

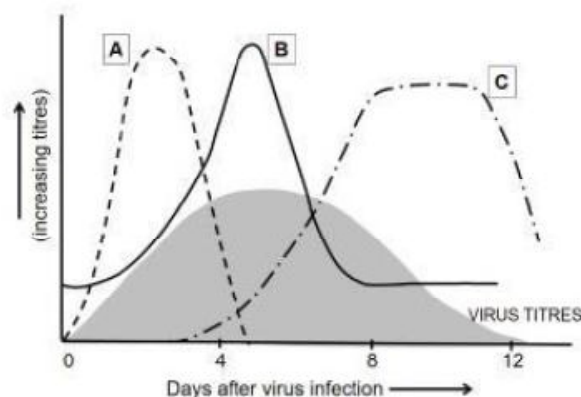
**QUESTION PAPER**  
**CSIR NET LIFE SCIENCES**

**Nov-2020 Shift-II**

**SECTION-B**

21. A plot with which one of the following axes is drawn to exhibit enzyme inhibition kinetics applying Dixon's plot?
- (a)  $V_i$  vs  $[I]$                       (b)  $\frac{1}{V_i}$  vs  $\frac{1}{[I]}$                       (c)  $\frac{1}{V_i}$  vs  $[I]$                       (d)  $V_i$  vs  $\frac{1}{[I]}$
22. Which one of the following enzymes present in erythrocytes helps bypass the first step of ATP formation in glycolysis?
- (a) Bisphosphoglycerate mutase                      (b) Phosphoglycerate kinase  
(c) Glyceraldehyde 3-phosphate dehydrogenase                      (d) Phosphofructose mutase
23. If the pyrrolidine ring of proline is reduced to a linear form, the new amino acid will have
- (a) constrained  $\phi$  than proline                      (b) constrained  $\psi$  than proline  
(c) relaxed  $\phi$  than proline                      (d) unaffected  $\phi$  and  $\psi$
24. The following table lists names of scientists and advances made by them
- | <b>Column-A</b>       | <b>Column-B</b>                      |
|-----------------------|--------------------------------------|
| A. Linus Pauling      | (i) Myoglobin structure              |
| B. Emil Fischer       | (ii) Model of $\alpha$ -helix        |
| C. John Kendrew       | (iii) Lock and Key model             |
| D. Christian Anfinsen | (iv) Sequence-structure relationship |
- Which one of the following options correctly matches contents of Column-A with Column-B?
- (a) A-(iii), B-(iv), C-(ii), D-(i)                      (b) A-(ii), B-(iii), C-(i), D-(iv)  
(c) A-(ii), B-(i), C-(iii), D-(iv)                      (d) A-(i), B-(iii), C-(ii), D-(iv)
25. Electron transfer from donors such as NADH and  $FADH_2$  to  $O_2$  occurs in
- (a) membranes of ER, chloroplast and mitochondria  
(b) chloroplast only  
(c) mitochondria only  
(d) organellar membranes which possess ATP synthase
26. Genome of an organism was analysed by Cot curve analysis. Highly repeated sequences represented 30% of the total genome fraction. The Cot value of the highly repeated sequence was found to be 0.001 moles nucleotide liter<sup>-1</sup>. What would be the actual Cot value (in moles nucleotide liter<sup>-1</sup>) of the highly repeated sequence?
- (a) 0.003                      (b) 0.001                      (c) 0.0003                      (d) 0.007
27. Which one of the statements given below is INCORRECT?
- (a) The three common types of membrane lipids are cholesterol, phospholipids and glycolipids.  
(b) Phosphoglycerides carry a glycerol backbone, two fatty acid chains, and a phosphorylated alcohol.  
(c) Most phospholipids and glycolipids form bimolecular sheets rather than micelles in aqueous media.  
(d) The common alcohol moieties in phosphoglycerides are glycerol, inositol, choline, ethanolamine and tyrosine.

28. The translocation into which one of the organelles listed below DOES NOT depend on an amino acid sequence as a signal for import?  
 (a) Nucleus (b) Endoplasmic reticulum  
 (c) Lysosome (d) Peroxisome
29. In *Trypanosoma*, some of the introns generate Y shaped structure in place of a lariat. Such structure is generated during  
 (a) *cis*-splicing (b) *trans*-splicing (c) alternate splicing (d) RNA editing
30. Which one of the following ensures stable binding of RNA polymerase at the promoter site?  
 (a) DNA photolyase (b) Sigma factor (c) DNA glycosylase (d) RecA
31. Erythromycin is an inhibitor of protein synthesis. It acts by:  
 (a) binding to 30S subunit of bacterial ribosome, thus inhibiting binding of aminoacyl - tRNAs.  
 (b) binding to 50S subunit of bacterial ribosome, thus inhibiting translocation.  
 (c) inhibits peptidyl transferase activity of eukaryotic 60S ribosomal subunit.  
 (d) causes premature chain termination by acting as an analog of aminoacyl-tRNA in both prokaryotes and eukaryotes.
32. Which one of the following conditions will switch on Lac operon in *E.coli*?  
 (a) + Glucose, + Lactose (b) + Glucose, - Lactose  
 (c) - Glucose, - Lactose (d) - Glucose, + Lactose
33. The immunoglobulin heavy-chain that is rearranged first and is displayed on the surface of early stages of B-cell development is associated with:  
 (a) class-II associated invariant chain peptide (CLIP).  
 (b) a surrogate light chain.  
 (c)  $\beta_2$  - macroglobulin.  
 (d) immunoglobulin-like cell adhesion molecule.
34. Given below are plots that show changing titres of natural killer cells (NK cells), cytotoxic T-lymphocytes specific to the virus (virus-specific CTLs) and interferon  $\alpha / \beta$  during a virus infection.

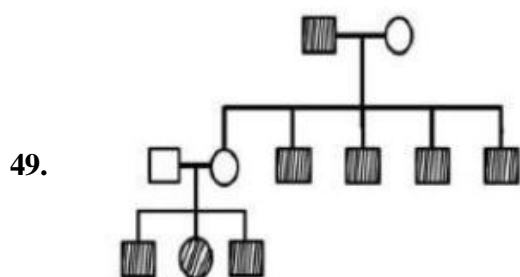


With respect to changing virus titers, select the plots that represent these factors correctly from the options given below.

- (a) A: Interferon; B: virus-specific CTLs; C: NK cells.  
 (b) A: NK cells; B: Interferon; C: virus-specific CTLs.  
 (c) A: Interferon; B: NK cells; C: virus-specific CTLs  
 (d) A: virus-specific CTLs; B: Interferon; C: NK cells.

