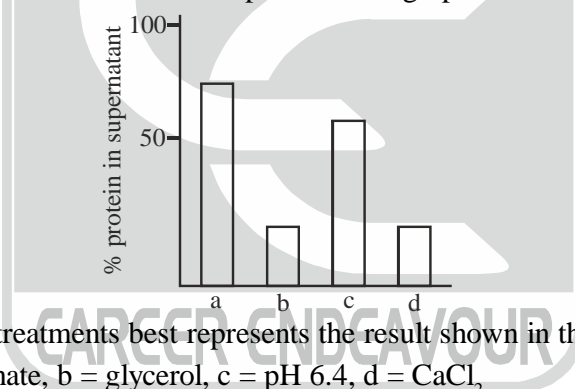
73. The following are four statements on peptide/protein conformation:

- Glycine has the largest area of conformationally allowed space in the Ramachandran plot of ϕ and ψ .
- A 20-residue peptide that is acetylated at the N-terminus and amidated at the C-terminus has $\phi = -60^\circ (\pm 5)$, $\psi = -30^\circ (\pm 5)$ for all the residues. It can be concluded that conformation of the peptide is helix-turn-strand.
- The allowed values of ϕ , ψ for amino acids in a protein are not valid for short peptides.
- A peptide Acetyl-A₁-A₂-A₃-A₄-CONH₂ (A₁ – A₄ are amino acids) adopts a well defined β -turn. The dihedral angles of A₂ and A₃ determine the type of β -turn.

Choose the combination of correct statements.

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

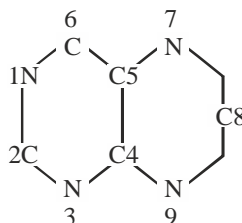
74. A researcher investigated a set of conditions for a protein with an isoelectric point of 6.5 and also binds to calcium. This protein was subjected to four independent treatments: (i) pH 6.4, (ii) 10% glycerol, (iii) 10 mM CaCl₂, (iv) 40% ammonium sulphate. This was followed by centrifugation and estimation of the protein in the supernatant. The results are depicted in the graph below :



Which of the following treatments best represents the result shown in the graph?

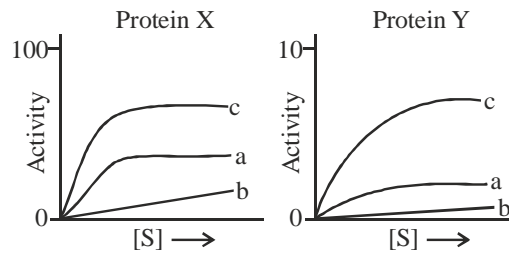
- a = ammonium sulphate, b = glycerol, c = pH 6.4, d = CaCl₂
- a = CaCl₂, b = glycerol, c = ammonium sulphate, d = pH 6.4
- a = pH 6.4, b = CaCl₂, c = ammonium sulphate, d = glycerol
- a = CaCl₂, b = pH 6.4, c = glycerol, d = ammonium sulphate

75. In the biosynthesis of purine :



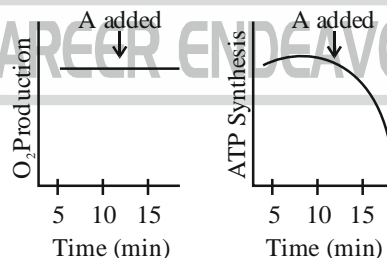
- All N atoms, C4 and C5 are from aspartic acid
- N1 is from Aspartic acid; N3 and N9 are from Glutamine side-chain; N7, C4 and C5 are from Glycine
- N1 is from Aspartic acid; N3 from Glutamine side-chain; N9 from N attached to C^α of Glutamine; N7, C4 and C5 are from Glycine
- N1 is from Glutamine; N3 from Glutamine side-chain; N9 from N attached to C^α of Glutamine; N7, C4 and C5 are from Glycine

76. A researcher was investigating the substrate specificity of two different enzymes, X and Y, on the same substrate. Both the enzymes were subjected to treatment with either heat or an inhibitor which inhibits the enzyme activity. Following are the results obtained where a = inhibitor treatment, b = heat treatment and c = control.



Which of the following statements is correct?

- (a) Only protein X is specific for the substrate, S (b) Only protein Y is specific for the substrate, S
 (c) Both X and Y are specific for the substrate, S (d) Both X and Y are non-specific for the substrate, S
77. In an experiment, red blood cells were subjected to lysis and any unbroken cells were removed by centrifugation at 600g. The supernatant was taken and centrifuged at 100,000 g. The pellet was extracted with 5M NaCl and again centrifuged at 100,000 g. Which of the following proteins would be present in the supernatant ?
- (a) Band 3 (b) Glycophorin (c) G protein-coupled receptor (d) Spectrin
78. In order to study the intracellular trafficking of protein 'A', it was tagged with GFP (A-GFP). Fluorescence microscopy showed that A-GFP co-localizes with LAMP1. In the presence of bafilomycin A, an inhibitor of H⁺-ATPase, A-GFP does not co-localize with LAMP1. Instead, it co-localizes with LC3 puncta. Which one of the following statements is TRUE ?
- (a) A-GFP targets to the ER in the absence of bafilomycin A.
 (b) Autophagy is required for trafficking of A-GFP to lysosomes.
 (c) Bafilomycin A facilitates targeting of A-GFP to the ER.
 (d) Bafilomycin A facilitates targeting of A-GFP to the mitochondria.
79. 'A' is an inhibitor of chloroplast function. The production of O₂ and the synthesis of ATP are measured in illuminated chloroplasts before and after addition of 'A' as shown below :



Which statement is correct

- (a) 'A' inhibits the reduction of NADP⁺
 (b) 'A' inhibits the proton gradient and the reduction of NADP⁺
 (c) 'A' inhibits the proton gradient but not the reduction of NADP⁺
 (d) 'A' inhibits neither the proton gradient nor the reduction of NADP⁺
80. During cell cycle progression from G₁ to S, cyclin D-CDK4 phosphorylates Rb and reduces its affinity for E2F, E2F dissociates from Rb and activates S-phase gene expression. Overexpression of protein 'A' arrests G₁ phase progression.

Which of the following statements is TRUE ?

- (a) 'A' inhibits Rb-E2F interaction (b) 'A' inhibits CDK4 activity
 (c) 'A' phosphorylates E2F (d) 'A' degrades Rb

81. Cells in S-phase of the cell cycle were fused to cells in the following stages of cell cycle : (a) G_1 phase, (b) G_2 phase, (c) M phase. These cells were then grown in medium containing tritiated thymidine. Maximal amount of freshly labelled DNA is likely to be obtained in S-phase cells fused with
- (a) G_1 phase cells (b) G_2 phase cells
(c) M phase cells (d) Both G_1 and G_2 phase cells
82. Addition of the antibiotic cephalixin to growing *E. coli* cells lead to filamentation of the cells, followed by lysis. Cephalixin is an inhibitor of
- (a) protein synthesis (b) DNA synthesis (c) peptidoglycan synthesis (d) RNA polymerase
83. Fluorescently tagged protein was used to study protein secretion in yeast. Fluorescence was observed in:
- A. the Golgi B. the secretory vesicles
C. the rough ER.

