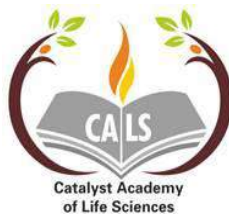


# CATALYST ACADEMY OF LIFE SCIENCES [CALs], MUMBAI

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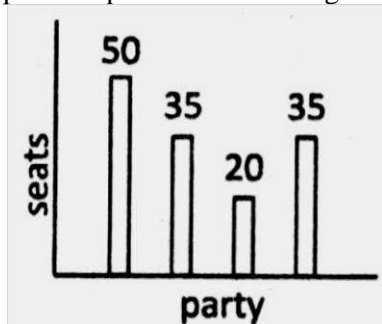
## CSIR NET LIFE SCIENCES Solved paper December 2016 Booklet- C

Part A

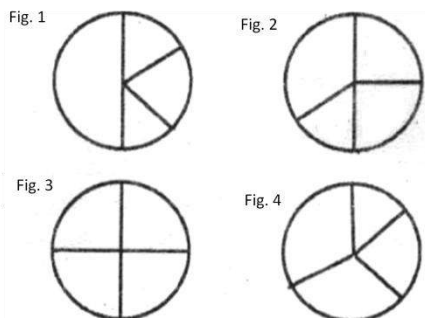
1. Two cockroaches of the same species have the same thickness but different lengths and widths. Their ability to survive in oxygen deficient environments will be compromised if:

- (1) Their thickness increases, and the rest of the size remains the same.
- (2) Their thickness remains unchanged, but their length increases
- (3) Their thickness remains unchanged, but their width decreases.
- (4) Their thickness decreases, but the rest of the size remains unchanged

2. The bar chart shows number of seats won by four political parties in a state legislative assembly.



Which of the following pie-charts correctly depicts this information?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

3. The random errors associated with the measurement of P and Q are 10% and 2%, respectively. What is the percentage random error in P/Q?

- (1) 12.0
- (2) 9.8
- (3) 8.0
- (4) 10.2

4. In how many distinguishable ways can the letters of the word CHANGE be arranged?

- (1) 120
- (2) 720
- (3) 360
- (4) 240

5. Find the missing term.

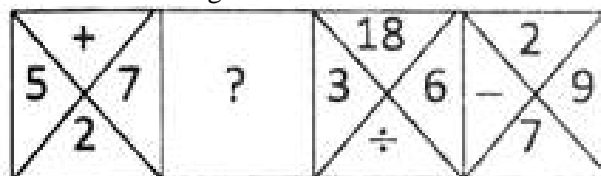


Fig. 1

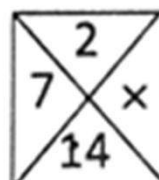


Fig. 2



Fig. 3



Fig. 4



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

6. Seeds when soaked in water gain about 20% by weight and 10% by volume. By what factor does the density increase?

- (1) 1.20
- (2) 1.10
- (3) 1.11
- (4) 1.09

7. Retarding frictional force,  $f$ , on a moving ball, is proportional to its velocity,  $V$ . Two identical balls roll down identical slopes (A & B) from different heights. Compare the retarding forces and the velocities of the balls at the bases of the slopes.

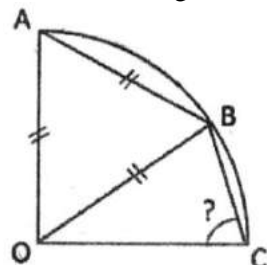


- (1)  $f_A > f_B ; V_A > V_B$
- (2)  $f_A > f_B ; V_B > V_A$
- (3)  $f_B > f_A ; V_B > V_A$
- (4)  $f_B > f_A ; V_A > V_B$

8. A river is 4.1 km wide. A bridge built across it has 1/7 of its length on one bank and 1/8 of its length on the other bank. What is the total length of the bridge?

- (1) 5.1 km
- (2) 4.9 km
- (3) 5.6 km
- (4) 5.4 km

9. OA, OB and OC are radii of the quarter circle shown in the figure. AB is also equal to the radius. What is angle OCB?

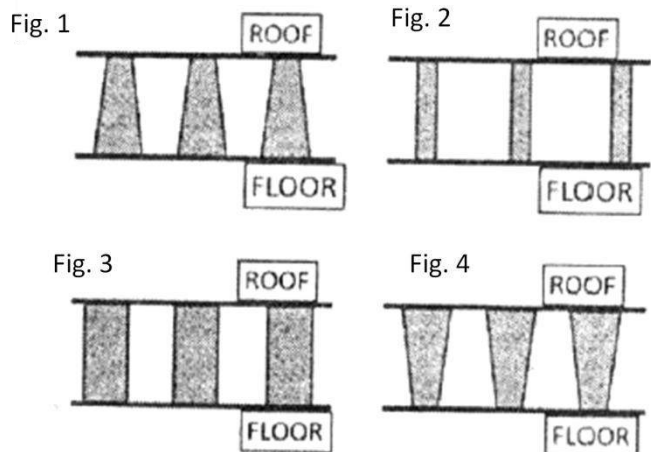


- (1)  $60^\circ$
- (2)  $75^\circ$
- (3)  $55^\circ$
- (4)  $65^\circ$

10. Intravenous (IV) fluid has to be administered to a child of 12 kg with dehydration, at a dose of 20 mg of fluid per kg of body weight, in 1 hour. What should be the drip rate (in drops/min) of IV fluid? (1 mg = 20 drops)

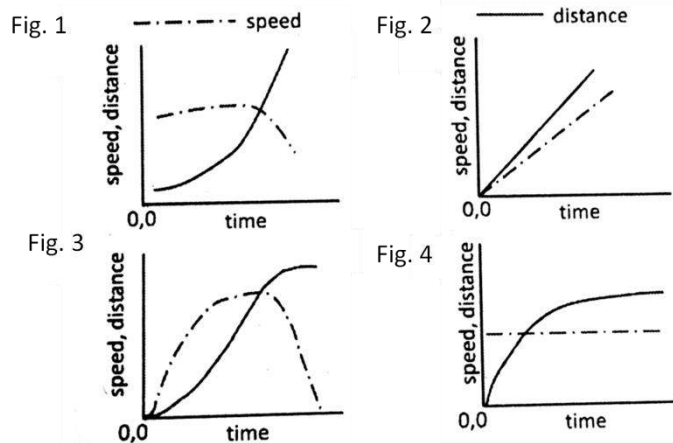
- (1) 7
- (2) 80
- (3) 120
- (4) 4

11. A hall with a high roof is supported by an array of identical columns such that, to a person lying on the floor and looking at the ceiling, the columns appear parallel to each other. Which of the following designs conforms to this?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

12. Which of the following graphs correctly shows the speed and the corresponding distance covered by an object moving along a straight line?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

13. A normal TV screen has a width to height ratio of 4:3, while a high definition TV screen has a ratio of 16:9. What is the approximate ratio of their diagonals, if the heights of the two types of screens are the same?

- (1) 5:9
- (2) 5:18
- (3) 5:15
- (4) 5:6

14. Comparing numerical values, which of the following is different from the rest?

- (1) The ratio of the circumference of a circle to its diameter.
- (2) The sum of the three angles of a plane triangle expressed in radians.
- (3)  $22/7$
- (4) The net volume of a hemisphere of unit radius, and a cone of unit radius and unit height.

15. If a person travels x% faster than normal, he reaches y minutes earlier than normal. What is his normal time of travel?

- (1)  $\left(\frac{100}{x} + 1\right) y$  minutes
- (2)  $\left(\frac{x}{100} + 1\right) y$  minutes
- (3)  $\left(\frac{y}{100} + 1\right) x$  minutes
- (4)  $\left(\frac{100}{y} + 1\right) x$  minutes

16. A and B walk up an escalator one step at a time, while the escalator itself move up at a constant speed. A walks twice as fast as B. A reaches the top in 40 steps and B in 30 steps. How many steps of the escalator can be seen when it is not moving?

- (1) 30
- (2) 40
- (3) 50
- (4) 60

17. Two iron spheres of radii 12 cm and 1 cm are melted and fused. Two new spheres are made without any loss of iron. Their possible radii could be:

- (1) 9 and 4 cm
- (2) 9 and 10 cm
- (3) 8 and 5 cm
- (4) 2 and 11 cm

18. A man buys alcohol at Rs. 75/cL, adds water, and sells it at Rs. 75/cL making a profit of 50%. What is the ratio of alcohol to water?

- (1) 2:1            (2) 1:2  
(3) 3:2            (4) 2:3

19. The sum of digits of a two-digit numbers is 9. If the fraction formed by taking 9 less than the number as numerator and 9 more than the number as denominator is  $\frac{3}{4}$ , what is the number?