35. Dr. Ralph M. Steinman was awarded Nobel Prize for his discovery on:  
(a) acquired immunological tolerance.  
(b) role of major histocompatibility complex in antigen recognition by T-cells  
(c) chemical structure of antibody  
(d) role of dendritic cells in adaptive immunity
36. Which one of the following systems forms a chemical mediator that is involved in the mechanism of pain during inflammation?  
(a) Activated blood clotting cascade (b) Plasmin - Fibrinolytic system  
(c) Kininogen - Bradykinin system (d) B-cell activation
37. Human polydactyly (joining of extra digits) syndrome results from a homozygous mutation at  
(a) antennapedia complex locus (b) one of the genes of Hox D  
(c) one of the genes of Hox C (d)  $\beta$ -catenin locus
38. Which one of the following statements regarding double fertilization in plants is correct?  
(a) The same sperm cell fuses with both egg cell and central cell  
(b) Two sperm cells fuse with the egg cell.  
(c) One sperm cell fuses with the egg cell and second with the central cell.  
(d) Two sperm cells fuse with the central cell.
39. Which one of the following statements regarding amphibian development is correct?  
(a) The Nieuwkoop centre is formed on the dorsal side of the embryo due to accumulation of  $\beta$ -catenin which helps activate the *siamois* and *twin* genes  
(b) The ectodermal cells form neural tissues in the presence of BMP molecules.  
(c) Brain formation requires the activation of both Wnt and BMP pathway.  
(d) There is a gradient of Nodal-related protein across the endoderm with low concentration on the dorsal side of the embryo
40. Sonic hedgehog (Shh) specifies the anterior-posterior axis during limb development. Which one of the following statements regarding it is correct?  
(a) Shh secreting cells undergo apoptosis after performing its function.  
(b) Descendants of Shh secreting cells become the bone and muscle of the anterior limb  
(c) When the genes for Shh and *Gli3* are conditionally knocked out in the mouse limb, the resulting limbs do not form any digit  
(d) Specification of the digit is primarily dependent on the amount of time the Shh gene is expressed and to a small extent on the concentration of the Shh protein that other cells receive.
41. Spermidine represents which of the following group of compounds:  
(a) jasmonic acid (b) polyamine (c) auxin (d) strigolactone
42. Suppression of VPE (Vascular Processing Enzymes) gene expression in *Nicotiana benthamiana* plants will NOT  
(a) abolish hypersensitive response  
(b) enhance TMV (Tobacco Mosaic Virus) infection  
(c) reduce caspase-like activity  
(d) reduce DNA fragmentation
43. In which one of the following subcellular organelles is serine synthesized during the oxidative photosynthetic carbon ( $C_2$ ) pathway?  
(a) Chloroplast (b) Mitochondria  
(c) Peroxisome (d) Rough endoplasmic reticulum
44. Artemisinin and Dhurrin belong to which two respective groups of the plant natural compounds?  
(a) Alkaloids and Terpenes (b) Flavonoids and Alkaloids  
(c) Cynogenic glycosides and Flavonoids (d) Terpenes and Cynogenic glycosides

45. Receptor for which one of the following proteins spans the plasma membrane of target cells but DOES NOT contain intrinsic protein kinase activity?  
 (a) Epidermal growth factor (b) Insulin  
 (c) Insulin like growth factor (d) Growth hormone
46. In both males and females, the gonads secrete a polypeptide hormone, called inhibin B, which inhibits  
 (a) luteinizing hormone (b) follicle-stimulating hormone  
 (c) prolactin (d) thyroid-stimulating hormone
47. Which one of the following routes is responsible for maximum amount of body heat loss in humans at an ambient temperature of 21°C?  
 (a) Radiation and conduction (b) Respiration  
 (c) Urination and defecation (d) Vaporization of sweat
48. Which one of the following is NOT released by sympathetic preganglionic neurons?  
 (a) Neurotensin (b) Enkephalin (c) Serotonin (d) Substance P



The trait shown in the above pedigree is

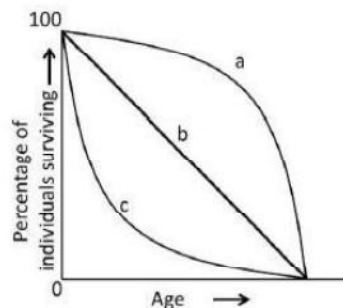
- (a) X-linked recessive trait (b) autosomal recessive trait  
 (c) Y-linked trait (d) X-linked dominant trait
50. A plant that produces disc-shaped fruit is crossed with another plant that produces long fruit. All the  $F_1$  plants gave disc-shaped fruits. When the  $F_1$  were intercrossed,  $F_2$  progeny were produced in the following ratio: 9/16 plants with disc-shaped fruits: 6/16 plants with spherical fruits and 1/16 plants having long fruits. Which one of the following options gives correct genotype of spherical fruits obtained in  $F_2$ ?  
 (a)  $A\_bb$  only (b)  $aaB\_$  only (c)  $A\_bb$  and  $aaB\_$  (d)  $A\_B\_$  and  $aabb$
51. The maximum frequency of recombination that can occur between two loci is  
 (a) 25% (b) 50% (c) 75% (d) 100%
52. A panel of six hybrid cell lines, each containing a different subset of human chromosomes, was examined for the presence of the gene product as shown below:

| Cell line | Gene product present | Human chromosomes present |   |   |   |   |   |   |   |   |    |
|-----------|----------------------|---------------------------|---|---|---|---|---|---|---|---|----|
|           |                      | 1                         | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A         | +                    | +                         | + | + | + | - | - | - | - | - | -  |
| B         | +                    | -                         | - | + | + | + | + | + | - | - | -  |
| C         | -                    | -                         | + | + | - | - | - | - | + | + | +  |
| D         | -                    | -                         | + | - | - | - | + | + | + | + | -  |
| E         | -                    | -                         | + | - | - | - | + | - | - | - | -  |
| F         | +                    | +                         | + | - | + | + | + | - | - | - | -  |

The gene which codes for the given gene product is located on which chromosome?

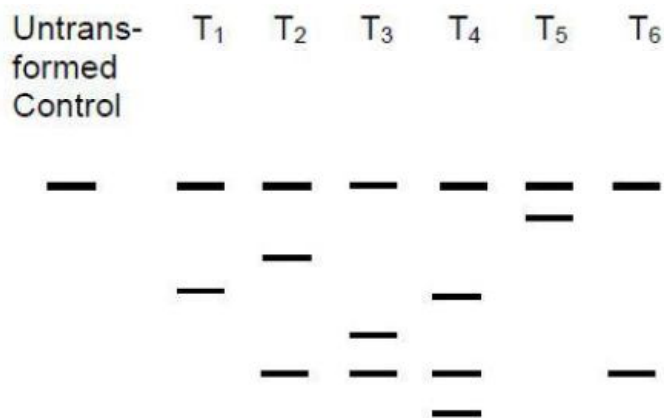
- (a) Chromosomes 3, 4 or 5 (b) Chromosome 3  
(c) Chromosome 3 or 4 (d) Chromosome 4

53. A gene was located on 10p11. This means the gene was located on the  
(a) short arm of chromosome 10 at G-sub band 1 of band 1  
(b) short arm of chromosome 10 at G-band 11  
(c) short arm of chromosome 10 much away from the centromere  
(d) long arm of chromosome 10 at G-sub band 1 of band 1
54. Autogamy refers to  
(a) self-abortion of gametes (b) flower failing to open  
(c) self-pollination of flowers (d) cross-pollination of flowers
55. Which one of the following plant pathogens has largest genome size?  
(a) *Phytophthora infestans* (b) *Ustilago maydis*  
(c) *Botrytis cinerea* (d) *Fusarium graminearum*
56. The 50 km wide Palghat Gap is the only major topographic breach in the Western Ghats. This gap continues as the Ranotsara Gap in the Angavo escarpment. Which country is the Ranotsara Gap located in?  
(a) Sri Lanka (b) Madagascar (c) Mozambique (d) Kenya
57. A lectotype refers to  
(a) a specimen of the opposite sex to the holotype and designated from among paratypes.  
(b) an illustration based on which a new species is described.  
(c) a specimen later selected from a group of syntypes to serve as the type specimen for a species, after its original description was published.  
(d) a substitute specimen selected to serve as the type specimen of a species after its original description was published, when an original holotype has been lost or destroyed.
58. Given below are the survivorship curves showing the proportion of individuals surviving over time or age. Three generalised types of curves (a, b and c) are depicted below. Which of the following represent the correct survivorship curve for the given organisms?