Which of the following describes best the sequence in which these events occur?

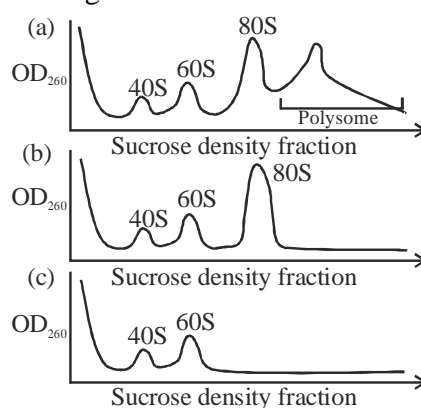
- (a) $A \rightarrow B \rightarrow C$ (b) $B \rightarrow C \rightarrow A$ (c) $C \rightarrow A \rightarrow B$ (d) $C \rightarrow B \rightarrow A$
84. In order to ensure that only fully processed mature mRNAs are allowed to be exported to cytosol, pre-mRNAs associated with snRNPs are retained in the nucleus. To demonstrate this, an experiment was performed where a gene coding a pre-mRNA with a single intron was mutated either at the 5' or 3' splice sites or both the splice sites.

Given below are a few possible outcomes :

- A. Pre-mRNA having mutation at both the splice sites will be retained in the nucleus because of the presence of bound snRNPs.
B. Pre-mRNA having mutation at both the splice sites will be exported to cytosol because of the absence of bound snRNPs.
C. Pre-mRNA mutated at either 5' or 3' splice sites will be retained in the nucleus because of the presence of bound snRNPs.
D. Pre-mRNA mutated at either 5' or 3' splice sites will be exported to cytosol because of the absence of bound snRNPs.

Choose the correct combination of the possible outcomes :

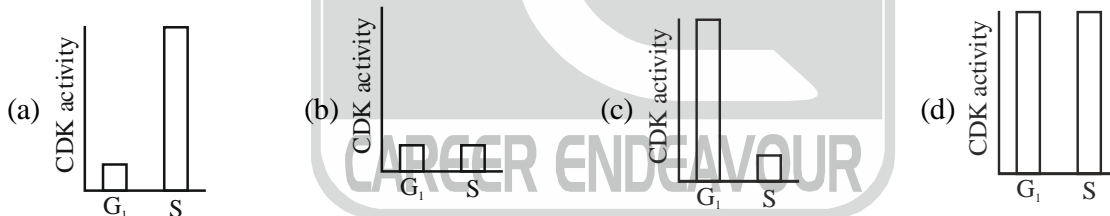
- (a) B and C (b) A and D (c) B and D (d) A and C
85. Polysome profiling of cells treated with three hypothetical translation inhibitors is shown in the plots below. These three inhibitors are
- (i) CHP-leaky inhibitor of translation. (ii) LTM-arrests ribosome at the initiation codon.
(iii) PTM-inhibits ribosome scanning.



Match the polysome profile to the inhibitor.

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

86. In mammals, CG rich sequences are usually methylated at C, which is a way for marking genes for silencing. Although the promoters of housekeeping genes are often associated with CpG islands yet they are expressed in mammals. Which one of the following best explains it ?
- Methylation of cytosine does not prevent the binding of RNA Pol II with the promoter, so housekeeping genes are expressed
 - During housekeeping gene expression, the enzyme methyltransferase is temporarily silenced by miRNA, thus shutting down global methylation
 - Unlike within the coding region of a gene, CG rich sequences present in the promoters of active genes are usually not methylated
 - As soon as the cytosine is methylated in the promoter region, the enzymes of DNA repair pathway remove the methyl group, thereby ensuring gene expression
87. Telomerase, a protein-RNA complex, has a special reverse transcriptase activity that completes replication of telomeres during DNA synthesis. Although it has many properties similar to DNA polymerase, some of them are also different. Which one of the following properties of telomerase is different from that of DNA polymerase?
- Telomerase requires a template to direct the addition of nucleotides
 - Telomerase can only extend a 3'-OH end of DNA
 - Telomerase does not carry out lagging strand synthesis
 - Telomerase acts in a processive manner
88. In eukaryotes, a specific cyclin dependent kinase (CDK) activity is required for the activation of loaded helicases to initiate replication. On the contrary, this CDK activity inhibits the loading of helicases onto the origin of replication. Considering the fact that during each cycle, there is only one opportunity for helicases to be loaded onto origins and only opportunity for these loaded helicases to be activated, which one of the following graphs best depicts this CDK activity in G_1 and S phases of the cell cycle?



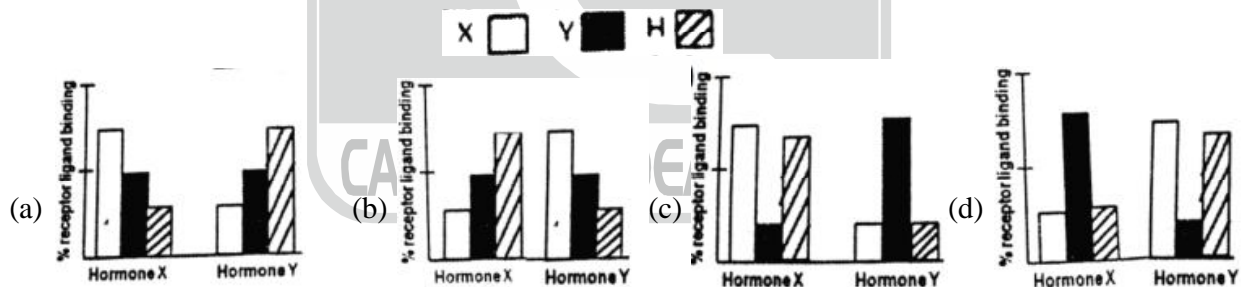
89. In Trypanosomes, a 35 base leader sequence is joined with several different transcripts making functional mRNAs. The leader sequence is joined with the other RNAs by
- a specific RNA ligase
 - the process of trans-splicing
 - a nucleophilic attack caused by a free guanine nucleotide
 - a nucleophilic attack caused by a 2' OH of an internal A present in the leader sequence

90. Following are the list of some of the pathogens (column A) and the unique mechanisms they employ for evading immune response (column B).

