PART – A:

1. We define a function F(N) = sum of digits of N, expressed as decimal number. e.g. f(137) = 1 + 3 + 7 = 11. Evaluate f($2^7 3^5 5^6$).

(1) 10 (2) 18

(3) 28 (4) 11

2. Every month the price of a particular commodity falls in this order:

1024, 640, 400, 250, ….

What is the next value?

(1) 156.25

(2) Approximately 39

(3) 64

(4) 40

3. A cubical piece of wood was filed to make it into the largest possible sphere. What fraction of the original volume was removed?

(1) More than 3/4

(2) 1/2

(3) Slightly less than 1/2

(4) Slightly more than 1/2

4. Three volumes of a Hindi book, identical in shape and size, are next to each other in a shelf, all upright, so that their spines are visible, left to right: I, II and III. A worm starts eating from the outside front cover of volume I, and eats its way horizontally to the outside back cover of volume III. What is the distance travelled by the worm, if each volume is 6 cm thick?

(1) 6 cm

(2) 12 cm

(3) 18 cm

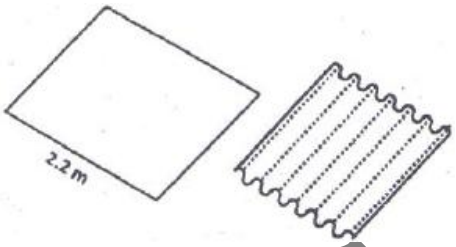
(4) a little more than 18 cm

5. What is the area of the triangle bounded by the lines y = 2x, y = –2x and y = 6?

(1) 36 (2) 18

(3) 12 (4) 24

6. A 2.2 m wide rectangular steel plate is corrugated as shown in the diagram. Each corrugation is a semi-circle in cross section having a diameter of 7 cm. What will be the width of steel sheet after it is corrugated?



(1) 1.4 m (2) 1.6 m

(3) 0.7 m (4) 1.1 m

7. Ajay, Bunty, Chinu and Deb were agent, baker, compounder and designer, but not necessarily in that order. Deb told the baker than Chinu is on his way. Ajay is sitting across the designer and next to the compounder. The designer didn't say anything. What is each person's occupation?

(1) Ajay- compounder; Bunty-designer; Chinu- baker; Deb- agent

(2) Ajay- compounder; Bunty-baker; Chinu-agent; Deb- designer

(3) Ajay- baker; Bunty-agent; Chinu-designer; Deb- compounder

(4) Ajay- baker; Bunty-designer; Chinu-agent; Deb- compounder

8. Two platforms are separated horizontally by distance A and vertically by distance B. They are to be connected by a staircase having identical steps. If the minimum permissible step length is a, and the maximum permissible step height is b, the number of steps the staircase can have is

(1) ≥ B/b (2) ≤ A/a

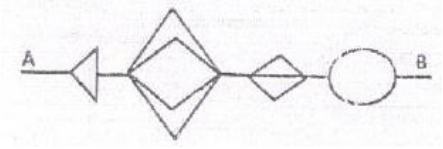
(3) ≥ B/b and ≤ A/a (4) ≤ B/b and ≥ A/a

9. The sum of first n natural numbers with one of them missed is 42. What is the number that was missed?

(1) 1 (2) 2

(3) 3 (4) 4

10. A mouse has to go from point A to B without retracing any part of the path, and never moving backwards. What is the total number of distinct paths that the mouse may take to go from A to B?



(1) 11 (2) 48

(3) 72 (4) 24

11. A certain day, which is x days before 17th August, is such that 50 days prior to that day, it was 4x days since March 30th of the same year. What is x?

(1) 18 (2) 30

(3) 22 (4) 16

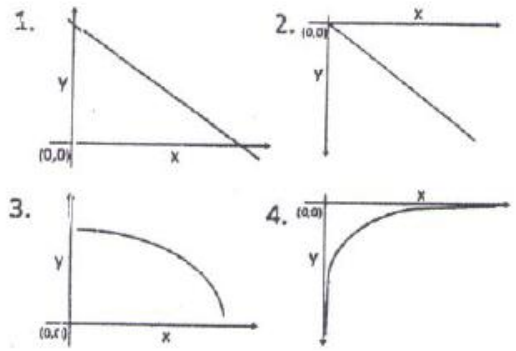
12. What is the next term in the following sequence?

7, 11, 13, 17, 19, 23, 29 ….