- (a) a = Elephants; b = Lizards; c = Oysters (b) a = Oysters; b = Elephants; c = Lizards  
(c) a = Lizards; b = Oysters; c = Elephants (d) a = Oysters; b = Lizards; c = Elephants
59. According to Hamilton's rule, 'r' is the coefficient of relatedness between two interacting individuals, 'B' is the benefit to the recipient and 'C' is the cost to the donor. Which of the following relationships will result in an altruistic behaviour?  
(a)  $rB = C$  (b)  $rC - B = 0$  (c)  $r > C/B$  (d)  $rC - B > 0$
60. Which one of the following statements is correct with reference to ecotones?  
(a) Ecotones are rich in endemic species and only contain species not found in surrounding ecosystems.  
(b) Ecotones refer to areas that are under habitat degradation and contain endangered species that are not found in the neighbouring communities.  
(c) Ecotones are species poor habitats due to scarcity of soil nutrients and availability of resources.  
(d) Ecotones are transition areas between two ecosystems and have greater number of species than either of the neighbouring communities.

61. Two populations of squirrels evolved across two regions separated by a large geographic barrier. Over a long period of time these populations are reproductively and geographically isolated from each other. This is an example of  
 (a) sympatric speciation (b) allopatric speciation  
 (c) artificial speciation (d) anagenesis
62. The term “abominable mystery” was used by Darwin in the context of origin and diversification of  
 (a) angiosperms (b) microorganisms (c) beetles (d) birds
63. If bird song is selected to maximize broadcast range and to minimise degradation, then according to the “Acoustic Adaptation Hypothesis” which of the following combination of features is likely to be shown by birds singing in dense forests?  
 (a) Low frequency with narrow bandwidth (b) High frequency with narrow bandwidth  
 (c) Low frequency with wide bandwidth (d) High frequency with wide bandwidth
64. In Africa “AS” represents a carrier of sickle cell anaemia, where A is the allele for normal haemoglobin and S for sickle cell haemoglobin. If the allele S is maintained at a high frequency in some populations, this represents a case of  
 (a) homozygote advantage (b) heterozygote advantage  
 (c) dominance (d) genetic drift
65. In mammals, the primary circadian clock is located in which of the following parts of the brain?  
 (a) Occipital lobe of cerebrum (b) Amygdala  
 (c) Suprachiasmatic nucleus (d) Frontal lobe of cerebrum
66. In Agrobacterium mediated transformation, which one of the following approaches is more likely to generate transgenic plants with INCOMPLETE transfer of the passenger gene?  
 (a) Placement of selection marker gene towards left border and passenger gene towards right border of T-DNA  
 (b) Expression of selection marker gene under constitutive promoter and passenger gene under tissue-specific promoter  
 (c) Placement of passenger gene towards left border and marker gene towards right border of T-DNA  
 (d) Expression of both selection marker gene and passenger gene under constitutive promoters
67. A student added DMEM culture medium which was pink in colour to growing liver cells. Three days later the medium colour was yellow. This indicated  
 (a) change in cell morphology (b) change in pH of the medium  
 (c) depletion of nutrients in the medium (d) lack of antibiotics in the culture
68. Given below is a schematic representation of a Southern blot performed to identify single copy integration events of the T-DNA among six transgenic plants ( $T_1 - T_6$ ).



Which one of the following options represents potential single copy events?

- (a)  $T_1$ ,  $T_5$  and  $T_6$  (b)  $T_2$  and  $T_3$  (c)  $T_4$  only (d)  $T_1$  only



69. In the enzyme-linked antibody used in ELISA, the interaction between the enzyme and antibody is stabilized by  
(a) hydrogen bond (b) ionic bond  
(c) covalent bond (d) van der Waal's interactions
70. Amongst the following, which one is the most appropriate strategy to sequence and assemble highly repeated regions of a genome?  
(a) Shot gun sequencing (b) Illumina sequencing  
(c) 454 sequencing (d) Sequencing of BAC libraries

**SECTION-C**

71. The Hill equation and its plot describe the following enzyme kinetic behaviours  
A. Saturation Kinetics  
B. Cooperative Kinetics  
C.  $\text{Log } V_i / (V_{\text{max}} - V_i)$  versus  $\text{Log } [s]$   
D.  $\text{Log } (V_{\text{max}} - V_i) / V_i$  versus  $\text{Log}[s]^{-1}$   
Which one of the following combination represents correct descriptions?  
(a) A and C (b) B and C (c) B and D (d) A and D
72. In regulating the quantity of enzyme, its degradation plays a pivotal role. Following statements are made to represent the degradation of enzymes in the 26S proteasome.  
A. The active sites of proteolytic subunits face exterior of the proteasome cylinder  
B. The active sites of proteolytic subunits face interior of the proteasome cylinder  
C. Degrading enzymes are targeted to exterior of proteasome by covalent attachment of one or more molecules of ubiquitin  
D. Degrading enzymes are targeted to interior of proteasome by covalent attachment of one or more molecules of ubiquitin  
Which one of the following combinations of statements represent correct mode of enzyme degradation?  
(a) A and B (b) B and C (c) B and D (d) A and C
73. In classical Anfinsen's protein folding experiment the enzymatically active ribonuclease is treated with  $\beta$ -mercaptoethanol and 8 M urea. Following which, the preparation was  
A. dialyzed to remove the  $\beta$ -mercaptoethanol and 8 M urea  
B. the sample was completely oxidized in 8M urea after dialysis  
C. trace amounts of  $\beta$ -mercaptoethanol was added to the dialysed sample  
D. 8M urea was added to the dialyzed sample  
Which one of the following steps will lead to regaining of the full enzymatic activity of ribonuclease?  
(a) A followed by C (b) A followed by B (c) A followed by D (d) A alone
74. The following statements were made regarding the role of protein modifications  
A. Attachment of acetyl groups to the amino termini of proteins makes it more resistant to degradation.  
B. Attachment of hydroxyl groups to proline residues stabilizes fibres of newly synthesized collagen  
C. Addition of sugars (glycosylation) makes protein more hydrophilic enabling protein-protein interactions  
D. Addition of sugars (glycosylation) makes protein more hydrophobic enabling protein folding  
Which one of the following combinations represents all correct statements?  
(a) A, B and C (b) A, B and D (c) B and C only (d) A and D only
75. The following statements were made to describe the role of Gibbs free energy  
A. Reaction can take place spontaneously if  $\Delta G$  is negative  
B. Reaction can take place spontaneously if  $\Delta G$  is positive  
C.  $\Delta G$  provides no information about the rate of a reaction  
D.  $\Delta G$  estimation provides the rate of a reaction.

Which one of the following represents all correct statements?

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

76. The following statements describe the propensity and role of amino acids in the secondary structure of proteins

- A. Alanine has a high frequency of occurrence in  $\alpha$ -helices  
 B. Proline has a high frequency of occurrence in  $\alpha$ -helices  
 C. The  $\chi_1$  does not affect the helix propensity of serine, threonine and valine  
 D. Peptide bonds involving 'N' of proline may display *cis-trans* isomerism

Choose the correct combination.

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

77. For an exponentially growing culture of bacteria where  $N_0$  is the initial population number and  $N_t$  is the population number at time  $t$ , the mean growth rate constant (K) is expressed as

- (a)  $\frac{\log N_t - \log N_0}{0.301t}$                       (b)  $\frac{\log N_t - \log N_0}{0.301}$                       (c)  $\frac{\log N_t - \log N_0}{t}$                       (d)  $\frac{\log N_t}{0.301t}$

78. The following statements are made with reference to membrane fusion reactions in vesicle transport catalyzed by transmembrane SNARE proteins.