A		B	
a	<i>Trypanosoma brucei</i>	I	Capable of employing unusual genetic processes by which they generate extensive variations in their variant surface glycoproteins (VSG)
b	<i>Plasmodium falciparum</i>	II	Capable of continually undergoing maturational changes in transformation to different forms which allow the organism to change its surface molecules
c	<i>Haemophilus influenzae</i>	III	Capable of evading immune response by frequent antigenic changes in its hemagglutinin and neuraminidase glycoproteins

Which of the following is the correct match between the organisms and their respective mechanism to evade immune response?

- (a) a - (i), b - (ii), c - (iii) (b) a - (ii), b - (iii), c - (i)
(c) a - (iii), b - (i), c - (ii) (d) a - (i), b - (iii), c - (ii)
91. Two steroid hormone receptors X and Y both contain a ligand binding domain and a DNA binding domain. Using recombinant DNA technology, a modified hybrid receptor H is prepared such that it contains the ligand binding domain of X and DNA binding domain of Y. Three sets of cells over-expressing receptors X, Y and H were then treated separately either with hormone X or with hormone Y. Assuming that there is no cross-reactivity, which one of the following graphs best represent the receptor-ligand binding in each case?



92. A protein X is kept in an inactive state in cytosol as complexed with protein Y. Under certain stress stimuli, Y gets phosphorylated resulting in its proteasomal degradation. X becomes free, translocates to nucleus and results in the transcription of a gene which causes cell death by apoptosis. Stress stimuli were given to following four different cases.

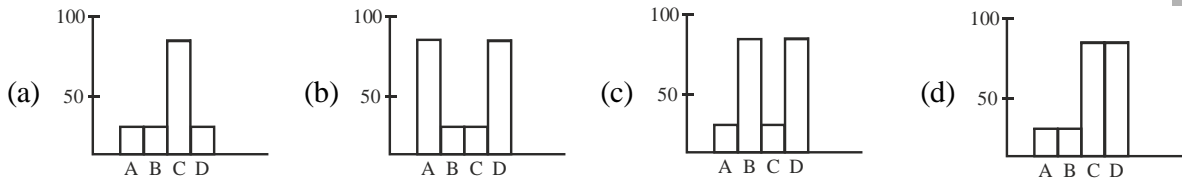
Case A: Protein Y has a mutation such that phosphorylation leading to proteasomal degradation does not occur.

Case B : Cells are transfected with a gene which encodes for a protein L that inhibits the translocation of protein Y to the nucleus.

Case C : Cell are transfected only with empty vector used to transfect the gene for protein L.

Case D : Cells are treated with Z-VAD-FMK, a broad spectrum caspase inhibitor.

Which one of the following graphs best describes the apoptotic state of the cells in the above cases? Y-axis represent % apoptotic cells.



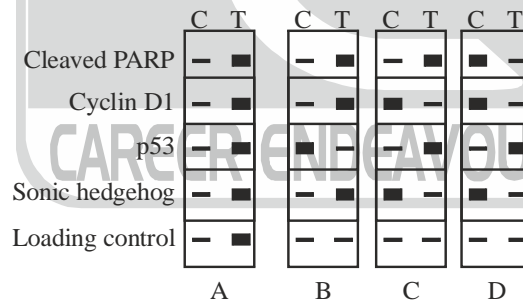
93. In animals, four separate families of cell-cell adhesion proteins are listed in Column A and their functional characteristics are given in Column B.

A		B	
a.	Integrin	I	Lectins that mediate a variety of transient, cell-cell adhesion interactions in the blood stream
b.	Cadherin	II	Contains extracellular Ig-like domains and are mainly involved in the fine tuning of cell-cell adhesive interactions during development and regeneration
c.	Ig-super-family	III	Mediates Ca^{2+} - dependent strong homophilic cell-cell adhesion
d.	Selectin	IV	Transmembrane cell adhesion proteins that act as extracellular matrix receptors

Which one of the following is the correct combination ?

- (a) a - (i), b - (ii), c - (iii), d - (iv) (b) a - (ii), b - (iii), c - (iv), d - (i)
 (c) a - (iii), b - (iv), c - (i), d - (ii) (d) a - (iv), b - (iii), c - (ii), d - (i)

94. A student treated cancer cells with an anti-cancer drug and performed western blot analysis. Which one of the following blots is the best representation of untreated control (C) and treated (T) samples ?



95. Which one of the following statements regarding B cell receptor (BCR) and T cell receptor (TCR) is NOT true?
 (a) TCR is membrane bound and does not appear as soluble form as does the BCR
 (b) Unlike BCR, most of the TCR are not specific for antigen alone but for antigen combined with MHC
 (c) In order to activate signal transduction, BCR associates itself with Ig- α /Ig- β whereas TCR associates with CD3
 (d) The antigen binding interactions of BCR is much weaker than TCR

96. In case amphibians, the dorsal cells and their derivatives are called as “Spemann – Mangold organizer”. Following statements are related to the “organizer” were made:

- A. It induces the host’s ventral tissues to change their fates to form neural tube and dorsal mesodermal tissues.
 B. It cannot organize the host and donor tissues into a secondary embryo.
 C. It does not have the ability to self-differentiate into dorsal mesoderm
 D. It has ability to initiate the movements of gastrulation.
 E. Both β -catenin and Chordin are produced by the organizer

Which of the above statements are correct?

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

97. Driesch performed famous “pressure plate” experiments involving intricate recombination with 8-celled Sea urchin embryo. This procedure reshuffled the nuclei that normally would have been in the region destined to form endoderm into the presumptive ectoderm region. If segregation of nuclear determinants had occurred, resulting embryo should have been disordered. However, Driesch obtained normal larvae from these embryos possible interpretations regarding the 8-celled sea urchin embryo are:

- A. The prospective potency of an isolated blastomere is greater than its actual prospective fate
 B. The prospective potency and prospective fate of blastomere were identical
 C. Sea-urchin embryo is a “harmoniously equipotential system” because all of its potentially independent parts interacted together to form single embryo.
 D. Regulative development occurs where location of a cell in the embryo determines its fate.

Which of the interpretation(s) is/are true?

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

98. Consider the following events which occur during fertilization of sea urchin eggs.

- A. Resact/Speract are peptides released from the egg jelly and help in sperm attraction.
 B. Bindin, an acrosomal protein interacts in a species specific manner, with eggs.
 C. A “respiratory burst” occurs during cross-linking of the fertilization envelope, where a calcium-dependent increase in oxygen level is observed.
 D. IP3, which is formed at site of sperm entry, sequesters calcium leading to cortical granule exocytosis.

Which of the above statement(s) is NOT true?

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

Both C and D statements are FALSE.