(1) 37 (2) 35

(3) 31 (4) 33

13. Which of the following figures best shows that y is inversely proportional to x?



14. What is the maximum number of whole laddoos having diameter of 6 cm that can be packed in a box whose inner dimenstions are $24 \times 18 \times 17$ cm^3?

(1) 24 (2) 30

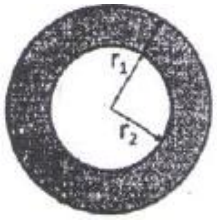
(3) 33 (4) 36

15. If N, E and T are distinct positive integers such that $N \times E \times T = 2013$, then which of the following is the maximum possible sum of N, E and T?

(1) 39 (2) 2015

(3) 675 (4) 671

16. The areas of the inner circle and the shaded ring are equal. The radii r_1 and r_2 are related by



(1) $r_1 = r_2$ (2) $r_1 = r_2\sqrt{2}$

(3) $r_1 = r_2\sqrt{3}$ (4) $r_1 = 2r_2$

17. The equation $m^2 - 33n + 1 = 0$, where m & n are integers, has

(1) no solution

(2) exactly one solution

(3) exactly two solutions

(4) infinitely many solutions

18. Which of the following numbers is a perfect square?

(1) 1022121 (2) 2042122

(3) 3063126 (4) 4083128

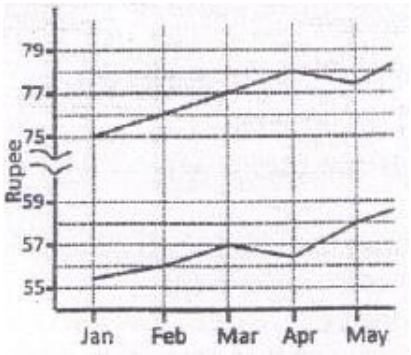
19. What is the 94th term of the following sequence?

1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, ….

(1) 8 (2) 9

(3) 10 (4) 11

20. The following graphs depict variation in the value of Dollar and Euro in terms of the Rupee over six months.



Which of the following statements is true?

(1) Values of Dollar and Euro rose steadily from January to June.

(2) Values of Dollar and Euro rose by equal rate between January to March.

(3) The rise in the value of Dollar from April to May is three times the fall in Euro during the same period.

(4) Values of Dollar and Euro rose equally between May and June.

PART – B:

21. Chirality of DNA is due to

(1) the bases

(2) base stacking

(3) hydrogen bonds between bases

(4) deoxyribose

22. Proton motive force during oxidative phosphorylation is generated in mitochondria by

(1) Exchanging protons for sodium ions.
(2) Pumping protons out into inter membrane space.
(3) Pumping hydroxyl ions into the mitochondria.
(4) Hydrolysis of ATP.

23. In proteins, hydrogen bonds form as follows:

Donor (D)-H---Acceptor (A). Hydrogen bond is more favorable if the angle between D-H and A is

(1) < 90° (2) 180°

(3) > 180° (4) 120°

24. Reaction products inhibits catalysis in enzymes by

(1) Covalently biding to the enzyme.
(2) Altering the enzyme structure.
(3) Occupying the active site.
(4) Form a complex with the substrate.

25. Which of the following statements regarding membrane transport is FALSE?

(1) Polar and charged solutes will not cross cell membranes effectively without specific protein carriers.
(2) Each protein carrier will only bind and transport one (or a few very similar) type of solute.
(3) Sugars such as glucose are always transported by active transport rather than by facilitated diffusion carriers.
(4) Ions are typically transported by special proteins that form membrane channels.

26. What will happen if histones are depleted from a metaphase chromosome and viewed under a transmission electron microscope?

(1) 30 nm chromatin fibres will be observed.
(2) 10 nm chromatin fibres will be observed.
(3) A scaffold and a huge number of loops of DNA fibres will be observed.
(4) A huge number of loops of DNA fibres without scaffold will be observed.

27. In chloroplast, the site of coupled oxidation-reduction reactions is the

(1) outer membrane (2) inner membrane

(3) thylakoid space (4) stromal space

28. Which of the statements about meiosis is NOT true?

(1) Kinetochores of sister chromatids attach to opposite poles in Meiosis I.
(2) Kinetochores of sister chromatids attach to opposite poles in Meiosis II.
(3) Chiasma is formed in Prophase I.
(4) Homologous chromosomes are segregated in Meiosis I.