- (1) 36            (2) 63  
(3) 45            (4) 54

20. The distance between X and Y is 1000km. A person flies from X at 8 AM local time and reaches Y at 10 AM local time. He flies back after a halt of 4 hours at Y and reaches X at 4 PM local time on the same day. What is his average speed for the duration he is in the air?

- (1) 500 km/hour  
(2) 250 km/hour  
(3) 750 km/hour  
(4) Cannot be calculated with the given information

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PART B

21. RNA editing, a post transcriptional process, is achieved with the help of guide RNA (g RNA) which one of the following statement about the process is NOT true?

- (1) g RNA dependant RNA editing happens in the kinetoplast of DNA.  
(2) g-RNA is involved in chemical modification of t-RNA.  
(3) This process involves insertion or deletion of uedines.  
(4) Sequences edited once may be re-edited using second g- RNA.

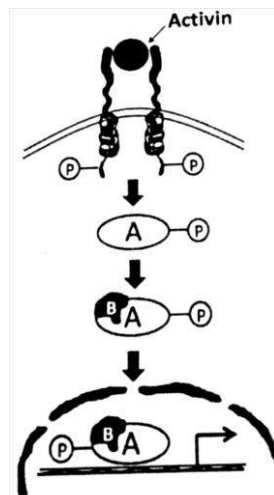
22. Telomerase, a RNA- protein complex which completes the replication of telomeres during DNA synthesis, is a specialized

- (1) RNA dependent DNA polymerase  
(2) DNA dependent DNA polymerase  
(3) DNA dependent RNA polymerase  
(4) RNA dependent RNA polymerase

23. 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

- (1) 105            (2) 20.5  
(3) 10.0            (4) 10.5

24.



In the above signaling cascade, which of the following molecules is denoted by 'B'?

- (1) STAT 5        (2) SMAD 6  
(3) GSK 3  $\beta$     (4) SMAD 4

25. The secondary antibodies routinely used for the detection of primary antibodies in western blotting experiment are

- (1) anti-allotypic            (2) anti-idiotypic  
(3) anti-isotypic            (4) anti-paratypic

26. Which of the following events will NOT usually lead to transformation of a normal cell into a cancer cell

- (1) Gain of function of oncogenes  
(2) Loss of function of tumor suppressors  
(3) Gain of function of genes involved in nucleotide excision repair  
(4) Loss of function of pro-apoptosis related genes

27. Which of the following a food borne toxin

- (1) Tetanus toxin            (2) Botulinum toxin  
(3) Cholera toxin            (4) Diphtheria toxin

28. Excess oxygen consumed after a vigorous exercise is

- (1) to pump out lactic acid from muscle  
(2) to increase the concentration of lactic acid in muscle  
(3) to reduce dissolved carbon dioxide in blood  
(4) to make ATP for gluconeogenesis

29. Which one of the following describes the primary function of flippases?

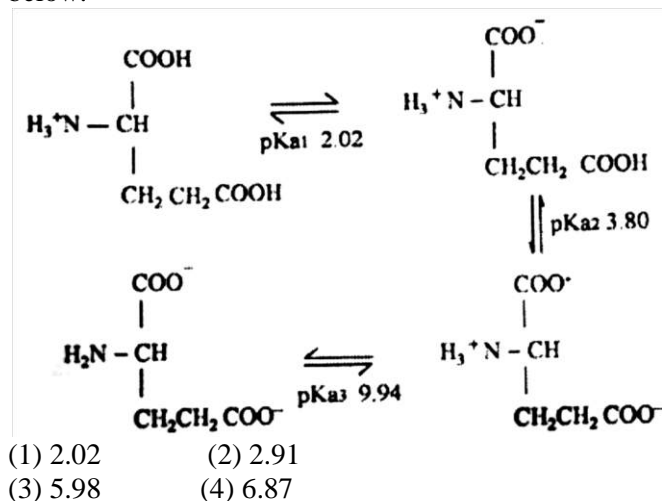
- (1) Help in increasing lipid protein interaction in the outer leaflet of the bilayer  
(2) Move certain phospholipids from one leaflet of the membrane to another  
(3) Localize more negatively charged membrane proteins in the lipid bilayer  
(4) Cause uncoupling of v-SNARES and t-SNARES after fusion of incoming vesicle with target membrane

30. Mitotic cyclin-CDK activity peaks in M phase. This is because

- (1) Mitotic cyclin is synthesized only in M phase.

- (2) Threshold level of mitotic cyclin accumulates only in late G2.  
 (3) Cyclin subunit is activated by phosphorylation only in M phase.  
 (4) The kinase subunit is activated by dephosphorylation only in M phase.

31. Choose the most appropriate pH at which the net charge is 0 for the molecule from the data shown below.



32. Choose the correct statement about peptides in Ramchandran plot.

- (1) Peptides that are unstructured will have all the backbone dihedral angles in the disallowed regions.  
 (2) It is not possible to conclude whether two peptide adopts entirely helix or entirely beta sheet confirmation.  
 (3) The occurrence of beta turn conformation formation in a peptide can be deduced.  
 (4) The sequence of a peptide can be deduced.

33. Equilibrium constant ( $K^{eq}$ ) of reaction is a ratio of product to substrate concentration. The reaction between ( $K^{eq}$ ) and free energy change in a reaction ( $\Delta G'$ ) is 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 statement is correct with respect to  $\Delta G'$ ?

- (1)  $\Delta G'$  of A =  $\Delta G'$  of B  
 (2)  $\Delta G'$  of A >  $\Delta G'$  of B  
 (3)  $\Delta G'$  of B >  $\Delta G'$  of A  
 (4)  $\Delta G'$  of A  $\approx$   $\Delta G'$  of B

34. The gel to liquid crystalline phase transition temperature in phosphatidyl choline (PC) lipids compose of dioleoyl (DO), dipalmitoyl (DP), disteoyl (DS) and palmitoyl oleoyl (PO) fatty acids in increasing order will be

- (1) DOPC > DPPC > POPC > DSPC  
 (2) DSPC > DPPC > POPC > DOPC  
 (3) DPPC > DSPC > DOPC > POPC  
 (4) POPC > DPPC > DOPC > DSPC

35. Which of the following is NOT an example of transmembrane transport between different subcellular compartments?

- (1) Transport from cytoplasm into lumen of the endoplasmic reticulum  
 (2) Transport from endoplasmic reticulum to the Golgi complex  
 (3) Transport from stroma into thylakoid space  
 (4) Transport from mitochondrial intermembrane space into the mitochondrial matrix

36. Which of the following are NOT transcribed by RNA polymerase II?

- (1) miRNA and some snRNA  
 (2) miRNA and snoRNA  
 (3) mRNA and snoRNA  
 (4) tRNA and 5S rRNA

37. Apical ectodermal ridge induction is essential tetrapod limb development. Which of the following is NOT essential for the formation of a functional limb?

- (1) Tbx genes and Wnt  
 (2) Androsterone  
 (3) Apoptotic gene  
 (4) Fibroblast growth factor

38. Which of the following statement is WRONG?

- (1) Megaspore develops within the megasporangium of the ovule  
 (2) Megaspore undergoes meiosis to produce four haploid megaspores  
 (3) All the four megaspore undergo several mitotic division to form female gametophyte in most angiosperms  
 (4) Female gametophyte is haploid

39. Certain proteins or mRNAs that are regionally localized within the unfertilized egg and regulate development are called

- (1) gene regulators.  
 (2) morphometric determinants .  
 (3) cytoplasmic determinants.  
 (4) mosaic forming factors.

40. Cell to cell communication is important in development of an organism. The ability of cells to respond to a specific inductive signal is called

- (1) Regional specificity of induction  
 (2) Competence  
 (3) Juxtacrine signalling  
 (4) Instructive interaction

41. Which one of the following compounds is NOT a part of alkaloid class of secondary metabolites?

- (1) Lignin            (2) Indole  
 (3) Tropane          (4) Pyrrolidine

42. Which one of the following best describe the symplast pathway of water flow from the epidermis to endodermis in plant root?