99. Following statement were given regarding decisions taken during development of mammalian embryos

- A. Pluripotency of inner cell mass is maintain by a core of three transcription factors, Oct 4, Sox 2 and nanog.
 B. Prior to blastocyst formation each blastomere expresses both Cdx 2 and the Oct 4 transcription factors and appears to be capable of becoming either ICM or trophoblast .
 C. Both ICM and trophoblast cells synthesize transcription factors Cdx 2.
 D. Oct4 activates Cdx2 expression enabling some cells to become trophoblast and other cells to become ICM.

Which of the above statement are true?

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

100. Apoptosis during early development is essential for proper formation of different structures. In *C. elegans*, apoptosis is accentuated by *ced-3* and *ced-4* genes, which in turn are negatively regulated by *ced-9* and eventually *Egl-1*. When compared to mammals, functionally similar homolog has been identified. Accordingly, which one of the following statements is NOT correct?

- (a) CED-4 resembles Apaf-1 (b) CED-9 resembles Bcl-XL
 (c) CED-3 resembles caspase-3 (d) CED-4 resembles caspase-9

101. Individual and overlapping expression of homoeotic genes in adjacent whorls of a flower determine the pattern of floral organ development. In an *Arabidopsis* mutant, floral organs are distributed as follows:

Whorl 1 (outer most) – carpel

Whorl 2 – stamens

Whorl 3 - stamens

Whorl 4 (inner most) – carpel

Loss of function mutation in which one of the following genes would have caused the above pattern of floral organ development?

- (a) APETALA 2 (b) APETALA 3 (c) PISTILLATA (d) AGAMOUS

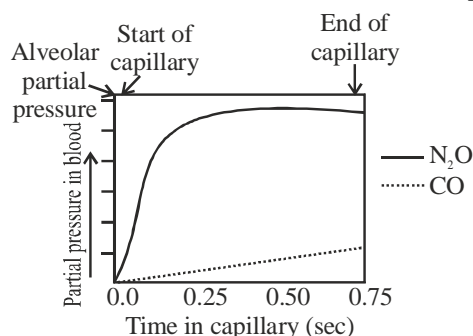
- 102.** In photosynthetic electron transport, electrons travel through carriers organized in the “Z-scheme”. The following are indicated as directions of electron flow :
- $P680 \rightarrow PQ_A \rightarrow PQ_B \rightarrow Cytb_6 \rightarrow Pheo \rightarrow PC \rightarrow P700$
 - $P700 \rightarrow A_0 \rightarrow A_1 \rightarrow FeS_x \rightarrow FeS_A \rightarrow FeS_B \rightarrow Fd$
 - $P680 \rightarrow Pheo \rightarrow PQ_A \rightarrow PQ_B \rightarrow Cytb_6 \rightarrow PC \rightarrow P700$
 - $P700 \rightarrow A_1 \rightarrow A_0 \rightarrow FeS_B \rightarrow FeS_A \rightarrow FeS_x \rightarrow Fd$
- Which one of the following combinations is correct ?
- (a) A and B (b) B and C (c) C and D (d) A and D
- 103.** Phytochrome-mediated control of photomorphogenesis is linked to many other gene functions. The following statements are made on the mechanism of phytochrome action :
- Phytochrome function requires COP1, an E3 ubiquitin ligase that brings about protein degradation
 - COP1 is slowly exported from the nucleus to the cytoplasm in the presence of light
 - HY5 is targeted by COP1 for degradation in the presence of light
 - HY5 is a transcription factor involved in photomorphogenetic response
- Which one of the following combinations is correct?
- (a) A, B and C (b) B, C and D (c) A, B and D (d) A, C and D
- 104.** The C_4 carbon cycle is a CO_2 concentrating mechanism evolved to reduce photorespiration. The following are stated as important features of the C_4 Pathway :
- The leaves of C_4 plants have Kranz anatomy that distinguishes mesophyll and bundle sheath cells.
 - In the peripheral mesophyll cells, atmospheric CO_2 is fixed by phosphoenol pyruvate carboxylase yielding a four-carbon acid.
 - In the inner layer of mesophyll, NAD-malic enzyme decarboxylates four-carbon acid and releases CO_2
 - CO_2 is again re-fixed through Calvin cycle in the bundle sheath cells.
- Which one of the following combinations is correct?
- (a) B, C and D (b) A, B and C (c) A, B and D (d) A, C and D
- 105.** Read the following statements related to plant-pathogen interaction
- Systemic acquired resistance is observed following infection by compatible pathogen.
 - Induced systemic resistance is activated following infection by compatible pathogen.
 - A bacterial infection can induce effector triggered immunity (ETI) leading to hypersensitive response locally.
 - NPR1 monomers that are released in cytosol due to salicylic acid accumulation is rapidly translocated to nucleus.
- Which combination of above statements is correct ?
- (a) A, B and C (b) A, C and D (c) A, B and D (d) B, C and D
- 106.** Given below are statements describing various features of solute transport and photoassimilate translocation in plants.
- Apoplasmic phloem loading of sucrose happens between cells with no plasmodesmatal connections.
 - Growing vegetative sinks (e.g., young leaves and roots) usually undergo symplasmic phloem unloading.
 - Movement of water between the phloem and xylem occurs only at the source and sink regions.
 - Symplasmic loading of sugars into the phloem occurs in the absence of plasmodesmatal connection.
- Select the option that given a combination of correct statements :
- (a) Only A and C (b) Only B and C (c) Only B and D (d) Only A and B

107. Given below are names of phytohormones in column I and their associated features/effects/functions in column II.

	Column I		Column II
A	Auxin	i	Delayed leaf senescence
B	Gibberellins	ii	Epinastic bending of leaves
C	Cytokinin	iii	Polar transport
D	Ethylene	iv	Removal of seed dormancy

Select the correct set of combinations from the options given below :

- (a) A - (iii), B - (ii), C - (iv), D - (i) (b) A - (iv), B - (iii), C - (i), D - (ii)
 (c) A - (iii), B - (iv), C - (i), D - (ii) (d) A - (i), B - (iv), C - (iii), D - (ii)
108. If in a blood transfusion, type A donor blood is given to a recipient having type B blood, the red blood cells (RBCs) of donor blood would agglutinate but the recipient's RBCs would be least affected. These observations can be explained in the following statements :
- A. Agglutinins in recipient's plasma caused agglutination by binding with type A agglutinogens.
 B. The agglutinins of donor blood was diluted in recipient's plasma resulting in low agglutination.
 C. Low titre of anti-A agglutinins is the cause of low agglutination of recipient's RBCs.
 D. High agglutination of donor RBCs is the outcome of high titre of anti-B agglutinins.
- Which of the above statement(s) is/are INCORRECT?
- (a) Only A (b) A and B (c) Only B (d) C and D
109. The arterial pressure usually rises and falls 4 to 6 mm Hg in a wave like manner causing "respiratory waves". The probable mechanism of these waves has been proposed in the following statements :
- A. The more negative intrathoracic pressure during inspiration reduces the quantity of blood returning to the left side of the heart causing decreased cardiac output.
 B. The changes of intrathoracic pressure during respiration can excite vascular and atrial stretch receptors which affect heart and blood vessels.
 C. The activity of medullary respiratory centres can influence the vasomotor centre.
 D. The "respiratory waves" are outcome of the oscillation of the central nervous system ischemic pressure control mechanism.
- Which of the above statement(s) is/are NOT appropriate?
- (a) Only A (b) A and B (c) B and C (d) Only D
110. The uptake of nitrous oxide (N_2O) and carbon monoxide (CO) in the blood of lung alveolar capillary relative to their partial pressure and the transit time of red blood cell in capillary is shown in the figure below:



The reasons for difference in the pattern of alveolar gas exchange of N_2O and CO have been proposed in the following statements :

- A. N_2O does not chemically combine with proteins in blood but equilibrate rapidly between alveolar gas and blood.
 B. CO has high solubility in blood.
 C. CO has high solubility in the alveolar capillary membrane.
 D. The dispersion of N_2O between alveolar gas and blood is considered as diffusion limited.

Which of the above statement(s) is/are INCORRECT?

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

- 111.** External pressure given on a mixed nerve causes loss of touch sensation while pain sensation remains relatively intact. On the other hand application of local anesthetics on the same nerve, induces loss of pain sensation keeping touch sensation least affected. These observations can be explained by the following statements :

- A. External pressure causes loss of conduction of impulses in small diameter sensory nerve fibres.
 B. Local anaesthetics depress the conduction of impulses in large diameter sensory nerve fibres.
 C. Touch-induced impulses are carried by fibre type A.
 D. Fibre type C is responsible for pain sensation.

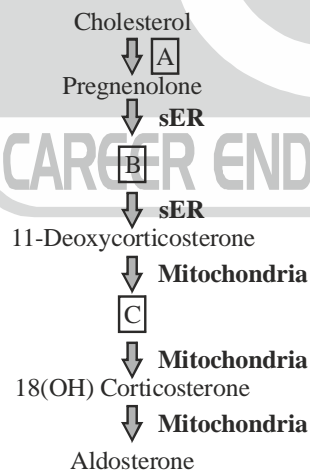
Which of the above statement(s) is/are INCORRECT?

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

- 112.** The probable effects of lesion of left optic tract on the vision of a human subject are given below. Identify the correct statements.

- (a) Blindness in the left eye but the visual field of right remains intact.
 (b) Blindness in the right half of the visual fields of both the eyes.
 (c) Blindness in the left half of the visual field of left eye and blindness in the right half of the visual field of right eye.
 (d) Blindness in the left half of the visual field of both the eyes.

- 113.** The following diagram represents steroidogenic pathway in the Zona Glomerulosa of the adrenal cortex :



What do A, B and C represent, respectively?

- (a) sER, Progesterone, 11(OH) cortisol (b) Mitochondria, Progesterone, Corticosterone
 (c) Mitochondria, 3β -pregnenolone, 11(OH) cortisol (d) sER, Progesterone, Corticosterone

- 114.** Inversions are considered as cross-over suppressors because

- (a) Homozygous inversion are lethal and thus they do not appear in next generation
 (b) Inversion heterozygotes, i.e., one copy having normal chromosome and its homologue having inversion, does not allow crossing over to occur as they cannot pair at all

(c) Due to inversion present, four chromosomes take part in the pairing and crossing over events and make the structure difficult for separation and gamete formation

(d) The pairing and crossing covers do occur in inversion heterozygotes but the gametes having cross over products are lethal

115. A pair of alleles govern seed size in a crop plant. 'B' allele responsible for bold seed is dominant over 'b' allele controlling small seed. An experiment was carried out to test if an identified dominant DNA marker (5kb band) is linked to alleles controlling seed size. A plant heterozygous for the marker and the alleles was crossed to a small seeded plant lacking the 5kb band. 100 progeny obtained from the cross were analysed for the presence and absence of the DNA marker. The results are tabulated below :

Phenotype	Plant with bold seed		Plant with small seed	
	Present	Absent	Present	Absent
No. of progeny showing presence or absence of DNA marker	22	23	27	28

Based on the above observations which one of the following conclusions is correct ?

- (a) The DNA marker assort independently of the phenotype
 (b) The 5 kb band is linked to the allele 'B'
 (c) The 5 kb band is linked to the allele 'b'
 (d) The DNA marker assort independently with bold seed but is linked to the small seed trait
116. Three met *E.coli* mutant strains were isolated. To study the nature of mutation these mutant strains were treated with mutagens EMS or proflavine and scored for revertants. The results obtained are summarized below :

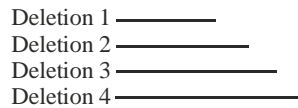
Mutant strain	Mutagen treatment	
	EMS	Proflavin
A	-	+
B	+	-
C	-	-

(+ stands for revertants of the original mutants and - stands for no revertants obtained)

Based on the above and the typical mutagenic effects of EMS and proflavin, what was the nature of the original mutation in each strain?

- (a) A - Transersion
 B - Insertion or deletion of a single base
 C - Deletion of multiple bases
- (b) A - Transition
 B - Transversion
 C - Insertion or deletion of a single base
- (c) A - Insertion or deletion of a single base
 B - Transition
 C - Deletion of multiple bases
- (d) A - Transition
 B - Insertion or deletion of multiple bases
 C - Transversion

117. The following scheme represents deletions (1 - 4) in the *rII* locus of phage T4 from a common reference point :



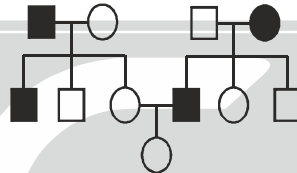
(The bars represent the extent of deletion in each case)

Four point mutations (a to d) are tested against four deletions for ability (+) or inability (-) to give wild type (*rII⁺*) recombinants. The results are summarized below :

	a	b	c	d
1	+	+	+	+
2	+	+	+	-
3	+	-	+	-
4	-	-	+	-

Based on the above the predicted order of the point mutations is

- (a) b - d - a - c (b) d - b - a - c (c) d - b - c - a (d) c - d - a - b
118. The following pedigree shows the inheritance pattern of a trait.



From the following select the possible mode of inheritance and the probability that the daughter in generation III will show the trait.