29. Leader sequence in some of the protozoan parasites is transcribed elsewhere in the parasite genome and gets joined with several transcripts to make the functional RNA. The joining of the two transcripts occur by the process of

(1) alternate splicing (2) trans splicing

(3) ligation (4) RNA editing

30. Small nucleolar RNAs used to process and chemically modify rRNAs are called

(1) Sca RNAs (2) Si RNAs

(3) Sno RNAs (4) Sn RNAs

31. During replication, the RNA primer is degraded by the 5' – 3' exonuclease activity of

(1) RNase H1 (ribonuclease H1)

(2) FEN-1 (flap endonuclease 1)

(3) Topoisomerase II B

(4) DNA polymerase γ

32. Which one of the following statements about eukaryotic translation is NOT true? In eukaryotic translation,

(1) ribosome binding site on mRNA is called Kozak consensus sequences.
(2) Initiator tRNA is $tRNA_i^{f-met}$
(3) Initiator amino acid is methionine
(4) Translocation factor is eEF2.

33. Some lymphocytes respond to antigenic stimulation by synthesizing a growth factor that causes T cell proliferation thereby increasing the responsive T lymphocytes

resulting in amplification of the immune response. This is an example of

(1) endocrine signaling

(2) paracrine signaling

(3) autocrine signaling

(4) cyclic signaling

34. Glycosaminoglycans are usually linked to proteins to form proteoglycans. Which of the following is NOT a proteoglycan?

(1) Hyaluranan (2) Aggrecan

(3) Betaglycan (4) Syndecan-l

35. A patient with ER^+/PR^+ breast cancer was cured with a drug 'T', whereas a second patient did not respond to 'T'. Which one of the following is the best therapy that you should suggest for the second patient?

(1) Surgery, followed by HER-2/neu targeted drugs.
(2) A drug that targets triple negative ($ER^-/PR^-/HER\text{-}2^-$) breast cancer.
(3) Radiation, followed by drug 'T'.
(4) Surgery, followed by radiation only.

36. If you run a pentavalent IgM through SDS-polyacrylamide gel electrophoresis, how many bands you are supposed to get by Western blotting using alkaline phosphatase conjugated secondary antibody?

(1) Five (2) Four

(3) Three (4) One

37. Lens formation requires sequential events whereby the anterior neural plate signals the anterior ectoderm to promote secretion of Pax 6, which renders the anterior ectoderm more receptive to secretions from the optic vesicle. The above can be best explained by which of the following phenomenon?

(1) Instructive interactions only.
(2) Epithetial – Mesenchymal interactions
(3) Permissive interactions
(4) Induction and competence

38. The splitting or migration or one sheet of cells into two sheets as seen during hypoblast formation in bird embryogenesis is termed as

(1) delamination (2) ingression

(3) involution (4) invagination

39. The group of cells of amphibian blastula capable of inducing the organizer is called as

(1) Hensen's node

(2) Nieuwkoop centre

(3) Dorsal blastopore lip

(4) Hypoblast

40. Which one of the following statements regarding seed germination of a wild type plant is NOT correct?

(1) Low ABA and high bioactive GA can break seed dormancy.
(2) Light accompanied with high temperature can break seed dormancy.
(3) GA induces synthesis of hydrolytic enzymes in cereal grains.
(4) Degradation of carbohydrates and storage proteins provide nourishment and energy to support seedling growth.

41. Light is the dominant environmental signal that controls stomatal movement in leaves of well-watered plants grown in natural environment. Which one of the following wavelengths of light is responsible for such regulation?

(1) Red light (2) Blue light

(3) Green light (4) Far-red light

42. Which one of the following is NOT the main factor that contributes to water potential during plant growth under normal conditions?

(1) Solute potential

(2) Hydrostatic pressure

(3) Gravity

(4) Temperature

43. Which one of the following is NOT a characteristic property of carotenoids?

(1) They possess complex porphyrin ring.
(2) They are integral constituent of thylakoid membrane.
(3) They are also called accessory pigments.
(4) They protect plants from damages caused by light.

44. The plant hormone indole-3-acetic acid (IAA) is present in most plants. The structure of this hormone is related to which one of the following amino acids?

(1) Glutamic acid (2) Aspartic acid

(3) Lysine (4) Tryptophan

45. The type-I glomus cells present in the carotid bodies contain granules which release some substances during hypoxia. Which one of the following is released in hypoxia?