- A. The SNARE transmembrane proteins exist as complementary sets, with v-SNARES on vesicle membranes and t-SNARES on target membranes  
 B. A v-SNARE is usually composed of 3 proteins and t-SNARE is a single polypeptide chain  
 C. The v-SNARE and t-SNARE proteins of a pair interact via helical domains possessed by the two proteins, resulting in formation of a stable two-helix bundle  
 D. Membrane fusion is catalysed by the energy that is freed when the interacting helices wrap around each other to pull the membrane faces together, concurrently squeezing out water molecules from the interface.

Which one of the following combinations represents all correct statements?

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

79. The mammalian protein HP1 plays a major role in heterochromatinization and silencing. The following mutations are proposed to negatively impact HP1 function.

- A. Mutation inactivating the deacetylase that targets H3K14Ac  
 B. Mutation inactivating HP1 bromo-domain  
 C. Mutation inactivating HP1 chromo-domain  
 D. Mutation inactivating the KMT1A methyltransferase whose target site is H3K9

Which one of the following combinations represents all correct statements?

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

80. The statements given below refer to the lambda phage.

- A. Clear plaques are formed in Q mutants  
 B. No plaques are formed in *nut* mutants  
 C. Clear plaques are formed in *cII* mutants  
 D. Turbid plaques are formed in integrase mutants  
 E. Clear plaques are formed in P mutants  
 F. No plaques are formed in *cI* mutants

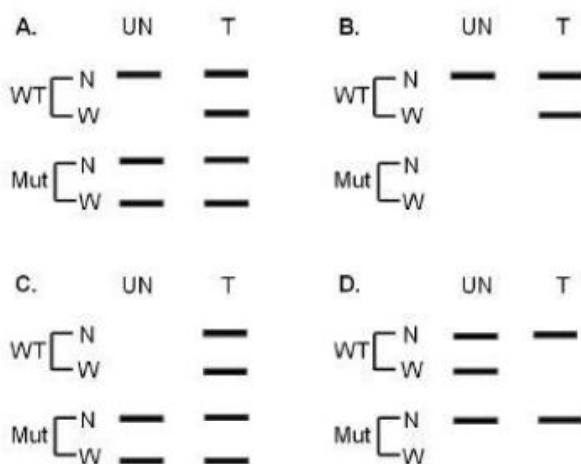
Which of the following combination of statements is correct?

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





85. Given below is a partial coding sequence of a gene:  
5'-AATGGACGCATGTGTCGATGG-3'
- Which one of the following polypeptides CANNOT be produced by transcription and translation of the above DNA sequence in any of the three possible reading frames?
- (a) Asn-Gly-Arg-Met-Cys-Arg-Trp                      (b) Asn-Ala-Cys-Phe-Ser-His  
(c) Met-Asp-Ala-Cys-Val-Asp                          (d) Trp-Thr-His-Val-Ser-Met
86. Expression of gene 'A' is regulated by  $Mg^{2+}$ . The expression of gene 'A' in untreated (UN) and cells treated with  $Mg^{2+}$  (T) was analysed by Northern hybridization (N) and Western blotting (W). A similar exercise was done for a mutant (Mut) which was isolated with a 6 bp deletion in 5'UTR of the transcript of gene 'A'. The following are summary of four possible results that are hypothesized to be obtained.



UN = Untreated Cells, WT = Wild type cells, T = Cells treated with  $Mg^{2+}$ , Mut = Cell with mutation in gene A, N = Northern hybridization, W = Western blotting

If the regulation of gene 'A' expression is controlled ONLY at the level of translation, which of the above profile/s are possible correct representation of the experimental results.

- (a) A only                      (b) D only                      (c) A and D                      (d) B and C
87. The following statements are made with reference to the replication of DNA.
- A. The eukaryotic counterpart of the bacterial  $\beta$ -clamp protein is proliferating cell nuclear antigen (PCNA)  
B. Mutation inactivating one of the subunits of the Mcm 2-7 complex negatively affects the initiation of DNA replication in eukaryotes, but has no effect on elongation of the replication fork  
C. All DNA polymerases responsible for replicating the eukaryotic genome catalyze DNA chain extension in a DNA template dependent manner.  
D. The FEN1 protein plays a role in the synthesis of the lagging strand during DNA replication as well as in base excision repair
- Which one of the following options represents INCORRECT statement(s)?
- (a) B only                      (b) B and C only                      (c) B and D only                      (d) A, B and C
88. The following statements are related to transcription in bacteria/eukaryotes.
- A. During concurrent promoter sequence recognition and melting, melting commences with base flipping where two bases are flipped out into pockets of the primary sigma factor  
B. Binding of  $\alpha$ -amanitin to RNA polymerase II permits entry of nucleotides into RNA pol II active site and synthesis of RNA, but prevents translocation  
C. RNA polymerase I can use upstream promoters with 3 consensus sequences, as well as internal promoters having a bipartite structure  
D. FACT is associated with RNA polymerase during transcriptional elongation and helps displace histone octomers during transcription

Which of the following combinations of statements represents all correct statements?

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

89. Suresh was bitten by a poisonous snake and was immediately treated with anti-venom human immunoglobulin and was saved. A year later he was bitten by the same type of snake second time. Predict his response to the venom from second bite from the following:

- (a) He will be fully protected from the effects of the poison second time because he developed adaptive immunity after first snake bite.  
 (b) He will be equally sensitive as first encounter because there would be no recall of the first encounter.  
 (c) There are residual cells or anti-venom antibodies that were involved in the original/first encounter, hence he will be protected.  
 (d) There will be memory cells made after the first encounter hence he will be more sensitive.

90. An antigen was injected into a mouse. Macrophages and antigen primed  $T_H$  cells were isolated from this mouse to perform the following in vitro experiments:

- A. Macrophages were treated with the antigen for an hour and then incubated with  $T_H$  cells.  
 B. Macrophages were treated with paraformaldehyde first and then treated with the antigen for an hour. These macrophages were then incubated with  $T_H$  cells.  
 C. Macrophages were treated with paraformaldehyde first then treated with the digested (proteolytically cleaved) antigen for an hour. These macrophages were then incubated with  $T_H$  cells.  
 D. Macrophages were treated with the antigen for an hour and then treated with paraformaldehyde. These macrophages were then incubated with  $T_H$  cells.

Which of the above experiments would lead to  $T_H$  cells proliferation?

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

91. Three strains of pathogenic bacteria were found to express proteins mimicking human proteins associated with complement pathway. Bacterium 'X' expressed on its surface proteins mimicking Decay Accelerating Factor (DAF) and Complement Receptor 1 (CR1). Bacterium 'Y' secreted a protein that mimicked protein S of humans and bacterium 'Z' secreted protein that mimicked Factor I activity.

Given below are statements on the possible effect of complement activation on these pathogenic bacteria. Select the INCORRECT statement.

- (a) Bacterium X will prevent formation of C3 convertase on its surface by alternate and classical pathways.  
 (b) Bacterium Y will prevent formation of C3 convertase on its surface by lectin pathway.  
 (c) Bacterium Z will be susceptible to complement attack by Membrane Attack Complex (MAC) despite secreting Factor I-like protein to cleave C3b and C4b.  
 (d) Bacterium Y will prevent formation of Membrane Attack Complex (MAC) on its surface.