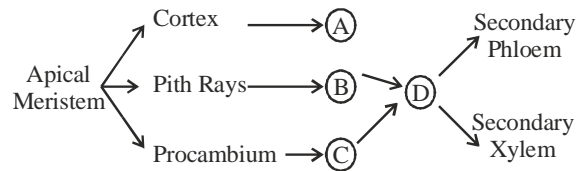
- (a) X-linked recessive, probability is 1/2 (b) X-linked recessive, probability is 1/4
 (c) Autosomal recessive, probability is 1/2 (d) Autosomal recessive, probability is 1/3
119. Interrupted mating experiments were performed using three different *Hfr* strains (1 - 3). The three strains have different combinations of selectable markers. The time of entry for markers for each strain is shown in the table below :

Strain	Time of entry				
	<i>met</i> (5')	<i>thr</i> (17')	<i>str^r</i> (25')	<i>phe</i> (30')	<i>pro</i> (45')
<i>Hfr</i> #1	<i>met</i> (5')	<i>thr</i> (17')	<i>str^r</i> (25')	<i>phe</i> (30')	<i>pro</i> (45')
<i>Hfr</i> #2	<i>str^r</i> (15')	<i>pur</i> (28')	<i>pro</i> (35')	<i>his</i> (45')	<i>met</i> (55')
<i>Hfr</i> #3	<i>pro</i> (2')	<i>his</i> (12')	<i>met</i> (22')	<i>str^r</i> (42')	<i>phe</i> (47')

Using the above data, predict the correct sequence of markers on the *E. coli* chromosome.

- (a) *met-thr-str^r-phe-pro-pur^r-his* (b) *pur^r-pro-his-met-thr-str^r-phe*
 (c) *str^r-pur^r-his-met-phe-pro-str^r* (d) *his-met-phe-thr-pro-str^r-pur^r*
120. Peripatus is an interesting living animal having unjointed legs, nephridia, haemocoel, trachea, dorsal tubular heart, claws, jaws, continuous muscle layers in body wall. This is considered as a connecting link between
- (a) Nematoda and Annelida: continuous muscle layers in body wall, unjointed legs and nephridia being nematode characters while haemocoel, trachea and dorsal tubular heart being annelid characters
 (b) Annelida and Arthropoda: unjointed legs and nephridia being annelid characters while claws, jaws, haemocoel, trachea and dorsal tubular heart being arthropod characters
 (c) Arthropoda and Mollusca: unjointed legs and nephridia being mollusca characters while claws, jaws, trachea and dorsal tubular heart being arthropod characters
 (d) Nematoda and Arthropoda: continuous muscle layers, unjointed legs and nephridia being nematode characters while claws, jaws, trachea and dorsal tubular heart being arthropod characters.

121. The following schematic diagram represents secondary growth in the angiosperms.



Based on the above scheme, which of the following options represents the correct identify of cambia labelled as A, B, C and D.

- (a) A - Inter-fascicular, B - Fascicular, C - Vascular, D - Cork
 (b) A - Fascicular, B - Inter-fascicular, C - Vascular, D - Cork
 (c) A - Cork, B - Inter-fascicular, C - Fascicular, D - Vascular
 (d) A - Cork, B - Fascicular, C - Fascicular, D - Vascular
122. The table below lists the major fungal groups and their characteristics :

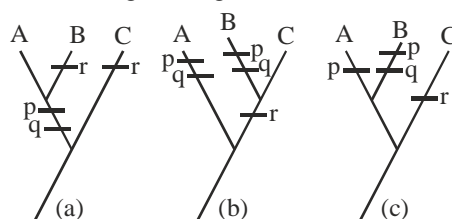
Fungal Groups		Characteristics	
A	Ascomycota	I	Hyphae aseptate, coenocytic; asexual reproduction by sporangioophores
B	Chytrids	II	Hyphae aseptate, coenocytic; asexual reproduction by zoospores
C	Glomeromycetes	III	Hyphae aseptate, coenocytic, no sexual spores
D	Zygomycetes	IV	Hyphae septate or unicellular; asexual reproduction by conidia

Which one of the following options represents the appropriate match between the fungal group and their characteristics ?

- (a) A - (ii), B - (iii), C - (i), D - (iv) (b) A - (iv), B - (ii), C - (iii), D - (i)
 (c) A - (i), B - (iv), C - (iii), D - (ii) (d) A - (ii), B - (iv), C - (iii), D - (i)
123. As a biologist, you want to classify three taxa, A, B and C. You have the information on three traits, p, q and r. The trait that is ancestral is counted '0' and the trait that is derived is counted as '1'. The distribution of traits found in three taxa is given below :

	A	B	C
p	1	1	0
q	1	1	0
r	0	1	1

Based on the above table, the following cladograms were drawn :



Based on the trait distribution and principle of parsimony, select the correct option.

- (a) Both 'a' and 'b' cladograms are possible (b) Only 'b' cladogram is possible
(c) Only 'c' cladogram is possible (d) Only 'a' cladogram is possible

124. Given below are some pathogens and diseases of humans, animals and plants.

A	Bordetella pertussis	I	Lyme disease of humans
B	Tilletia indica	II	Grain rot in rice
C	Borrelia burgdorferi	III	Karnal bunt of wheat
D	Anaplasma marginale	IV	Whooping cough in humans
E	Burkholderia glumae	V	Hemolytic anemia in cattle

Which one of the following is the correct match between the pathogen and disease caused?

- (a) A - (iv), B - (iii), C - (i), D - (v), E - (ii) (b) A - (iv), B - (v), C - (i), D - (ii), E - (iii)
(c) A - (iii), B - (iv), C - (v), D - (i), E - (ii) (d) A - (ii), B - (v), C - (i), D - (iii), E - (iv)

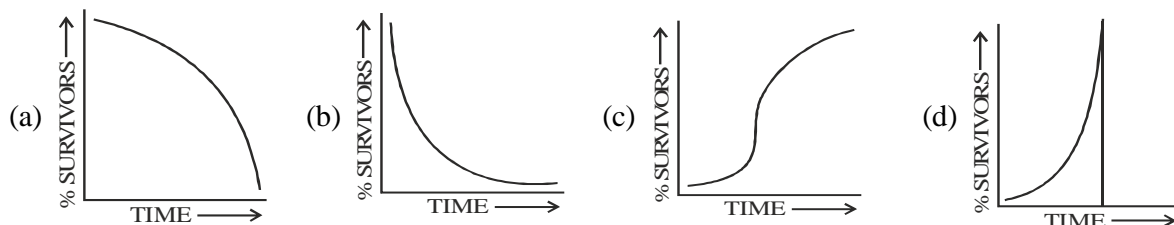
125. Given below are statements pertaining to organisms belonging to three domains of life. Identify the INCORRECT statements.