- (1) Water moves through cell walls and extracellular spaces without crossing any membrane  
 (2) Water travel across the root cortex via the plasmodesmata  
 (3) Water crosses the plasma membrane of each cell in its path twice, once on entering and once on exiting  
 (4) Transport across the tonoplast
43. The herbicide, dichlorophenyldimethylurea, is an inhibitor of  
 (1) Shikimate pathway for biosynthesis of aromatic amino acids.  
 (2) Electron transport from P680 to P700.  
 (3) Branch in amino acid pathway.  
 (4) Electron transport from P700 to ferredoxin.
44. Vasopressin secretion does NOT increase with  
 (1) Exercise  
 (2) An increase in extracellular fluid volume  
 (3) Standing  
 (4) Vommiting
45. Which one of the following does NOT occur due to stimulation of baroreceptors?  
 (1) Bradycardia (2) Hypotension  
 (3) Venodilation (4) Vasoconstriction
46. Serum has essentially the same composition as plasma EXCEPT that it lacks  
 (1) Albumin  
 (2) Stuart-Prower factor  
 (3) Antihemophilic factor  
 (4) Hageman factor
47. Which type of cells located in gastric glands is responsible for the release of histamine?  
 (1) Mucus neck cells  
 (2) Enterochromaffin like cells  
 (3) Cheif cells  
 (4) Parietal cells
48. Which one of the following plant derived signalling molecule induces hyphal branching of arbuscular mycorrhizal fungi, a phenomenon that is observed at the initial stages of colonisation of these fungi?  
 (1) Salicylic acid (2) Abscisic acid  
 (3) Strigolactones (4) Systemin
49. If non-disjunction occurs in meiosis I, which of the following scenario is most likely to occur?  
 (1) Two gametes will be  $n+1$  and two will be  $n-1$   
 (2) One gametes will be  $n+1$ , two will be 'n' and one will be  $n-1$   
 (3) Two gametes will be normal and two will be  $n-1$   
 (4) Two gametes will be normal and two will be  $n+1$
50. Which one of the following is true for cells harbouring F' plasmid?  
 (1) Their F plasmid is non-functional.  
 (2) They exhibit increased rates of transfer of all chromosomal genes.  
 (3) They are merodiploids.  
 (4) They fail to survive as the chromosomal origin of replication is inactivated.
51. Maternal inheritance of coiling of shell in snail (*limnaea 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?  
 (1) 3:1 (2) 1:1  
 (3) 1:3 (4) 1:2:1
52. Which of the following mutagens is most likely to results in a single amino acid change in a gene product?  
 (1) Acridine orange  
 (2) X-rays  
 (3) Ethylmethane sulphonate (EMS)  
 (4) Ethidium bromide
53. Which one of the following statements supports the concepts of trade-off in the evolution of life history trades?  
 (1) Level of parental care and clutch size are positively correlated.  
 (2) Animals mature in early tend to live longer  
 (3) An increase in the seed size is usually associated with the decrease in the seed number.  
 (4) Allocation of higher energy for reproduction leads to higher population growth
54. A plot of  $dN/dt$  as a function of population density yields a  
 (1) rectangular hyperbola  
 (2) negative exponential curve  
 (3) positive rectilinear curve  
 (4) bell- shaped curved
55. For a species having logistic growth, if  $K = 20,000$  and  $r = 0.15$ , the maximum sustainable yield will be  
 (1) 450 (2) 1500  
 (3) 3000 (4) 6000
56. which of the following is a correct ranking of ecosystems based on the roots: shoot ratio of plants?  
 (1) Tropical wet forest > Tropical dry forest > Temperate grassland > Tropical grassland  
 (2) Temperate grass land > Tropical grassland > Tropical wet forest > Tropical dry forest  
 (3) Tropical dry forest > Tropical wet forest > Tropical grassland > Temperate grassland  
 (4) Temperate grass land > Tropical grassland Tropical dry forest > Tropical wet forest
57. Which of the following periods is known as "Age of fishes"?

- (1) Devonian (2) Jurassic  
(3) Cambrian (4) Carboniferous

58. Which of the following is NOT an assumption of the Hardy- Weinberg model?

- (1) Population mates at random with respect to the locus in question  
(2) Selection is not acting on the locus in question.  
(3) One allele is dominant and other is recessive at this locus  
(4) The population is effectively infinite in size

59. Which of the following geographical periods is characterized by the first appearance of mammals?

- (1) Tertiary (2) Cretaceous  
(3) Permian (4) Triassic

60. An alga having chlorophyll a, floridean starch as storage product and lacking flagellate cells belongs to the class

- (1) Phaeophyceae (2) Chlorophyceae  
(3) Rhodophyceae (4) Xanthophyceae

61. Which of the following is NOT true for monocots?

- (1) Sieve tube members with companion cells  
(2) Vasculature atactostelic  
(3) Tricolpate pollen  
(4) Vascular cambium absent.

62. Individuals occupying a particular habitat and adapted to it phenotypically but not genotypically are known as

- (1) Ecophenes (2) Ecotypes  
(3) Ecospecies (4) Coenospecies

63. Different leads are used to record ECG of humans. Which one of the following is NOT unipolar leads?

- (1) Augmented limb leads  
(2) V1 and V2 leads  
(3) Standard limb leads  
(4) VR and VL leads

64. The presence and distribution of specific mRNAs within a cell can be detected by

- (1) Northern blot analysis  
(2) RNase protection assay  
(3) In situ hybridization  
(4) Real-time PCR

65. In which of the following mating systems there is likely to be NO conflict of interest over reproductive success between the sexes?

- (1) polyandry (2) monogamy  
(3) promiscuity (4) polygamy

66. Which one of the following analytical techniques does NOT involve an optical measurement?

- (1) ELISA  
(2) Microarray  
(3) Flow cytometry

(4) Differential Scanning Calorimetry

67. Which genes have been introduced in Bollgard II cotton to get resistance against cotton bollworm, tobacco bollworm and pink bollworm?

- (1) cry 1Ab + cry 1Ac  
(2) cry 1Ac + cry 2 Ab  
(3) cry 1Ab + cry 2 Ab  
(4) cry9 C cry 1Ab

68. An optical measurement of protein is taken both before and after digestion of the protein by a protease. In which of the following spectroscopic measurement the signal change, i.e., before v/s after protease treatment, could be the maximum?

- (1) Absorbance at 280 nm  
(2) Circular dichromism  
(3) Absorbance at 340nm  
(4) Fluorescence value

69. The tetanus vaccine given to humans in the case of a deep cut is a

- (1) DNA vaccine  
(2) Recombinant vector vaccine  
(3) Subunit vaccine  
(4) Toxoid vaccine

70. The electrospray ionization spectrum of a mixture of two peptides show peak with m/z values 301, 401, 501 and 601. The molecular weight of the peptides are

- (1) 1200 and 1250  
(2) 1200 and 1500  
(3) 1350 and 1500  
(4) 1220 and 1350

#### PART C

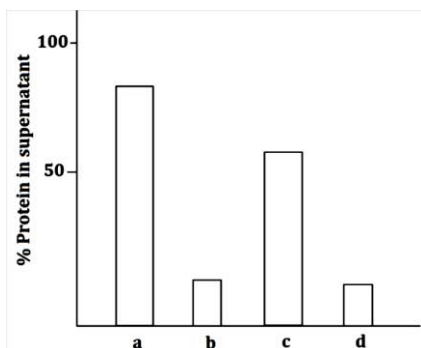
71. From the following statements,

- A. For a reaction to occur spontaneously the free energy change must be negative  
B. The interaction between two nitrogen molecules in the gaseous state is predominantly electrostatic  
C. By knowing the bond energies, it is possible to deduce whether the bond is covalent or hydrogen bond  
D. Hydrophobic interactions are not important in a folded globular protein.

Pick the combination with ALL WRONG statements.