92. Pathogens continuously evolve strategies to evade host immune responses. For each of the following evasion strategies (listed in column X) match the pathogen (listed in column Y) which adopts it:

**Column-X**

- A. Changing the antigen expressed on their surface  
 B. Increasing phagocytic activity of macrophage  
 C. Developing resistance to complement-mediated lysis  
 D. Secreting proteases to inactivate antibodies  
 E. Allowing point mutations in surface epitopes resulting in antigenic drift

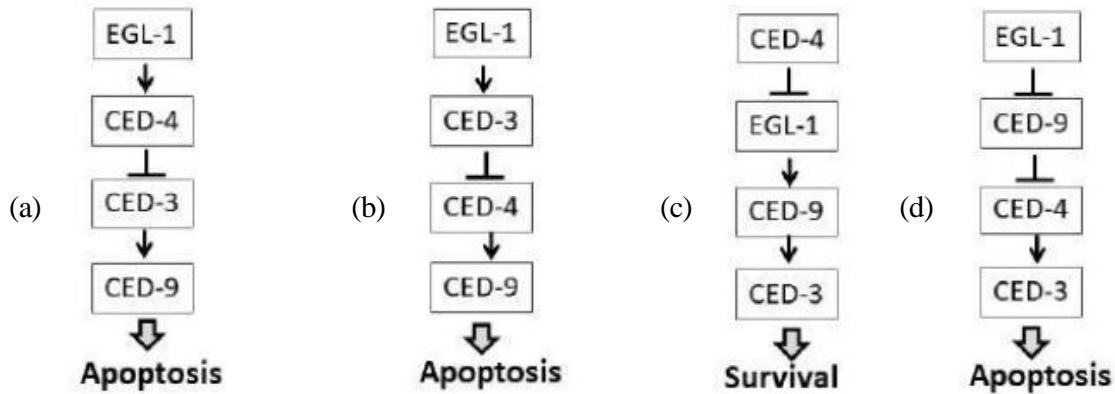
**Column-Y**

- (i) Influenza virus  
 (ii) *Neisseria*  
 (iii) Gram +ve bacteria  
 (iv) No bacteria

Choose the correct match

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

93. Following are the statements which explain why patients with  $\alpha$ -linked hyper-IgM syndrome express normal genes for other antibody subtypes but fail to produce IgG, IgA, or IgE:
- CD40 expressed on B cells is defective
  - CD40L mediates binding of B-cells to T-cells and sends co-stimulatory signals to the B-cells for class switching
  - Without CD40 on macrophage, class switching does not occur
  - CD40L mediates binding of B-cells to macrophages and sends co-stimulatory signals to the B-cells for class switching.
- Select the option with correct combination.
- (a) A, C and D                      (b) A, B and C                      (c) A and B                      (d) A and D
94. PR proteins play important role during plant-pathogen interactions. Column-X represents some of the PR family proteins and Column-Y represents their main properties.
- | Column-X | Column-Y                     |
|----------|------------------------------|
| A. PR-2  | (i) Defensin                 |
| B. PR-5  | (ii) Thaumatin-like          |
| C. PR-12 | (iii) Lipid transfer protein |
| D. PR-14 | (iv) $\beta$ -1, 3-glucanase |
- The correct match of Column-X with the property in Column-Y is
- (a) A-(iv), B-(iii), C-(ii), D-(i)                      (b) A-(i), B-(ii), C-(iii), D-(iv)  
 (c) A-(iv), B-(ii), C-(i), D-(iii)                      (d) A-(iii), B-(iv), C-(ii), D-(i)
95. Dreisch performed the “pressure plate experiment” to alter the distribution of nuclei in a 8-cell sea urchin embryo. He obtained normal larvae from these embryos. Following possible conclusions could be drawn:
- Prospective potency of the blastomeres is less than the actual prospective fate.
  - Sea urchin embryo is a “harmonious equipotential system” implying that cell interaction is critical for normal development.
  - Prospective potency of the blastomere is greater than the actual prospective fate.
  - Prospective potency of the blastomere is equal to the prospective fate.
- Which one of the following combinations of statements represents the correct inference from the experiment?
- (a) A and B                      (b) B and C                      (c) B only                      (d) D only
96. The continued expression of *engrailed* and *wingless* is maintained by interactions between the Engrailed- and Wingless-expressing cells. The following statements are given towards the initiation of the cascade of events that occur for this interaction:
- The *engrailed* gene is expressed in cells where neither even skipped nor *fushi tarazu* gene is active.
  - The *wingless* gene is expressed in those cells that contain high concentration of either Even skipped or Fushi tarazu.
  - Wingless is a secreted protein, diffuses to the surrounding, binds with the Frizzled and Lrp6 receptor proteins and activates engrailed gene via Armadillo.
  - Hedgehog protein activates the transcription of engrailed and also activates its own transcription.
  - Hedgehog protein diffuses from cells and binds to Patched receptor on neighbouring cells and enables transcription of *wingless* gene.
- Which combination of above statements correctly represent the maintenance of engrailed and wingless expression?
- (a) A and B                      (b) B and D                      (c) A and D                      (d) C and E
97. In *C. elegans*, activation of the CED-3 and CED-4 proteins are essential for the apoptosis pathway. In addition, gain-of-function mutations in the *ced-9* gene cause its protein to be made in cells that would normally die, resulting in survival of those cells. Given these facts, which one of the following diagrams correctly represents a cell death pathway?



98. Several marine organisms release their gametes into the environment, where sperm attraction and subsequent events lead to successful fertilization. With reference to sea urchins, which one of the following statements is NOT true?
- Addition of resact into a drop of seawater containing sperms specifically attracts sperms of *A. punctulata*.
  - $IP_3$  is formed initially at the site of sperm entry and releases sequestered  $Ca^{2+}$ .
  - $Ca^{2+}$  prevents docking of cortical granules of the egg to the cell membrane.
  - Inhibitors that specifically block  $PLC_\gamma$  can be circumvented by microinjecting  $IP_3$  into the egg.
99. The major structural characteristic of avian gastrulation is the primitive streak, which becomes the blastopore lips of amniotic embryos. Migration through the primitive streak is controlled by Fgf8. What would happen if the Fgf8 protein, which repels migrating cells away from the streak, is over expressed in the primitive streak?
- The yolk sac will be deformed.
  - Wnt signalling will be activated and orientation of the primitive streak will change.
  - Cells of the streak will not form the paraxial mesoderm.
  - Cells generate mesodermal portions of the embryo.
100. Programmed cell death (PCD) plays an important role in development of barley aleurone. The following statements are made with respect to involvement of various phytohormones and signaling molecules.
- |  |                                       |
|--|---------------------------------------|
| A. Gibberellic acid promotes PCD.      | B. Abscisic acid postpones PCD.       |
| C. Cyclic GMP signaling postpones PCD. | D. Nitric oxide scavenger delays PCD. |
- Which one of the following combinations of statements is correct?
- A and C
  - B and D
  - A and B
  - C and D
101. Following are certain statements regarding nitrogen uptake and assimilation by plants:
- Plant roots can take up nitrogen in the form of  $NO_3^-$  and  $NH_4^+$ .
  - $NH_4^+$  taken up by plants can be directly assimilated into amino acids.
  - Amino acids are synthesized exclusively in plastids and chloroplast of roots and leaves, respectively.
  - $NO_3^-$  can be stored in vacuole of both, roots and leaves.
- Which one of the following combinations is correct?
- A, B and C
  - B, C and D
  - A, B and D
  - A, C and D
102. Dark grown *Arabidopsis* seedlings when exposed to ethylene gas shows typical triple response. Following are certain statements regarding the triple response:
- A dominant ethylene receptor mutant will not show triple response in the presence of ethylene.
  - Tightening of apical hook is one of the features of triple response.
  - Loss of function of multiple receptors will show triple response even in the absence of ethylene.
  - Increase in hypocotyl length is a feature of triple response.
- Which one of the following combinations is correct?
- A, B and C
  - A, C and D
  - B, C and D
  - A, B and D