(1) Serotonin (2) GABA

(3) Dopamine (4) IL 8

46. Which one of the following cells in the renal corpuscle can influence glomerular filtration by its contraction?

(1) Podocytes
(2) Endothelial cells of glomerular capillaries
(3) Parietal epithelial cells of Bowman's capsule
(4) Mesangial cells

47. Production of excessive amount of corticotrophin (ACTH) occurs in which one of the following:

(1) Graves' disease

(2) Cushing's syndrome

(3) Grieg's syndrome

(4) Alport's syndrome

48. Which one of the following functions is NOT served by the plasma proteins?

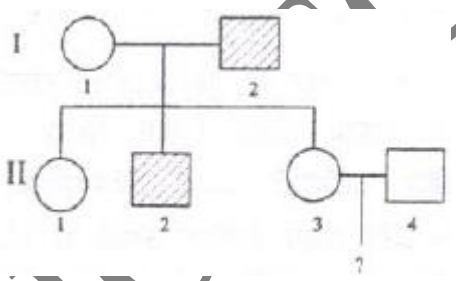
(1) Blood clotting

(2) O_2 transport

(3) Hormone binding and transport

(4) Buffering capacity of blood

49. The following pedigree shows the inheritance of a common phenotype controlled by an autosomal recessive allele. The probability of carriers in the population is 1/3.



What is the probability that a child from parents II-3 and II-4 will show the phenotype?

(1) 1/16 (2) 1/18

(3) 1/36 (4) 3/16

50. Two plants with white flowers are crossed. White flowers arise due to recessive mutation. All F_1 progeny have red flowers. When the F_1 plants are selfed, both red and white flowered progeny are observed. In what ratio will red-flowered plants and white-flowered plants occur?

(1) 1:1 (2) 3:1

(3) 9:7 (4) 15:1

51. 5-Bromouracil is a base analog that can cause mutation when incorporated into DNA. Which of the following is the most likely change that 50Bromouracil induces:

(1) T:A to C:G (2) T:A to A:T

(3) G:C to T:A (4) C:G to A:T

52. An interrupted mating experiment was performed between Hfr Str^s a^+ b^+ c^+ and F^- Str^r a^- b^- c^- strains. The genotype of majority of streptomycin resistant (Str^r) exconjugant after 10, 20 and 30 minutes of interrupted mating is given below:

10 min	a^- b^- c^-
20 min	a^- b^- c^+
30 min	a^+ b^+ c^+

The most probable gene order would be

(1) a b c (2) c a b

(3) b a c (4) a c b

53. Individuals with greater mass have a smaller surface area to volume ratio, which helps to conserve heat. This is known as

(1) Leibig's rule (2) Cope's rule

(3) Gloger's rule (4) Bergmann's rule

54. Schizocoelour coelom formation, mouth formation from embryonic blastopore, spiral and determinate cleavage are characteristic of

(1) deuterostomes

(2) pseudocoelomates

(3) protists

(4) protostomes

55. Which of the following is a correct match of the animal with its taxonomic group?

(1) Hirudinea-Leech; Chelicerata-Horse shoe crab; Cestoda-Tapeworm Echinoidea-Sea urchins; Cephalopoda-Octopus; Oligochaeta-Earthworm.
(2) Hirudinea-Earthworm; Chelicerata-Horse shoe crab; Cestoda-Octopus; Echinoidea-Tapeworm; Cephalopoda-Earthworm; Oligochaeta-Leech
(3) Hirudinea-Tapworm; Chelicerata-Leech; Cestoda-Tapeworm; Echinoidea-Horse shoe crab; Cephalopoda-Earthworm; Oligochaeta-Octopus.

(4) Hirudinea-Leech; Chelicerata-Tapeworm; Cestoda-Earthworm Echinoidea-Sea urchins; Cephalopoda-Octopus, Oligochaeta-Horse shoe crab.

56. During which geological period was there an explosive increase in the number of many marine invertebrate phyla?

(1) Ordovician (2) Devonian

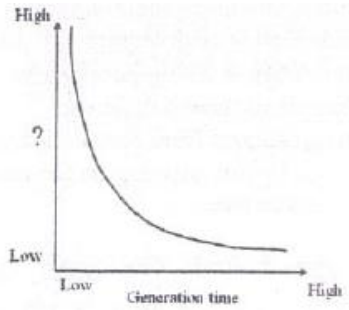
(3) Permian (4) Cambrian

57. In which ecosystem is the detrital pathway pathway of energy flow most important?

(1) Lakes (2) Grasslands

(3) Tropical rain forests (4) Oceans

58. What parameter, plotted on Y-axis against generation time, would yield the curve shown in the figure?



(1) Survivorship

(2) Body size

(3) Lifespan

(4) Intrinsic rate of increase

59. An example of the species interaction called commensalism is

(1) Nitrogen-fixing bacteria in association with legume plant roots.