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

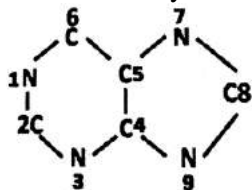
72. A researcher investigated the a set of conditions for a protein with an isoelectric point of 6.5 and also bind to calcium. This protein was subjected to four independent treatments: (i) pH 6.4, (ii) 10% glycerol, (iii) 10mM CaCl<sub>2</sub>, (iv) 40% ammonium sulphate. This was followed by centrifugation and estimation of protein in supernatant. The results are depicted in the graph below:



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

- (1) a = ammonium sulphate, b = glycerol, c = pH 6.4, d = CaCl<sub>2</sub>
- (2) a = CaCl<sub>2</sub>, b = glycerol, c = ammonium sulphate, d = pH 6.4
- (3) a = pH 6.4, b = CaCl<sub>2</sub>, c = ammonium sulphate, d = glycerol
- (4) a = CaCl<sub>2</sub>, b = pH 6.4, c = glycerol, d = ammonium sulphate

73. In the biosynthesis of purine:



- (1) All N atoms, C4 and C5 from Aspartic acid
- (2) N1 is from aspartic acid; N3 and N9 are from Glutamine side-chain; N7, C4 and C5 are from Glycine
- (3) N1 is from Aspartic acid; N3 from Glutamine side-chain; N9 from N attached to C $\alpha$  of Glutamine; N7, C4 and C5 from Glycine
- (4) N1 is from Glutamine; N3 from Glutamine side-chain; N9 from N attached to C $\alpha$  of Glutamine; N7, C4 and C5 from Glycine

74. 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

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

75. The following are four statements on the peptides/proteins conformation:

- A. Glycine has a largest area of conformationally allowed space in the Ramachandran plot of  $\Phi$  and  $\Psi$
- B. 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

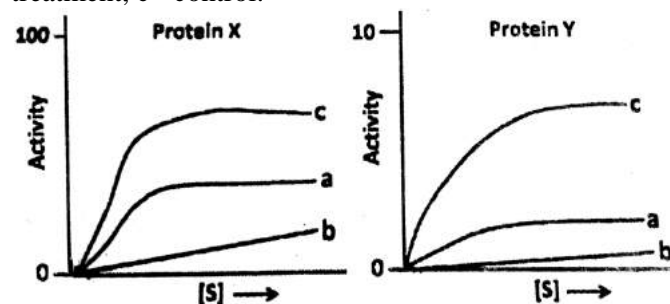
C. The allowed values of  $\Phi$ ,  $\Psi$  for amino acids in a protein are not valid for short peptide

D. A peptide Acetyl-A1 – A2 – A3 – A4-CONH<sub>2</sub> (A – A4 are amino acids) adopts well defined  $\beta$ -turn. The dihedral angles of A2 and A3 determined the type of  $\beta$ -turn

Choose the combination of correct statements.

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

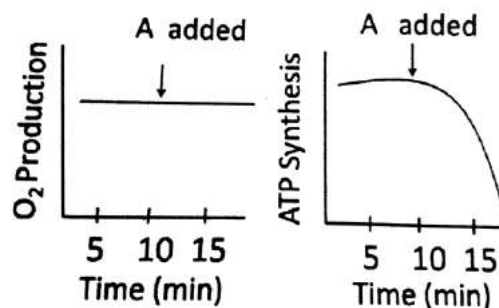
76. A researcher was investigating the substrate specificity of two different enzymes, X and Y, on the same substrate. Both the enzymes were subjected to treatment with either heat or an inhibitor which inhibits the enzyme activity. Following are the results obtained where, a = inhibitor treatment, b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



Which of the following statements is correct?

- (1) Only protein X is specific for the substrate, S
- (2) Only protein Y is specific for the substrate, S
- (3) Both X and Y are specific for the substrate, S
- (4) Both X and Y are non-specific for the substrate, S

77. 'A' is an inhibitor of chloroplast function. The production of O<sub>2</sub> and synthesis of ATP are measured in illuminated chloroplast before and after addition of 'A' as shown below.



Which statement is correct?

- (1) 'A' inhibits the reduction of NADP<sup>+</sup>
- (2) 'A' inhibits the proton gradient and the reduction of NADP<sup>+</sup>
- (3) 'A' inhibits the proton gradient but not the reduction of NADP<sup>+</sup>
- (4) 'A' inhibits neither the proton gradient nor the reduction of NADP<sup>+</sup>

78. During cell cycle progression from G<sub>1</sub> 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 statement is true?

- (1) 'A' inhibits Rb-E2F interaction
- (2) 'A' inhibits CDK4 activity
- (3) 'A' phosphorylates E2F
- (4) 'A' degrades Rb

79. Cells in S- phase of the cell cycle were fused to cells in the following stages of cell cycle: (a) G1 phase, (b) G2 phase, (c) M phase these cells were then grown in the medium containing tritiated thymidine. The maximal amount of freshly labelled DNA is likely to be obtained in S- phase cells fused with

- (1) G1 phase cells
- (2) G2 phase cells
- (3) M phase cells
- (4) Both G1 and G2 phase cells

80. Addition of antibiotic cephalixin to growing *E. coli* cells lead to filamentation of the cells, followed by lysis. Cephalixin is an inhibitor of

- (1) Protein synthesis
- (2) DNA synthesis
- (3) Peptidoglycan synthesis
- (4) RNA polymerase

81. 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 the best sequence in which these events occur?

- (1)  $a \rightarrow b \rightarrow c$
- (2)  $b \rightarrow c \rightarrow a$
- (3)  $c \rightarrow a \rightarrow b$
- (4)  $c \rightarrow b \rightarrow a$

82. 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 the gene coding a pre-mRNA, with a single intron was mutated either at 5' or 3' splice sites or both the splice site.

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.

C. Pre-mRNA mutated at either 3' or 5' splice sites will be retained in the nucleus because of the presence of bound snRNPs

D. Pre-mRNA mutated at either 3' or 5' splice sites will be exported to cytosol because of the absence of bound snRNPs

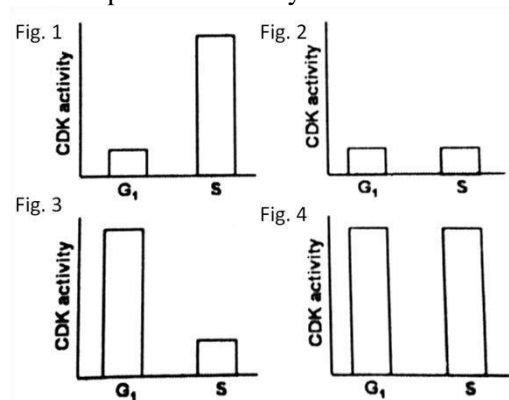
Choose the correct combination of possible outcomes:

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

83. Telomerase, a protein RNA complex, has special reverse transcriptase activity that completes replication of telomerase 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?

- (1) Telomerase requires a template to direct the addition of nucleotide
- (2) Telomerase can only extend a 3'-OH end of DNA
- (3) Telomerase does not carry out lagging strand synthesis
- (4) Telomerase acts in processive manner

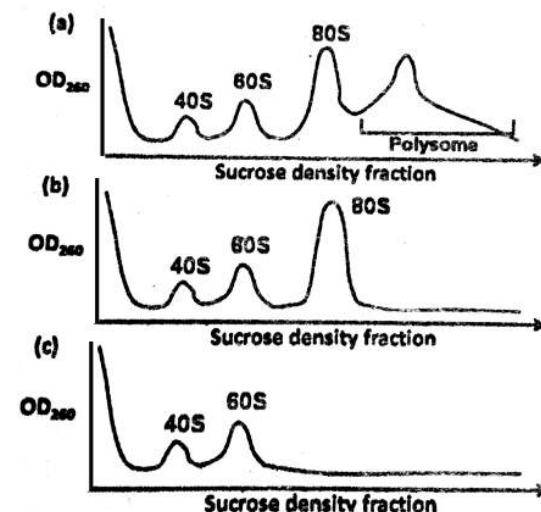
84. In eukaryotes, a specific cyclin dependent kinase (CDK) activity is required for the activation of loaded helicases to initiate replication. On the contrary, this CDK activity inhibits the loading of helicases onto the origin of replication. Considering the fact that during each cycle, there is only one opportunity for helicases to be loaded on to origins and only one opportunity for these helicases to be activated, which one of the following graphs best depicts this CDK activity in G1 and S phases of cell cycle?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

85. Polysome profiling of cells treated with three hypothetical translation inhibitors is shown in the plot below. These three inhibitors are

- (i) CHP – leaky inhibitor of translation
- (ii) LTM – arrests ribosomes at the initiation codon
- (iii) PTM – inhibits ribosome scanning





Match the polysome profile to the inhibitor

- (1) (i) – a; (ii) – b; (iii) – c
- (2) (i) – b; (ii) – c; (iii) – a
- (3) (i) – c; (ii) – b; (iii) – a
- (4) (i) – a; (ii) – c; (iii) – b

86. In mammals CG rich sequences are usually methylated at C, which is a way for making 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?

- (1) Methylation of cytosine does not prevent the binding of RNA Pol II with the promoter, so housekeeping genes are expressed.
- (2) During housekeeping gene expression, the enzyme methyl transferase is temporarily silenced by mi-RNA, thus shutting down global methylation.
- (3) Unlike within the coding region of a gene, CG rich sequences present in the promoters of active genes are usually not methylated.
- (4) As soon as the Cytosine is methylated in the promoter region, the enzymes of DNA repair pathways remove the methyl group, thereby ensuring gene expression.

87. 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 100,000g, the pellet was extracted with 5M NaCl and again centrifused at 100,000g. Which of the following protein will be present in supernatant?