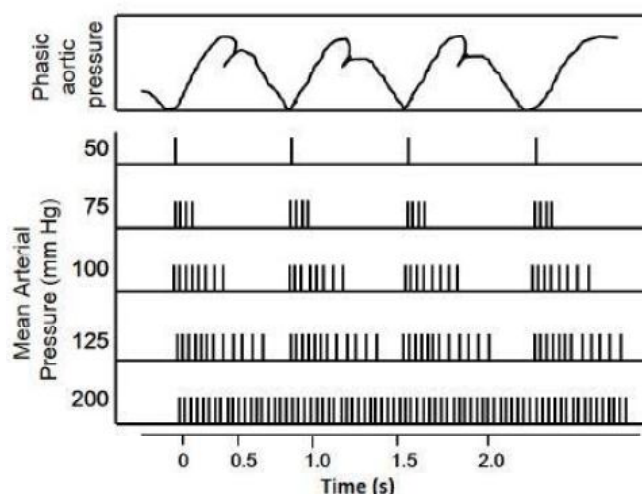


- 103.** Calvin-Benson cycle is divided into three phases, namely carboxylation, reduction and regeneration. The following statements are related to the three phases of Calvin-Benson cycle:
- A. The product of light reaction, ATP and NADPH is utilized in the carboxylation phase.
  - B. Six molecules of 3-phosphoglycerate is converted into six molecules of glyceraldehyde 3-phosphate in the reduction phase.
  - C. The action of aldolase enzyme for the production of fructose 1, 6-bisphosphate takes place in reduction phase.
  - D. Formation of seven carbon compound, sedoheptulose-7-phosphate takes place in the regeneration phase.
- Which one of the following combinations is correct?
- (a) A and C                      (b) B and D                      (c) A and B                      (d) C and D
- 104.** A researcher has treated pea leaves with *p*-chloromercuribenzenesulfonic acid (PCMBs), which inactivates plasma membrane transporters. It was observed that phloem loading of sucrose is inhibited. Which one of the following interpretations is correct?
- (a) Symplastic loading is eliminated.
  - (b) Apoplastic loading is eliminated.
  - (c) Both symplastic and apoplastic loadings are eliminated.
  - (d) Photosynthesis rate is reduced.
- 105.** The NPR1 (non-expressor of pathogenesis-related genes 1) and two SA receptors (NPR3 and NPR4) are known to play important role in SA mediated plant defense. The following statements were made regarding their role in infected and non-infected tissues of the plants:
- A. In the infected tissue, SA binds to NPR3 and induces degradation of NPR1 to promote cell death.
  - B. In the infected tissue, SA binds to NPR4 and blocks the degradation of NPR1 to promote cell death.
  - C. In the non-infected tissue, SA binds to NPR4 and blocks the degradation of NPR1 to favour cell survival.
  - D. In the non-infected tissue, SA binds to NPR3 and promotes degradation of NPR1 to favour cell survival.
- Which one of the following combination of statements is correct?
- (a) A only                      (b) B only                      (c) A and C                      (d) B and D
- 106.** A researcher developed a mutant of Arabidopsis plant where the function of SLEEPY 1 (SLY1) containing SCF complex has been disrupted. Which one of the following statements is INCORRECT in the developed mutant in relation to gibberellic acid (GA) signal transduction?
- (a) GA will bind to GA-insensitive dwarf 1 (GID1) protein.
  - (b) A complex of GA-GID1 and DELLA protein will be formed.
  - (c) The DELLA protein will be ubiquitinated.
  - (d) The DELLA protein will not be degraded.
- 107.** Loss of a large quantity of blood in an individual due to haemorrhage provokes many physiological changes which are compensatory and decompensatory in nature. The following statements describe few compensatory or decompensatory mechanisms operating in this condition.
- A. The peripheral chemoreceptors are stimulated when arterial blood pressure is reduced below 60 mm Hg due to blood loss.
  - B. The cardiovascular centres in the brain stem become depressed in severe hypotension due to blood loss.
  - C. The mononuclear phagocytic system becomes depressed during the course of haemorrhagic hypotension.
  - D. Renin is secreted from juxtaglomerular apparatus in haemorrhagic hypotension.
  - E. Considerable quantity of interstitial fluid may be drawn into circulation due to lower hydrostatic pressure in capillaries resulting from blood loss.
- Choose the option describing only the decompensatory mechanisms:
- (a) A and B                      (b) B and C                      (c) C and D                      (d) D and E



- 108.** In high altitude, a number of compensatory mechanisms operate over a period of time to increase altitude tolerance in humans which is called acclimatization. The following statements propose these compensatory changes:
- A. The initial increase of ventilation is relatively small in high altitude but the ventilation steadily increases over next few days.
  - B. Red blood cell 2, 3-DPG is increased.
  - C. The blood pH becomes more alkaline.
  - D. The oxygen dissociation curve is shifted to the left.
  - E. The pH of cerebrospinal fluid is further increased.
- Choose the option with both INCORRECT statements:
- (a) A and B                      (b) B and C                      (c) C and D                      (d) D and E
- 109.** The electrical response of the afferent nerve terminal in a Pacinian corpuscle (PC), after application of different grades of pressure, are proposed in the following statements:
- A. A non-propagated depolarizing potential or receptor potential is elicited when small magnitude of pressure is applied to PC.
  - B. The magnitude of receptor potential is increased as the pressure to PC is increased.
  - C. An action potential is generated when receptor potential attains a critical value.
  - D. The receptor potential shows all-or-none response.
  - E. The receptor potential is not a graded potential.
- Choose the option with both INCORRECT statements:
- (a) A and B                      (b) B and C                      (c) C and D                      (d) D and E
- 110.** cGMP is produced from GTP by the enzyme guanylate cyclase which exists in soluble and membrane-bound forms. Following statements are made related to signaling molecules that are associated with cGMP signaling cascade.
- A. Atrial natriuretic factor causes natriuresis and diuresis by interacting with membrane-bound form of guanylate cyclase.
  - B. Nitroglycerin causes smooth muscle relaxation and vasodilation by interacting with soluble form of guanylate cyclase.
  - C. Nitroprusside causes smooth muscle relaxation and vasodilation by interacting with membrane-bound form of guanylate cyclase.
  - D. Atrial natriuretic factor causes natriuresis and diuresis by interacting with soluble form of guanylate cyclase.
- Which one of the following combinations is correct?
- (a) A and B                      (b) B and C                      (c) C and D                      (d) A and D
- 111.** Kallmann syndrome generally exhibits gonadal dysfunctions in males. Following statements are made relating to such males.
- A. They mostly suffer from hypergonadism.
  - B. They mostly suffer from hypogonadism.
  - C. They have higher level of circulating gonadotropins.
  - D. They have lower level of circulating gonadotropins.
- Which one of the following combinations of statements is correct?
- (a) A and B                      (b) B and C                      (c) B and D                      (d) A and C

112. The discharge patterns in a single afferent nerve fibre from carotid sinus at various levels of mean arterial pressure (MAP) are plotted against changes in aortic pressure with time in the following figure:



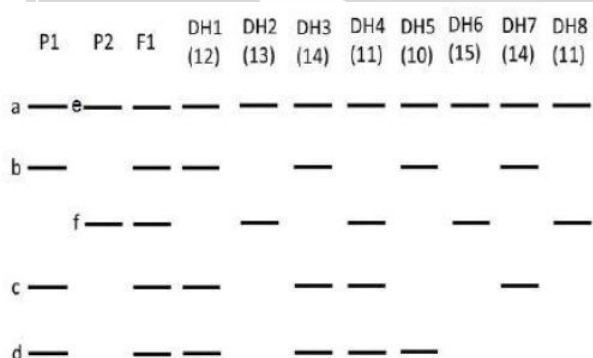
The following statements were proposed from the above figure:

- A. Baroreceptors are more sensitive to phasic change of aortic pressure at normal MAP.
- B. The baroreceptor firing rate is reduced at lower MAP than in normal MAP.
- C. The phasic change in baroreceptor fibre is less prominent at lower MAP.
- D. A burst of action potentials appear in a single baroreceptor fibre during diastole at normal MAP.
- E. The discharge of baroreceptors even extends to systole at higher MAP.