(2) Microbes in living human gut.

(3) Female mosquito deriving nourishment from human blood.

(4) Orchid plant growing on the trunk of a mango tree.

60. The population density of an insect species increases from 40 to 46 in one month. If the birth rate during that period is 0.4 what is the death rate?

(1) 0.25 (2) 0.15

(3) 0.87 (4) 0.40

61. Worker bees, instead of themselves reproducing, help the queen reproduce. This behavior is explained as an example of

(1) kin selection (2) group selection

(3) sexual selection (4) natural selection

62. The degree of genetic relatedness between the offspring and their parents is

(1) higher than that between sister and brother.

(2) lower than that between sister and brother.

(3) the same as that between sister and brother.

(4) dependent on the number of siblings.

63. Which species concept utilizes morphological and molecular characters to distinguish between species?

(1) Evolutionary (2) Ecological

(3) Biological (4) Phylogenetic

64. The wings of insects and the wings of bats represent a case of

(1) divergent evolution

(2) convergent evolution

(3) parallel evolution

(4) neutral evolution

65. You want to purify a recombinant protein of your interest. You can use affinity chromatography to purify as you have nickel columns available in the laboratory. With what molecule will you tag the protein to purify using those columns?

(1) GST (2) Histidine

(3) Histamine (4) Proline

66. Lower limits of detection by sensors is important. Which method of detection is more sensitive than glass electrode used for pH measurement?

(1) Absorption spectroscopy

(2) Refractive index

(3) Circular dichroism

(4) Fluorescence spectroscopy

67. Which of the following statements is INCORRECT for fluorescence in situ hybridization (FISH) technique?

(1) A fluorescence or confocal microscope is used for detection of signal.

(2) A labeled sequence of nucleotides is used.

(3) Specific fluorescence tagged antibodies are used.
(4) A stringent washing step is essential to remove appearance of non specific signal.

68. In an experiment to detect a new protein in fixed cells, no secondary antibody tagged with fluorescence dye is available. What should be the best choice out of the following to detect the protein?

(1) Protein A-FITC
(2) Protein A-Sepharose
(3) Biotin-FITC
(4) Avidin-FITC

69. If a researcher intends to identify a specific brain area activity linked to a cognitive function in human subjects, which one of the following techniques should be used?

(1) CAT (2) MRI
(3) fMRI (4) Patch-champ

70. Two 18-residue helical peptides A and B are enantiomers. They can be distinguished by

(1) recording their MALDI mass spectrum.
(2) Hydrolysis followed by amino acid analysis.
(3) Sequencing by Edman's method.
(4) Examining their circular dichroism spectra.

PART-C

71. The lifetime of a peptide bond in proteins is very large (~1000 years). Which statement below is INCORRECT with respect to stability of the peptide bond?

(1) The free energy of hydrolysis is negative.
(2) The free energy of hydrolysis is positive and large.
(3) The energy barrier to be crossed to go to the hydrolyzed state is large
(4) The peptide bond can be hydrolyzed by 6N HCl at 100°C.

72. Acetyl-$(Ala)_{18}$-$CONH_2$ exists in α-helical conformation in solution. Most of the backbone dihedral angles (ϕ, ψ) will be

(1) –60°, –30°
(2) 60°, 30°
(3) –60°, –30° (50%) and 60°, 30° (50%)
(4) –80°, 120°

73. DNA is not hydrolyzed by alkali whereas RNA is readily hydrolyzed. This is due to

(1) The double helical structure of DNA.
(2) The presence of uridine in RNA
(3) Due to features observed in RNA such as stem-loop structures.
(4) The presence of 2'-OH group in RNA

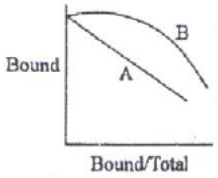
74. Two homologous proteins were isolated from a psychrophile (P) and a thermophile (T). The purified proteins were subjected to denaturation, protease digestion and circular dichroism (CD). Following observations were made:

A. The CD spectra of P and T proteins are identical.
B. Their amino acid composition is 95% identical.
C. T and P are equally susceptible to proteolysis in the presence or absence ore reducing agent.
D. T has higher midpoint of thermal denaturation than P.