- (1) Band3
- (2) Glycophorin
- (3) G protein- coupled receptor
- (4) Spectrin

88. In order to study 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<sup>+</sup>- ATPase, A-GFP does not co-localize with LAMP1. Instead, it localizes with LC3 puncta. Which one of the following statements is true?

- (1) A-GFP targets to the ER in the absence of bafilomycin A.
- (2) Autophagy is required for trafficking of A-GFP to lysosome.
- (3) Bafilomycin A facilitates targeting of A-GFP to ER.
- (4) Bafilomycin A facilitates targeting of A-GFP to mitochondria.

89. In animals, four separates families of cell – cell adhesion proteins are listed in Column A and their functional characteristics are given in Column B

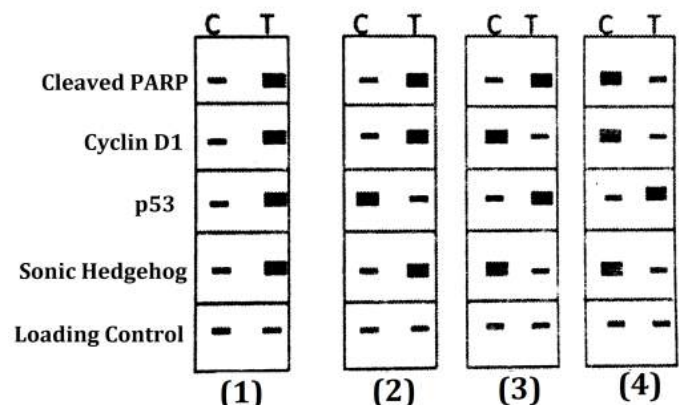
A	B
(a) Integrin	(i) Lectins that mediates a variety of transient, cell- cell adhesion interactions in the blood stream

(b) Cadherin	(ii) Contains extracellular Ig-like domain and are mainly involved in the fine tuning of cell-cell adhesive interaction during development and regeneration.
(c) Ig-superfamily	(iii) Mediates Ca <sup>2+</sup> -dependent strong homophilic cell – cell adhesion.
(d) Selectin	(iv) Transmembrane cell adhesion proteins that acts as a extracellular matrix receptor

Which one of the following is the correct combination?

- (1) a – (i), b – (ii), c – (iii), d – (iv)
- (2) a – (ii), b – (iii), c – (iv), d – (i)
- (3) a – (iii), b – (iv), c – (i), d – (ii)
- (4) a – (iv), b – (iii), c – (ii), d – (i)

90. A student treated cancer cells with an anticancer drug and perform western blot analysis. Which one of the following blots is the best representation under the control (C) and treated (T) samples?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

91. 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

- (1) A specific RNA ligase
- (2) The process of trans-splicing
- (3) A nucleophilic attack caused by free guanine nucleotide
- (4) A nucleophilic attack caused by 2' OH of an internal A present in the leader sequence

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

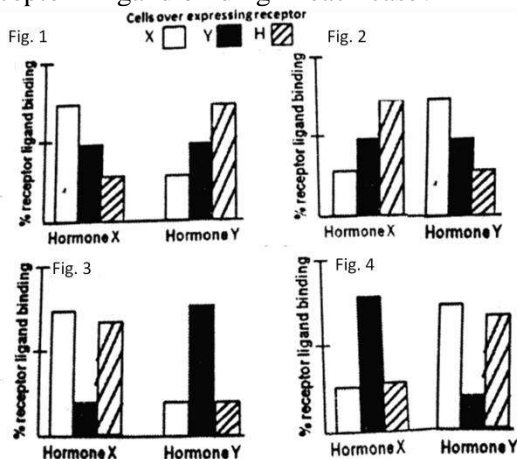
A	B
(a) <i>Trypanosoma brucei</i>	(i) Capable of employing unusual genetic processes by which they generate extensive variations in their surface glycoproteins ( VSG)
(b) <i>Plasmodium falciparum</i>	(ii) Capable of continually undergoing maturational changes in transformation to two different forms which allow the organism to change its surface molecules

(c) <i>Haemophilus influenzae</i>	(iii) Capable of invading immune response by frequent antigenic changes in its hemagglutinin and neuraminidase glycoproteins
-----------------------------------	--

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

- (1) a – (i), b – (ii), c – (iii)
- (2) a – (ii), b – (iii), c – (i)
- (3) a – (iii), b – (i), c – (ii)
- (4) a – (i), b – (iii), c – (ii)

93. Two steroid hormone receptors X and Y both contain a ligand 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 overexpressing 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?



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

94. A protein X is kept 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 the nucleus and results in the transcription of a gene which causes cell death by apoptosis. Stress stimuli were given to the following four different cases

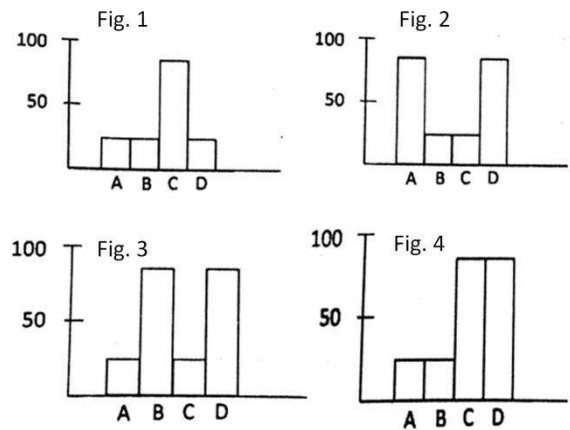
Case A: Protein Y has a mutation such that phosphorylation leading to proteasomal degradation does not occur.

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: Cells are transfected only with an 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 of the following graphs best describes the apoptotic state of the cells in the above cases? Y-axis represents % apoptotic cells.



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

95. 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. IP<sub>3</sub>, which is formed at site of sperm entry, sequesters calcium leading to cortical granule exocytosis.

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

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

96. 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?

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

97. 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?

- (1) CED-4 resembles Apaf-1
- (2) CED-9 resembles Bcl-XL

- (3) CED-3 resembles caspase-3  
 (4) CED-4 resembles caspase-9

98. Which one of the following statements regarding B cell receptor (BCR) and T cell receptor (TCR) is not true?

- (1) TCR is membrane bound and does not appear as soluble form as does the BCR  
 (2) Unlike BCR, most of the TCR are not specific for antigen alone but for antigen combined with MHC  
 (3) In order to activate signal transduction, BCR associates itself with Ig- $\alpha$ /Ig- $\beta$  whereas TCR associates with CD3  
 (4) Antigen binding interaction of BCR is much weaker than TCR

99. 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  $\beta$ -catenin and Chordin are produced by the organizer

Which of the above statements are correct?

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

100. 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?

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

101. Read the following statements related to plant pathogen interaction

- A. Systemic acquired resistance is observed following infection by compatible pathogen  
 B. Induce systemic resistance is activated following infection by compatible pathogen  
 C. A bacterial infection can induce effector triggered immunity (ETI) leading to hypersensitive response locally  
 D. NPR1 monomers that are released in cytosol due to salicylic acid accumulation is rapidly translocated to nucleus

Which combination of above statements is correct?

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

102. Given below are statements describing various features of solute transport and photoassimilate translocation in plants:

- A. Apoplastic phloem loading of sucrose happens between cells with no plasmodesmatal connections.  
 B. Growing vegetative sinks (e.g. young leaves and roots) usually undergo symplastic phloem unloading  
 C. Movement of water between the phloem and xylem occurs only at the source and sink regions  
 D. Symplastic loading of sugars into the phloem occurs in the absences of plasmodesmatal connections

Select the option that gives combination of correct statements:

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

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

I	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;

- (1) A-iii, B-ii, C-iv, D-I  
 (2) A-iv, B-iii, C-i, D-ii  
 (3) A-iii, B-iv, C-i, D-ii  
 (4) A-i, B-iv, C-iii, D-ii

104. If in a blood transfusion, type A donor blood is given to recipient having type B blood, the red blood cells (RBC) of donor blood would agglutinate but the recipients 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 agglutinations of recipients RBC's.



D. High agglutination of donor RBC's is the outcome high titre of anti-B agglutinins

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

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

105. The arterial pressure usually raises 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.

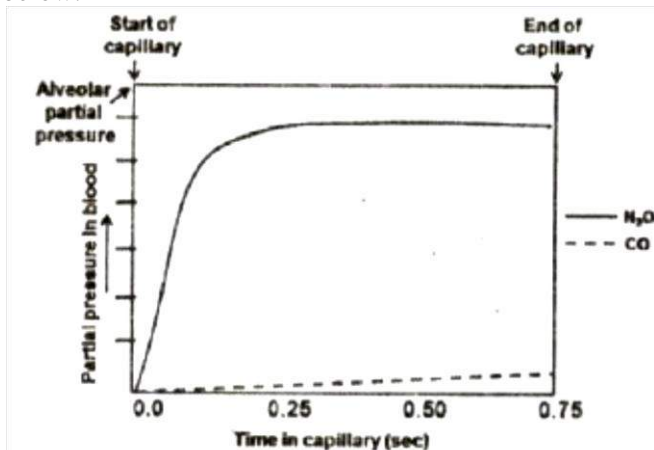
C. The activity of medullary respiratory centers can influence the vasomotor center.