- (a) Unlike Bacteria and Eukarya, some Archaeal membrane lipids contain long chain hydrocarbons connected to glycerol molecules by either linkage.
(b) Peptidoglycans are absent in the cell wall of Archaea.
(c) Proteobacteria include many species of bacteriochlorophyll-containing, sulphur using photoautotrophs.
(d) Mycoplasma, a group of low GC content, gram positive bacterial that lack cell wall, belong to the same family as the gram positive Mycobacteriascace.

126. You observed that two species of barnacles, species 1 and species 2, occupy upper and lower strata of intertidal rocks, respectively. Only when species 2 was removed by you from the lower strata, species 1 could occupy both the upper and lower strata. From the choices given below, what would be your inference from these observations ?

- (a) Upper strata of the intertidal rock is the realized niche of species 1
(b) Upper strata of the intertidal rock is the fundamental niche of species 1
(c) Species 1 and species 2 exhibit mutualism
(d) Species 1 can compete out species 2

127. In a natural system, a species producing large numbers of offsprings, with little or no parental care, generally exhibits which one of the following kind of survivorship curves ?



128. Match the correct local names of temperate grasslands with their geographical range.

Geographical range		Local name of the grassland	
(I)	Asia	A	Pampas
(II)	North America	B	Prairies
(III)	South America	C	Steppes
(IV)	South Africa	D	Veldt

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

129. Following is a hypothetical life table for a species.

Age class (x)	Number alive (n_x)	Number dying (d_x)	Age specific survivorship (l_x)	Age specific fertility (m_x)
0-5	100	50		0.0
5-10	500		0.5	0.5
10-15		10		0.5
15-20	20	10	0.2	1.0
20-25		10		1.0

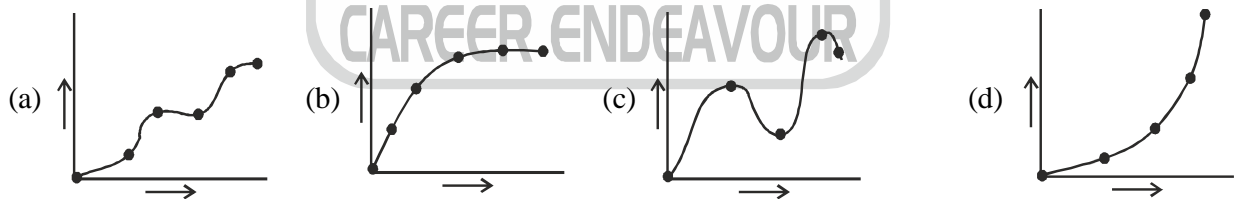
Which one of the following is the correct net reproductive rate (R_0)

- (a) 0.0 (b) 0.3 (c) 0.7 (d) 1.5

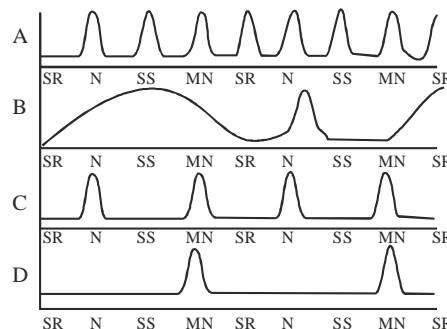
130. Which one of the following statements is true for the trends of Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) in a water stream receiving pollutants from a point source ?

- (a) In septic zone, both DO and BOD levels remain stationary
 (b) In recovery zone, both DO and BOD levels increase rapidly
 (c) In decomposition zone, DO level drops rapidly, whereas BOD level remains more or less stable
 (d) In septic zone, DO level decreases and BOD level increases whereas in recovery zone DO increases and BOD decreases

131. Following are the graphical representations of various hypotheses proposed for explaining the possible relationships between species richness (X-axis) and community services (Y-axis).



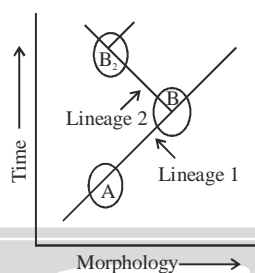
132. Following are the plots representing biological rhythms at different time points depicted as: SR = Sunrise; N = Noon; SS = Sunset; MN = Midnight



Which of the plot(s) represent the ultradian biological rhythm(s) ?

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

133. A population of non-poisonous butterflies have the same colour pattern as some highly poisonous butterflies. Assume that the population of non-poisonous butterflies is higher than the population of poisonous butterflies. Given this, what will be impact of this mimicry on the fitness of the population of the poisonous butterflies in the presence of the predator ?
- It will lower the fitness, that is, fitness of the mimic is negatively frequency-dependent
 - It will increase the fitness, that is, fitness of the mimic is positively frequency-dependent
 - It will not affect the fitness, that is, fitness of the mimic is frequency independent
 - It will increase the fitness, that is, fitness of the mimic is negatively frequency-dependent
134. Given below is a graphical representation of changes in morphological features over a period of geological time scale, where population A accumulates heritable morphological changes and give rise to a distinct species B. Population B splits into a distinct species B₂.



Which of the above lineages represent the pattern of speciation by cladogenesis?

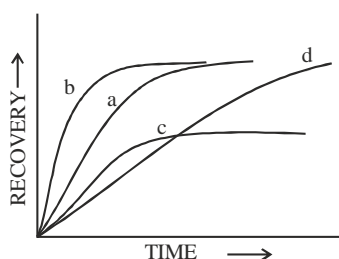
- Lineage 1
 - Both the lineages 1 and 2
 - Lineage 2
 - Neither of the lineages 1 and 2
135. Red hair is a recessive trait in humans. In a randomly mating population in Hardy-Weinberg equilibrium, approximately 9% of individuals are red-haired. What is the frequency of heterozygotes?
- 81%
 - 49%
 - 42%
 - 18%
136. The frequency of M-N blood types in a population of 6129 individuals is as follows : (NET_Dec_2016)

Blood type	Genotype	Number of individuals
M	$L^M L^M$	1787
MN	$L^M L^N$	3039
N	$L^N L^N$	1303

The frequency of LN allele in this population is

- 0.4605
 - 0.2121
 - 0.5395
 - 0.2911
137. *Mayfair genes* (hypothetical) consist of a super family of transcription factors. They are found in 4 clusters in mammals; in 2 clusters in insects; and in a single cluster in an ancestor to insects. These data are consistent with all of the following explanations **EXCEPT**:
- Two successive genome duplication events occurred between ancestral organism and vertebrates
 - The first duplication may have taken place before divergence of vertebrates
 - Exon shuffling exclusively produced such cluster
 - Whole genome duplications could lead to such observations
138. Fluorescence recovery after photobleaching (FRAP) is a method to estimate the diffusion of molecules in a membrane. Fluorescently labelled molecules such as
- a receptor tagged with green fluorescent protein (GFP).
 - a receptor labelled with GFP which interacts with cytoskeleton.
 - a labelled lipid.
 - a labelled protein that binds to the membrane surface

are photobleached and the recovery profiles (a - d) were obtained to estimate their diffusion coefficients. The following data were obtained :



Which one of the combinations is correct?