Choose the option with both CORRECT statements:

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

113. The figure below represents a profile of DNA markers in two parents (P1 and P2), progeny (F1) from a cross between P1 and P2 and that of gametes produced from F1. Eight different patterns (DH1 to DH8) were observed in case of gametes. The numbers below, DH1 to DH8 indicate the number of individuals observed in each case.



Based on the above observations, the following statements were made:

- A. Markers 'b' and 'f' are likely to be allelic in nature.
- B. Markers 'c' and 'd' are linked in *trans* with a map distance of 24 cM.
- C. Marker 'b' assort independently from marker 'c'.

Which one of the following have a combination of all correct statements?

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

114. A species of plant (species 1) is diploid ( $2n = 6$ ) with chromosomes AABBCC and a related species (species 2) is also diploid ( $2n = 4$ ) with chromosomes PPQQ. The following statements were given by students regarding the chromosome numbers involving these plant species:



| Progeny phage genotype | Number of plaques |
|------------------------|-------------------|
| $h^+ c^+ st^+$         | 350               |
| $h^+ c st$             | 86                |
| $h^+ c^+ st$           | 4                 |
| $h c st$               | 300               |
| $h^+ c st^+$           | 90                |
| $h c st^+$             | 6                 |
| $h c^+ st^+$           | 114               |
| $h c^+ st$             | 50                |

What will be the order of the three genes and the map distance between them?

- (a)  $h \xrightarrow{36cM} c \xrightarrow{15cM} st$  (b)  $c \xrightarrow{21cM} h \xrightarrow{15cM} st$   
 (c)  $h \xrightarrow{21cM} st \xrightarrow{15cM} c$  (d)  $h \xrightarrow{36cM} c \xrightarrow{\infty cM} st$

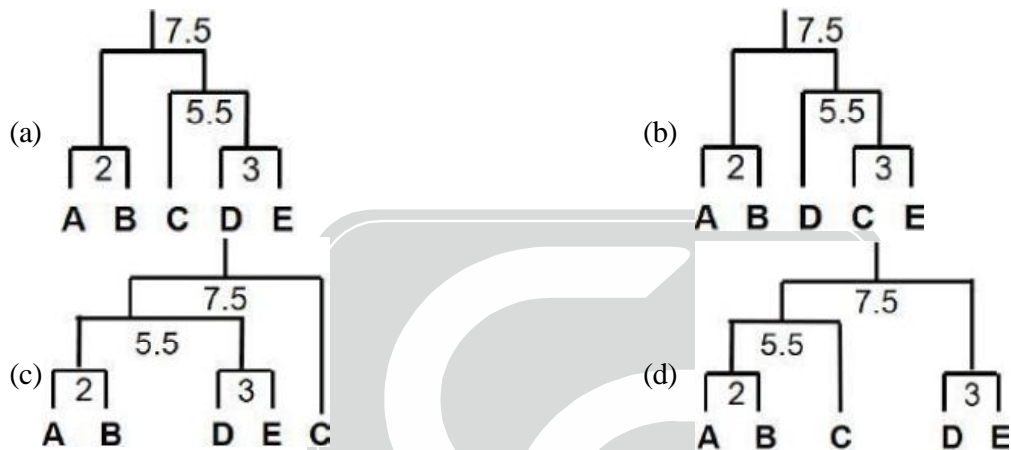
119. The three domain classification of life proposed by Carl Woese divides life forms on the basis of  
 (a) mitochondrial DNA and membrane structures (b) ribosomal rRNA and protein sequences  
 (c) mitochondrial DNA and protein sequences (d) presence of single or double membranes
120. Appendix masculina is found in  
 (a) second abdominal appendages of male palaemon (b) second maxillipede of male palaemon  
 (c) maxilla of both sexes of palaemon (d) mandibles of male palaemon
121. Select the correct statement. The bark of a woody plant is collectively made up of the following tissues:  
 (a) primary phloem, primary phloem fibres, pericycle and periderm  
 (b) primary xylem, primary phloem fibres, stem cortex, rays, and periderm  
 (c) vascular cambium, rays, pericycle and periderm  
 (d) secondary phloem, secondary phloem fibres, stem cortex, pericycle and periderm
122. Given below is a list of plant species and reproductive forms:
- | Plant species | Reproductive form |
|---------------|-------------------|
| (i) Gingko    | (a) Monoecious    |
| (ii) Conifers |                   |
| (iii) Poplar  |                   |
| (iv) Maize    | (b) Dioecious     |
| (v) Date palm |                   |
| (vi) Mango    |                   |
- Which one of the following options correctly matches all the given plant species with their reproductive forms?  
 (a) a = (i), (iii), (v); b = (ii), (iv), (vi) (b) a = (i), (ii), (v); b = (iii), (iv), (vi)  
 (c) a = (ii), (iv), (vi); b = (i), (iii), (v) (d) a = (iii), (iv), (vi); b = (i), (ii), (v)
123. Given below is a list of natural disturbances.
- |                                   |                           |
|-----------------------------------|---------------------------|
| A. Coral bleaching                | B. Rising sea levels      |
| C. Shifts in species distribution | D. Lowering of sea levels |
| E. Increase in glacial sheets     |                           |
- Which one of the following combinations of disturbances can be attributed to global warming?  
 (a) A, D and E (b) A, B and C (c) B, C and E (d) C, D and E

- 124.** To study the effect of temperature on seed germination, 16 seeds of a plant species were selected for an experiment. A total of four temperature treatments were provided to sets of four seeds to study the onset of germination. What would be the within, between and total degrees of freedom, respectively, in an analysis of variance?  
 (a) 3, 15 and 18                      (b) 16, 4 and 20                      (c) 4, 16 and 20                      (d) 15, 3 and 18
- 125.** The following information refers to ecological interactions.
- | <b>Column-X</b>                           | <b>Column-Y</b>        |
|---|------------------------|
| A. Bass introduction into aquatic systems | (i) Bioaccumulation    |
| B. Beavers                                | (ii) Aposematism       |
| C. Sea bird (such as puffins)             | (iii) Keystone species |
| D. Yellow and black stripes in a wasp     | (iv) Trophic cascades  |
- Which one of the following options represents the correct match between Column-X and Column-Y?  
 (a) A-(ii), B-(i), C-(iii), D-(iv)                      (b) A-(iv), B-(iii), C-(i), D-(ii)  
 (c) A-(ii), B-(i), C-(iv), D-(iii)                      (d) A-(iii), B-(iv), C-(i), D-(ii)
- 126.** A large patch of forested area was devastated by raging fires. After some years, the area was found to recover its species. Which one of the following options best describes the process of re-establishment in the area?  
 (a) mosses and lichens → grasses → shrubs and small plants → woody trees  
 (b) grasses → woody trees → herbs and shrubs → mosses and lichens  
 (c) woody plants → lichens and mosses → herbs and shrubs  
 (d) grasses → herbs and shrubs → woody trees
- 127.** According to the classical Lotka-Volterra competition model, which of the following conditions allow for co-existence of two competing species?  
 (a) both species are equally capable of inhibiting each other  
 (b) intraspecific competition of each species > interspecific competition  
 (c) intraspecific competition < interspecific competition  
 (d) there is no intraspecific competition in either species
- 128.** Co-existence of several species of birds in an area is possible under the following conditions  
 (a) High niche overlap and high niche differentiation  
 (b) Low niche overlap and high niche differentiation  
 (c) High niche overlap and low niche differentiation  
 (d) Low niche overlap and low niche differentiation
- 129.** Given below are the possible reasons of high probability for extinction of species:  
 (i) Increased homozygosity of alleles                      (ii) Increased heterozygosity of alleles  
 (iii) Decreasing population sizes                      (iv) Increasing demographic stochasticity  
 (v) Decreasing environmental stochasticity
- Which one of the following options represents the correct combination of reasons that can lead to the highest probability of extinction of species?  
 (a) (ii), (iii) and (v)                      (b) (i), (iii) and (iv)                      (c) (i), (ii) and (iii)                      (d) (ii), (iii) and (vi)