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?

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

106. The uptake of nitrous oxide (N<sub>2</sub>O) 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 reason for difference in the pattern of alveolar gas exchange of N<sub>2</sub>O and CO have been proposed in the following statements:

A. N<sub>2</sub>O does not chemically combine with proteins in blood but equilibrate rapidly between alveolar gas and blood.

B. CO has high solubility in the blood

C. CO has high solubility in the alveolar capillary membrane.

D. The dispersion of N<sub>2</sub>O between alveolar gas and blood is considered as diffusion limited.

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

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

107. 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?

- (1) APETALA 2 (2) APETALA 3  
(3) PISTILLATA (4) AGAMOUS

108. In photosynthetic electron transport, electrons travel through carriers organized in the "Z-scheme". The following are indicated as directions of electron flow:

A. P680 → PQA → PQB → Cytb<sub>6</sub>f → Pheo → PC → P700

B. P700 → A0 → A1 → FeS<sub>x</sub> → FeSA → FeSB → Fd

C. P680 → Pheo → PQA → PQB → Cytb<sub>6</sub>f → PC → P700

D. P700 → A1 → A0 → FeSB → FeSA → FeSX → Fd

Which of the following combinations is correct?

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

109. Phytochrome-mediated control of photomorphogenesis is linked to many other gene functions. The following statements are made on the mechanism of phytochrome action:

A. Phytochrome function requires COP1, an E3 ubiquitin ligase that brings about protein degradation.

B. COP1 is slowly exported from the nucleus to the cytoplasm in the presence of light.

C. HY5 is targeted by COP1 for degradation in the presence of light.

D. HY5 is a transcription factor involved in photomorphogenetic response.

Which of the following combinations is correct?

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

110. The C<sub>4</sub> carbon cycle is a CO<sub>2</sub> concentrating mechanism evolved to reduce photorespiration. The following are stated as important features of the C<sub>4</sub> pathway:

A. The leaves of C<sub>4</sub> plants have Kranz anatomy that distinguishes mesophyll and bundle sheath cells.

B. In the peripheral mesophyll cells, atmospheric CO<sub>2</sub> is fixed by phosphoenol pyruvate carboxylase yielding a four-carbon acid.

C. In the inner layer of mesophyll, NAD-malic enzyme decarboxylates four-carbon acid and releases CO<sub>2</sub>.

D. CO<sub>2</sub> is again re-fixed through Calvin cycle in the bundle sheath cells.

Which one of the following combinations is correct?



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

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

- (1) Blindness in the left eye but the visual field of right remains intact.  
(2) Blindness in the right half of the visual fields of both the eyes.  
(3) Blindness in the left half of the visual field of left eye and blindness in the right half of the visual field of the right eye.  
(4) Blindness in the left half of the visual field of both the eyes.

113. Inversions are considered as cross-over suppressors because:

- (1) Homozygous inversions are lethal and thus they do not appear in next generation.  
(2) 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.  
(3) 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.  
(4) The pairing and crossing overs do occur in inversion heterozygotes but the gametes having cross over products are lethal.

114. Three *met- E. coli* mutant strains were isolated. To study the nature of mutation these mutant strains were treated with mutagens EMS or proflavins and scored for revertants. The results obtained are summarized below:

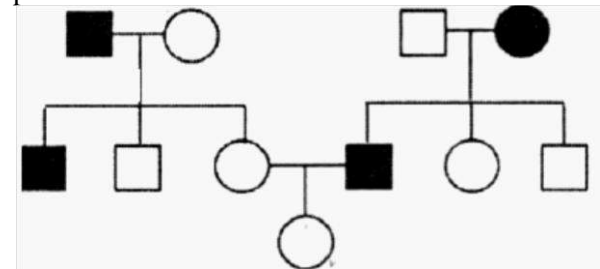
Mutant Strain	Mutagen treatment	
	Proflavin	EMS
A	-	+
B	+	-
C	-	-

(+ 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?

- (1) A-Transversion; B- Insertion or deletion of a single base; C- Deletion of multiple bases  
(2) A-Transition; B- Transversion; C- Insertion or deletion of a single base  
(3) A- Insertion or deletion of a single base; B- Transition; C- Deletion of multiple bases  
(4) A-Transition; B- Insertion or deletion of a multiple bases; C- Transversion

115. 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.

- (1) X-linked recessive, probability is 1/2  
(2) X-linked recessive, probability is 1/4  
(3) Autosomal recessive, probability is 1/2  
(4) Autosomal recessive, probability is 1/3

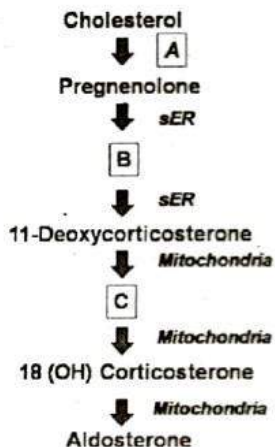
116. A pair of alleles govern seed size in a crop plant. 'B' allele responsible for bold seed is dominant over 'b' allele controlling small seed. An experiment was carried out to test if an identified dominant DNA marker (5kb band) is linked to alleles controlling seed size. A plant heterozygous for 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 result 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?

- (1) The DNA marker assort independently of the phenotype  
(2) The 5kb band is linked to the allele 'B'  
(3) The 5kb band is linked to the allele 'b'  
(4) The DNA marker assort independently with bold seed but is linked to the small seed trait.

117. The following diagram represents steroidogenic pathway in the Zona Glomerulosa of the adrenal cortex:



What do A, B and C represents, respectively?

- (1) sER , Progesterone , 11(OH) cortisol
- (2) Mitochondria, Progesterone, Corticosterone
- (3) Mitochondria, 3β-pregnenolone, 11(OH) cortisol
- (4) sER, Progesterone, Corticosterone

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



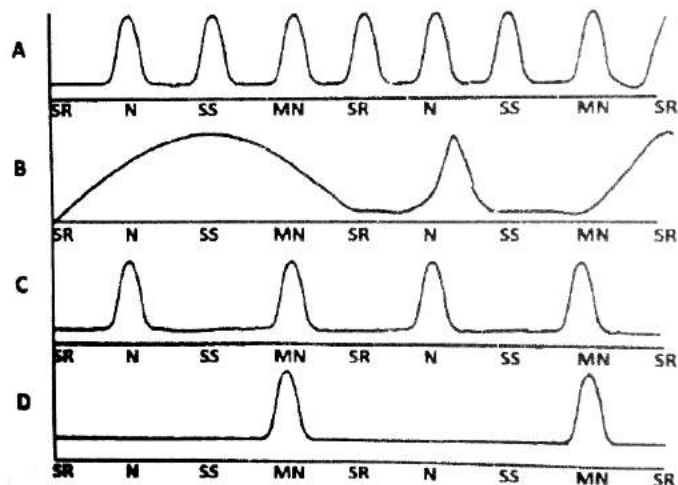
(The bars represent the extent of deletion in each case) Four point mutations (a to d) are tested against four deletions for their ability (+) or inability (-) to give wild type (rII+) recombinants. The results are summarized below:

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

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

- (1) b-d-a-c
- (2) d-b-a-c
- (3) d-b-c-a
- (4) c-d-a-b

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



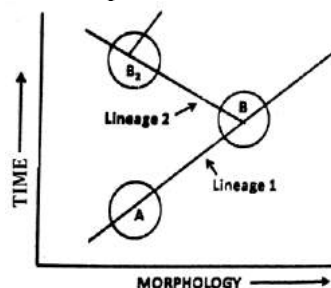
Which of the plot(s) represents the ultradian biological rhythm(s)?

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

120. The Population of the Non-poisonous butterflies have the same the color pattern as some highly poisonous butterflies. Assume that the population of non-poisonous butterflies is higher than the poisonous butterflies. Given this, what will be the impact of this mimicry on the fitness of the population of the poisonous butterflies in the presence of the predator?