- (a) a = i; b = ii (b) b = iii; a = iv (c) c = iii; d = iv (d) d = ii; b = i

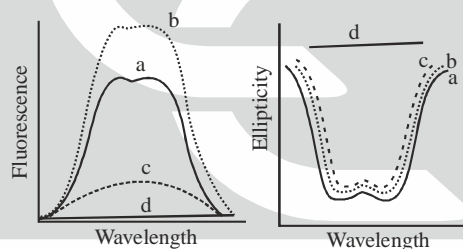
139. *Agrobacterium* Ti plasmid vectors are used to generate transgenic plants. The following are examples of *vir* gene-encoded proteins that are important for the transfer of T-DNA into plants:

- A. Vir E, a single-stranded DNA binding protein.
 B. Vir D2 that generates T-strands.
 C. Vir A that senses plant phenolic compounds.
 D. Vir F which directs T-complex proteins for destruction in proteasomes.

Which one of the following combinations of proteins functions inside the plant cells?

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

140. A researcher is investigating structural changes in a protein by following tryptophan fluorescence and by circular dichroism (CD). Fluorescence and CD spectra of a pure protein were obtained in the absence of any treatment (a), in the presence of 0.5 M Urea (b), upon adding acrylamide, a denaturant of tryptophan (c) and upon heating (d). The data are shown below :



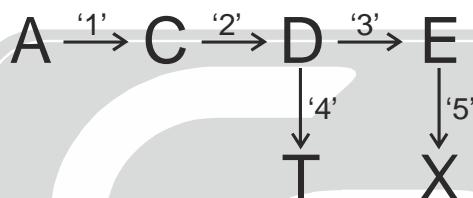
Which one of the following statement is correct ?

- (a) CD is more sensitive to structural changes than fluorescence
 (b) Fluorescence is more sensitive to structural changes than CD
 (c) Both methods are equally responsive to structural changes
 (d) Acrylamide alters the secondary structure of the protein

141. Polynucleotide kinase (PNK) is frequently used for radiolabeling DNA or RNA by phosphorylating 5'-end of non-phosphorylated polynucleotide chains. Which of the following statement about PNK is NOT true?

- (a) PNK catalyzes the transfer of α -phosphate from ATP to 5'-end of polynucleotide chains (DNA or RNA)
 (b) PNK has 3'-phosphatase activity
 (c) PNK is inhibited by small amount of ammonium ions
 (d) PNK is a T4 bacteriophage-encoded enzyme

142. A gene concluding for protein X was cloned in an expression vector under the T7 RNA polymerase promoter and *lac* operator. Cells were induced by the addition of 1 mM IPTG at 37°C for 6 h. Cells were lysed and fractionated into insoluble bodies and cell-free supernatant by centrifugation. Protein X is present in the insoluble bodies. Which one of the following strategies would you use to express protein X in the soluble fraction (cell-free supernatant)?
- Increase the duration of induction with 1mM IPTG
 - Grow cell at lower temperature after induction with 1 mM IPTG
 - Increase the concentration of IPTG
 - Grow cells at higher temperature after induction with 1 mM IPTG
143. Engineering of metabolic pathways in plants can be achieved by introduction and over expression of appropriate candidate gene(s) using transgenic technology. The figure given below represents a biochemical pathway in plants where a precursor molecule 'A' is converted into products 'T' and 'X' through a series of enzymatic reactions. Enzymes 1-5 are involved in this pathway. Scientists attempted to increase the level of 'X' by introducing an additional copy of the gene for enzyme '5' under transcriptional control of a strong constitutive promoter. However, the developed transgenic plants did not display a proportionate increase in the level of 'X'.



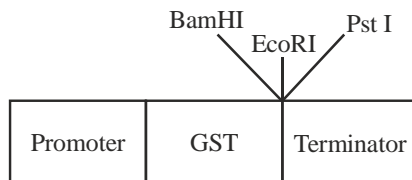
The following statements were proposed for explaining the above results:

- Enzyme '4' has greater affinity for D than enzyme '3'.
- Feedback inhibition of enzyme '5' by compound X.
- Substrate limitation for enzyme '5'.

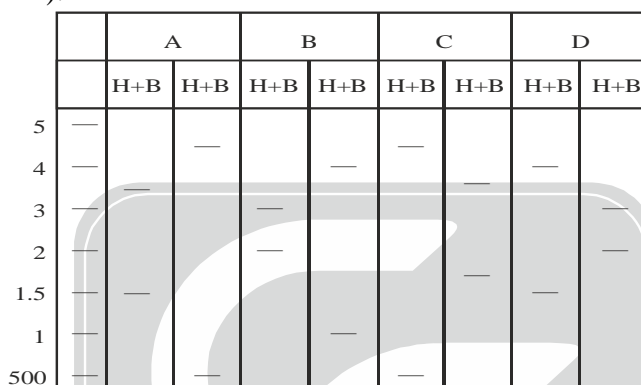
Which of the above statements could represent probable reasons for NOT obtaining a proportionate increase in the amount of X in the transgenic plants?

- Only C
 - Only A and B
 - Only A
 - A, B and C
144. A single copy homozygous transgenic plant containing the transgene 'A' for fungal resistance was subsequently re-transformed with another gene 'B' for conferring resistance to salt-stress. The selection marker genes used for both the transformation experiments were different. Transgenic plants obtained following the re-transformation experiment were screened for salt-stress resistance and single copy events were identified by Southern hybridization. These single copy events were self-pollinated. In the event of the two T-DNAs (containing the A and B transgenes) getting integrated in unlinked locations in all the transgenic plants, the phenotypic ratios among the T_1 progeny would be :
- 3 (Fungal resistant + Salt-stress resistant) : 1 (fungal resistant)
 - 1 (Fungal resistant): 2 (Fungal resistant + Salt-stress resistant): 1 (Salt-stress resistant)
 - 3 (Salt-stress resistant) : 1 (Fungal resistant)
 - 1 (Fungal resistant) : 1 (Salt-stress resistant) : 1 (Fungal resistant + Salt stress resistant)

145. You are inserting a gene of 2kb length into a vector of 3kb make a GST fusion protein. The gene is being inserted at the EcoRI site and the insert has a HindIII site 500bp downstream of the first codon. You are screening for the clone with the correct orientation by restriction digestion of the plasmid using HindIII plus BamHI (H + B) and HindIII plus PstI (H + P). The map of the relevant region of the vector is shown below:



Given below is the pattern following restriction digestion of plasmid isolated from four independent clones (A, B, C or D).



Which of the plasmids shown above represents the clone in the correct orientation?

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

==== end =====