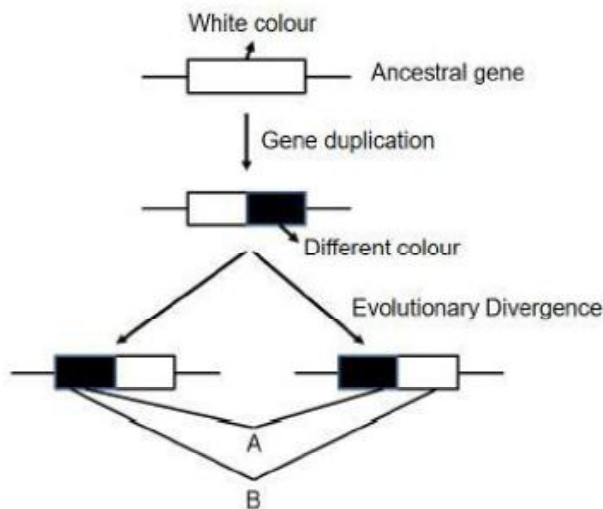
130. Distance matrix of five species A to E is given below.

|   | A  | B | C | D | E |
|---|----|---|---|---|---|
| A | 0  |   |   |   |   |
| B | 2  | 0 |   |   |   |
| C | 6  | 5 | 0 |   |   |
| D | 10 | 4 | 8 | 0 |   |
| E | 8  | 6 | 4 | 3 | 0 |

Which one of the following topologies represents the accurate species relationships among species A to E if UPGMA clustering method is used for the given data?



131. The figure below shows a gene duplication event followed by a divergence event in species 1 and 2.



Based on the details given above determine what is represented by A and B

- (a) A: duplicated genes; B: ancestral genes  
 (b) A: paralogs ; B: ancestral genes  
 (c) A: orthologs; B: paralogs  
 (d) A : paralogs; B: orthologs
132. Felsenstein zone in a phylogenetic tree refers to a region of tree space where,
- (a) maximum likelihood would be inconsistent  
 (b) lineages converge due to shared common ancestry  
 (c) outgroups relationship is influential  
 (d) maximum parsimony would be inconsistent



133. Creationism is rejected by evolutionary biologists because
- it offers no explanation about the origin of adaptation
  - it suggests that all species descended from a common ancestor
  - theologians have not settled on a date for the origin of life on earth
  - supernatural events have not been shown to be very common
134. Given below are proposed analogous structures among organisms.
- wings of birds and bats
  - wings of bats and tetrapod digits
  - tendrils of vitis and tendrils of pumpkin
  - tubers of potatoes and sweet potatoes
  - fins of fish and flippers of a whale
- Which one of the following options correctly states the analogous structures?
- A, C and D
  - B, C and D
  - A, C and E
  - A, D and E
135. An experiment was performed to introduce a transgenic trait in a crop plant by *Agrobacterium*-mediated transformation using a transgene construct in which the transgene was expressed using the CaMV 35S promoter. It was observed that expression levels of the transgenic protein were very low in all transgenic plants while transgene mRNA levels were high and variable among different plants. Further, different transgenic lines contained different numbers of the T-DNA insert. The following statements were made to explain the above observation:
- Variations in the number of T-DNA inserts in different transgenic plants is due to more number of host cells getting infected with the T-DNA
  - Low expression levels of the transgenic protein in all transgenic plants could be due to codon usage variations between the host plant and the heterologous source of the transgene
  - The coding sequence of the transgene contained sequences that destabilized the transgene MRNA
  - Variation in copy number of T-DNA in different transgenic plants is due to variation in the promoter used to express the transgene.
- Which one of the following options represents all correct statements?
- A only
  - B and C
  - A and D
  - B only
136. Given below are a few statements related to biological principles and/or techniques:
- Genetic diversity plays an important role in the identification of combiners for heterosis breeding
  - Genotyping by sequencing (GBS) can be used to identify allelic diversity but is not useful for construction of linkage maps.
  - Genome editing by sequence specific nucleases (SSNs) in the presence of guide RNAs would result in NHEJ-mediated knock outs and loss of function mutations.
  - In a comparison of synteny and colinearity between diploid and polyploid plant genomes, colinearity is high but synteny is low.
- Which one of the following options represents all correct statements?
- A and C only
  - B and D only
  - A, C and D
  - B only
137. Given below are some terms in Column-A and their corresponding properties/related terms in Column-B
- | <b>Column-A</b>            | <b>Column-B</b>   |
|----------------------------|---|
| A. Bulk segregant analysis | (i) QTL analysis of wider genetic diversity using fewer individuals |
| B. NILs                    | (ii) Mapping monogenic qualitative traits                           |
| C. Association mapping     | (iii) Co-dominant markers   |
| D. SNPs                    | (iv) Repeated backcrossing of $F_1$ to recurrent parent             |



In the absence of any other factors such as (but not restricted to)  $T_m$ , length, percent GC, etc., which one of the above template-primers combinations would produce an amplified fragment?

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

143. A field biologist is sampling tree species in a forest area to estimate tree diversity. What method can be employed to decide if his sampling effort is adequate to estimate the tree diversity in the area?

- (a) Quadrat method of sampling      (b) Saturation using species accumulation curves  
(c) Frequency distributions      (d) Jaccard's dissimilarity coefficient

144. For a given immunological application [Column-X], select the type of antibody [Column-Y] that should be used:

**Column-X**

- A. Bacterial agglutination  
B. Western blotting  
C. Detection of a cytokine using a solid phase ELISA  
D. Diagnostic tissue typing

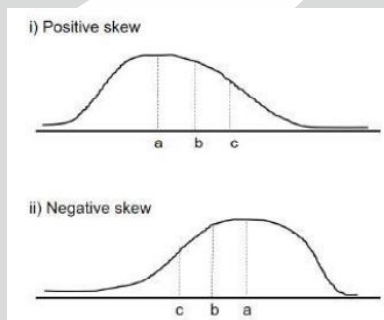
**Column-Y**

- i. Only monoclonal  
ii. Only polyclonal  
iii. Either monoclonal or polyclonal

Choose the option with correct matches between terms of Columns-X and Y.

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

145. In the two graphs given above, what do  $a$ ,  $b$  and  $c$  refer to:



- (a)  $a$  = mean,  $b$  = median,  $c$  = mode      (b)  $a$  = median,  $b$  = mode,  $c$  = mean  
(c)  $a$  = mode,  $b$  = median,  $c$  = mean      (d)  $a$  = mean,  $b$  = mode,  $c$  = median

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