- (1) It will lower the fitness, that is, fitness of the mimic is negatively frequency – dependent
- (2) It will increase the fitness, that is, fitness of the mimic is positively frequency dependent
- (3) It will not affect the fitness, that is, fitness of the mimic is frequency independent
- (4) It will increase fitness, that is, fitness of the mimic is negatively frequency dependent

121. The given below is the graphical representation of the changes in morphological features over a period of the geological time scale, where population A accumulates heritable morphological features and give rise to distinct species B. Population B splits in to a distinct species B2



Which of the following lineage represent the pattern of speciation by cladogenesis?

- (1) Lineage 1
- (2) Both lineage 1 And 2
- (3) Lineage 2
- (4) Neither of the lineage 1 and 2

122. Red hair is a recessive trait in human. In a randomly mating population in Hardy-Weinberg equilibrium approximately 9% of individuals are red-haired. What is the frequency of the heterozygotes?

- (1) 81%
- (2) 49%
- (3) 42%
- (4) 18%

123. 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 given.

Strain	Time of Entry				
Hfr #1	met (5')	thr (17')	strr (25')	phe (30')	pro (45')
Hfr #2	strr (15')	purr (28')	pro (35')	his (45')	met (55')
Hfr #3	pro (2')	his (12')	met (22')	strr (42')	phe (47')

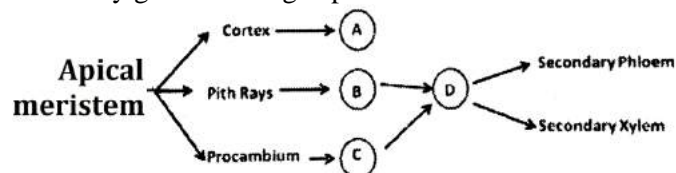
Using the above data, predict the correct sequence of markers on the *E. coli* chromosome.

- (1) *met-thr- str<sup>r</sup> -phe-pro-pur<sup>r</sup>-his*
- (2) *pur<sup>r</sup>-pro-his-met-thr- str<sup>r</sup>-phe*
- (3) *str<sup>r</sup>- pur<sup>r</sup>-his-met-phe-pro- str<sup>r</sup>*
- (4) *his-met-phe-thr-pro- str<sup>r</sup>- pur<sup>r</sup>*

124. Paripatus 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

- (1) Nematoda and Annelida: continuous muscle layers in body wall, unjointed legs and nephridia being nematode character while haemocoel, trachea and dorsal tubular heart being annelid character.
- (2) Annelida and Arthropoda: unjointed legs and nephridia being annelid characters while claws, jaws, haemocoel, trachea and dorsal tubular heart being arthropod characters.
- (3) Arthropod and Mollusca: unjointed legs and nephridia being mollusca characters while claws, jaws, trachea, dorsal tubular heart being arthropod characters
- (4) Nematoda and Arthropoda: contentious muscles layers, unjointed legs and nephridia being nematode characters while claws, jaws, haemocoel, trachea and dorsal tubular heart being arthropod characters

125. The following schematic diagram represents secondary growth in angiosperms



Based on above scheme which of the following option represents correct identity of the cambia labelled as A, B, C and D

- (1) A- Inter-fascicular, B- Fascicular, C- Vascular, D- Cork
- (2) A- Fascicular, B- Inter-fascicular, C- - Vascular, D- Cork
- (3) A- Cork, B- Inter-fascicular, C- Fascicular, D- Vascular
- (4) A- Cork, B- Fascicular, C- Inter-fascicular, D- Vascular

126. The table below list the major fungal groups and their characteristics:

Fungal Groups		Characteristics	
A	Ascomycota	i	Hyphae aseptate, coenocytic, asexual reproduction by sporangiophores
B	Chytrids	ii	Hyphae aseptate, coenocytic, asexual reproduction by zoospores
C	Glomeromycetes	iii	Hyphae aseptate, coenocytic, no sexual spores
D	Zygomycete	iv	Hyphae septate or

s	unicellular, asexual reproduction by conidia
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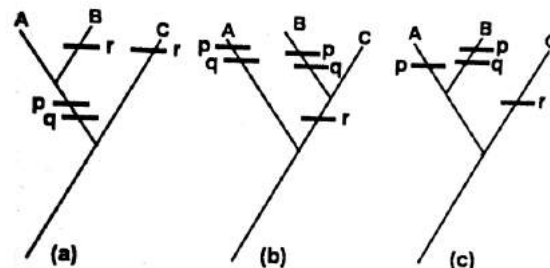
Which of the following represents the appropriate match between the fungal group and their characteristics?

- (1) A-ii, B-iii, C-i, D-iv
- (2) A-iv, B-ii, C-iii, D-i
- (3) A- i, B-iv, C-iii, D-ii
- (4) A-ii, B-iv, C-iii, D-i

127. As a biologist you want to classify three taxa, A, B and C. You have the information of the 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 the trait found in the three taxa 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 the principle of parsimony select the correct option:

- (1) Both 'a' and 'b' cladograms are possible
- (2) Only 'b' cladogram is possible
- (3) Only 'c' cladogram is possible
- (4) Only 'a' cladogram is possible

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

	Pathogen	Disease	
A	<i>Bordetella pertusis</i>	i	Lyme disease of humans
B	<i>Tilletia indica</i>	ii	Grain rot in rice
C	<i>Borrelia burgdorferi</i>	iii	Karnal blunt of wheat
D	<i>Anaplasma marginale</i>	iv	Whooping cough in Humans
E	<i>Burkholderia glumae</i>	v	Hemolytic anemia in Cattle

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

- (1) A- iv, B-iii, C-i, D-v, E-ii
- (2) A-iv, B- v, C- i , D-ii, E-iii
- (3) A- iii, B-iv, C-v, D-i, E- ii
- (4) A-ii, B-v, C-i, D-iii, E-iv

129. Given below are statements pertaining to organisms belonging to three domains of life. Identify INCORRECT statement.

- (1) Unlike Bacteria and Eukarya, some Archeal membrane lipids contain long chain hydrocarbons connected to Glycerol molecule by ether linkage
- (2) Peptidoglycans are absent in cell wall of Archea

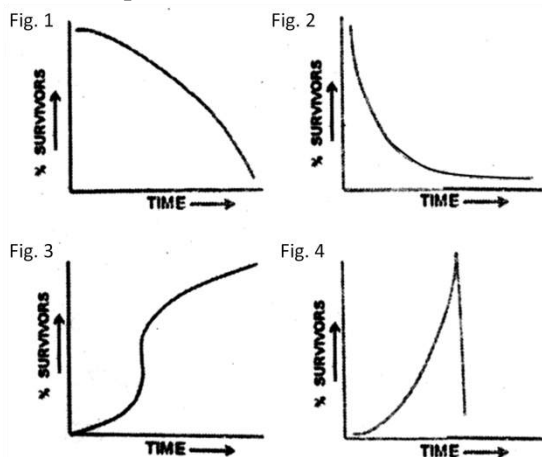
(3) Proteobacteria include many species bacteriochlorophyll containing sulphur using Photoautotrophs

(4) Mycoplasma, a group of low GC content gram positive bacteria lack the cell wall, belonging to same family of gram positive of mycobacteriaceae

130. You observed the 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 choice given below what would be your inference from these observations.

- (1) Upper strata of intertidal rocks is the realised niche of the species 1
- (2) Upper strata of intertidal rocks is the fundamental niche of the species 1
- (3) Species 1 and species 2 exhibit mutualism
- (4) Species 1 can compete out species 2

131. In natural system, a species producing large number of offsprings with little or no parental care generally exhibits which one of the following kind of survivorship curve



- (1) Fig 1
- (2) Fig 2
- (3) Fig 3
- (4) Fig 4

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

Geographical range		Local name of grassland	
i	Asia	A	Pampas
ii	North America	B	Prairies
iii	South America	C	Steppes
iv	South Africa	D	Veldt

- (1) i-C, ii-B, iii- D, iv-A
- (2) i- C, ii-B, iii-A, iv-D
- (3) i- D, ii-B, iii-A, iv-C
- (4) i-B, ii-C, iii-A, iv-D

133. Following is the hypothetical life table for species

Age Class (x)	Number alive (n <sub>x</sub> )	Number dying (d <sub>x</sub> )	Age specific survivorship (l <sub>x</sub> )	Age specific fertility (m <sub>x</sub> )
0-5	100	50	--	0.0
5-10	50	--	0.5	0.5
10-15	--	10	--	0.5

15-20	20	10	0.2	1.0
20-25	--	10	--	1.0

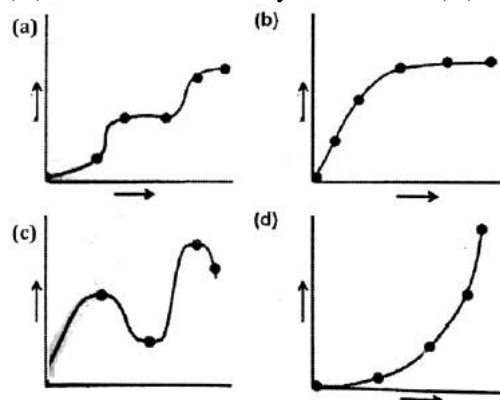
Which one of the following is the correct net reproductive rate (R<sub>0</sub>)

- (1) 0.0
- (2) 0.3
- (3) 0.7
- (4) 1.5

134. Which one of the following statements is true for trends of the dissolved oxygen (DO) and biological oxygen demand in water stream receiving pollutants from point source.

- (1) In septic zone, both DO and BOD levels remains stationary
- (2) In recovery zone, both DO and BOD levels increase rapidly
- (3) In decomposition zone, DO levels drop rapidly whereas BOD level remains more or less stable
- (4) In septic zone, DO levels decrease and BOD level increase whereas in recovery zone DO increase and BOD decrease

135. Following are the graphical representation of various hypothesis proposed for explaining the possible relationship between the species richness on (X) axis and community services on (Y) axis.



Which of the following is the correct match between the graphical representation and the hypothesis

- (1) a- redundancy, b- keystone, c- rivat, d- idiosyncratic
- (2) a- idiosyncratic, b- rivat, c- keystone, d- redundancy
- (3) a- rivat, b- redundancy, c- idiosyncratic, d- keystone
- (4) a-rivat, b- keystone, c- redundancy, d-idiosyncratic

136. Agobacterium Ti plasmid vectors are used to generate transgenic plants. The following are examples of vir gene encoded proteins that are important for transfer of T-DNA in to plants.

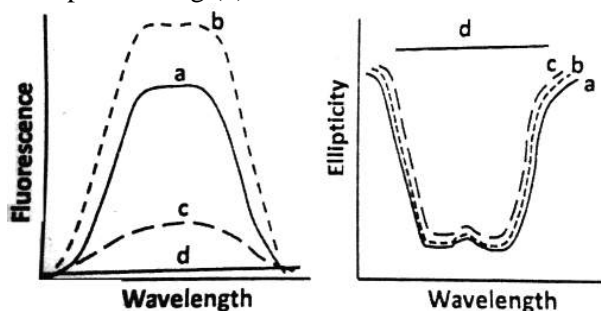
- A- vir E, single stranded DNA binding protein
- B- virD2 that generates T-strands
- C- vir A that sense plant phenolic compounds
- D- vir F which directs T complex proteins for destruction in proteasome

Which one of the following combination of the proteins functions inside the plant cell?

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



137. Researcher is investigating structural changes in protein by following tryptophan fluorescence and by Circular dichroism. Fluorescence and CD spectra of pure protein were obtained in the absence of any treatment (a), in the presence of 0.5 molar urea (b), upon adding acrylamide, a quencher of tryptophan (c) and upon heating (d) the data are shown below.



Which one of the following statements is correct?

- (1) CD is more sensitive to structural changes than fluorescence
- (2) Fluorescence is more sensitive to structural changes than CD
- (3) Both the methods are equally responsive to structural changes
- (4) Acrylamide alter the secondary structure of the protein

138. Polynucleotide kinase (PNK) is frequently used for radio labeling DNA or RNA by phosphorylating 5' end of non-phosphorylated polynucleotide gene. Which of the following statements about PNK is NOT true?

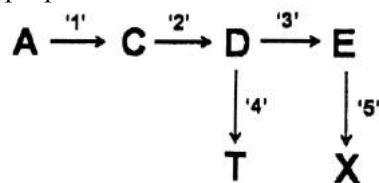
- (1) PNK catalyse the transfer of alpha phosphate from ATP to 5' end of polypeptide chains of (DNA or RNA)
- (2) PNK has three phosphatase activity
- (3) PNK is inhibited by small amount of ammonium ions
- (4) PNK is T4 bacteriophage encoded enzyme

139. A gene encoding for protein X was cloned in an expression vector under the T7 RNA polymerase promoter and lac operator. Cells were incubated by the addition of 1 mM IPTG at 37°C for 6 h. Cells were lysed and fractionised into insoluble bodies. Which one of the following strategies would you use to express protein X in the soluble fraction (cell free supernatant)?

- (1) Increase the duration of induction with 1mM IPTG
- (2) Grow cells at lower temperature after induction with 1mM IPTG
- (3) Increase the concentration of IPTG
- (4) Grow cells at higher temperature after induction with 1 mM IPTG

140. Engineering of metabolic pathways in plants can be achieved by introduction and overexpression 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 in to products 'T' and 'X'

through a series of enzymatic reactions. Enzymes 1-5 are involved in this pathway. Scientists attempted to increase the levels of 'X' by introducing 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:

A- Enzyme '4' has greater affinity for D than enzyme '3'

B- Feedback inhibition of enzyme '5' by compound X

C- Substrate limitation for enzyme '5'

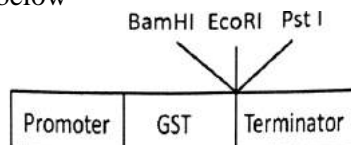
Which of the above statement could represent probable reasons for NOT obtaining proportionate increase in the amount of 'X' in the transgenic plants?

- (1) Only C
- (2) Only A and B
- (3) Only A
- (4) A, B and C

141. 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 experiment were different. Transgenic plant obtained following the retransformation experiment were screened for salt stress resistance and single copy event were identified by southern hybridization. These single copy event were self - pollinated. In the event of the two T-DNA (containing the A and B transgenes) getting integrated in unlinked location in all transgenic plants, the phenotypic ratios among the T1 progeny would be:

- (1) 3 (fungal resistant + salt- stress resistant): 1(fungal resistant)
- (2) 1 (fungal resistant): 2 (fungal resistant + salt resistant): 1(salt- stress resistant)
- (3) 3 (salt -stress resistant): 1 (fungal resistant)
- (4) 1 (fungal resistant) :1(salt- stress resistant): 1(fungal resistant+ salt stress resistant)

142. You are inserting a gene of 2 kb length in to a vector of 3kb to make a GST fusion protein the gene is being inserted at the *E. coli* site and the insert has a Hind III site 500bp downstream of the first codon. You are screening for the clone with the correct orientation by a restriction digestion of the plasmid using Hind III plus Bam HI (H+P) and Hind iii plus PSTI (H+P) the map of the relevant region of the vector is shown below



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

	A		B		C		D	
	H+B	H+P	H+B	H+P	H+B	H+P	H+B	H+P
5	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—
1.5	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—
500	—	—	—	—	—	—	—	—

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

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

143. The frequency of M-N blood types in a population of 6129 individuals is as follows:

Blood type	Genotype	Number of individuals
M	LMLM	1787
MN	LMLN	3039
N	LNLN	1303

The frequency of LN allele in this population is

- (1) 0.4605
- (2) 0.2121
- (3) 0.5395
- (4) 0.2911

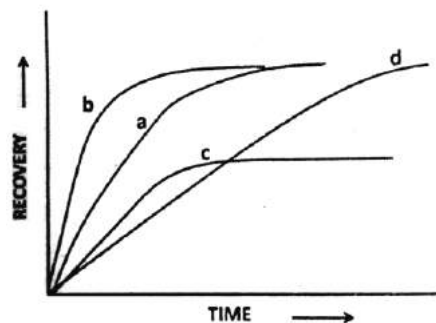
144. Mayfair genes (HYPOTHETICAL) consist of a superfamily of transcription factors. They are found in 4 clusters in mammals; in 2 clusters in insects; and in a single cluster in an ancestor to insects. These data consistent with all of the following explanations EXCEPT:

- (1) Two successive genome duplication event occurred between ancestral organisms and vertebrates
- (2) the first duplication may have taken place before divergence of vertebrates
- (3) exon shuffling exclusively produced such cluster
- (4) whole genome duplication could lead to such observation.

145. Fluorescence recovery after photo bleaching (FRAP) is a method to estimate the diffusion of molecules in a membrane. Fluorescently labelled in a membrane such as

- i) a receptor tagged with green fluorescent protein (GFP)
- ii) a receptor labelled with GFP which interacts with cytoskeleton
- iii) a labelled lipid
- iv) a labelled protein that binds to the membrane surface

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



Which one of the combination is correct?

- (1) a = i; b = ii
- (2) b = iii; a = iv
- (3) c = iii; d = iv
- (4) d = ii; b = i