The reason of enhanced stability in T is due to

(1) Altered secondary structure.
(2) Increased number of disulfides in T.
(3) Increase in water of hydration.
(4) Increase in number of salt bridges.

75. Binding of two ligands to their binding proteins were investigated. Following binding isotherms were obtained.



Which of the following statements is correct?

(1) A is obtained with an oligomeric protein and B is obtained with a monomeric protein.
(2) B is obtained with protein with positive cooperativity.
(3) A and B were obtained by the same protein at two different temperatures.
(4) The profile B is not possible

76. Enzyme parameters of four isozymes is given below:

Isozyme	**K_m micromolar**	**V_{max}**
A	0.1	15

B	1.5	45
C	4.0	100
D	0.01	10

These isozymes are localized in different tissues. In liver the substrate concentration is 0.2 micromolar.

The liver isozyme is likely to be

(1) A (2) B

(3) C (4) D

77. A null mutation if created in a gene which is responsible for specific phosphorylation at 6^{th} carbon position of mannose on acid hydrolases occurring in cis-Golgi. The following statements are given towards explaining the effect of this mutation:

A. The lysosomes will be devoid of lysosomal enzymes.
B. Lysosomal enzymes will be secreted out
C. Lysosomal enzymes will get localized in cytoplasm.

Which statement or combination of statements will explain the effect of mutation if the acid hydrolases in the mutant do not get degraded?

(1) A and C (2) B and C

(3) C only (4) A and B

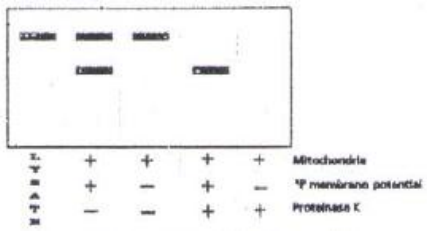
78. In order to prove that liposome can serve as a model membrane (mimicking cellular plasma membrane) and can be used as a target for complement-mediated immunolysis, an experiment as below is designed. To initiate such experiment, hapten-conjugated liposomes are made and loaded with umbelliferyl phosphate (UMP; hyrolysed product of UMP is umbelliferone and is fluorescent). Such loaded, hapten-conjugated liposomes in 10 mM Tris buffered saline, pH 7.4 were mixed with anti-hapten antibodies and fresh guinea pig serum (as a source of complement) to induce immunolysis of liposomal membrane. To quantify only the membrane lysis component which of the assay sequences below is MOST appropriate?

(1) Mixture is ultra centrifuged and the supernatant reacted with alkaline phosphatase and fluorescence measured.
(2) Mixture is sequentially reacted with phospholipase and alkaline phosphatase followed by fluorescence measurements.
(3) Mixture is directly subjected to fluorescence measurement.
(4) Mixture is treated with Triton X-100 and fluorescence measured.

79. A gene producing red pigment was placed near centromeres of fission yeast and thus subjected to position effect variegation and produced white colonies. A screen for mutants that increased the red pigment production was undertaken. Which of the following genes, when mutated, is likely to produce this genotype?

(1) Histone deacetylase
(2) Histone acetylase
(3) RNA polymerase II
(4) TATA binding factor

80. A newly identified sequence was experimentally tested by in vitro transport assay using a radiolabelled protein containing the sequence to test import into mitochondria. Transport assay was done for a short time with or without membrane potential and after the assay, the mitochondria were either treated or not treated with proteinase K. At the end of the assay the mitochondria were pelleted and total protein of the pellet was isolated and separated on SDS-PAGE and autoradiographed. A representative autoradiogram is shown below. Based on this experimental data, which of the following statements is NOT correct.



(1) The protein goes into the matrix.
(2) Not all of the added protein was imported.
(3) The protein requires membrane potential for import.
(4) The protein is associated with the outer mitochondrial membrane.

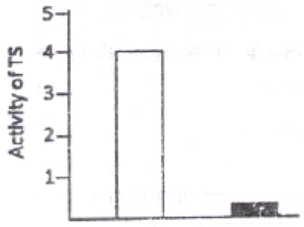
81. If a proteasome inhibitor is added to synchronously cycling human cells in G2 phase which one of the following events is likely to happen?

(1) Induce re-replication of DNA
(2) Arrest cells in G2 phase
(3) Arrest cells in Anaphase
(4) Block chromatin condensation

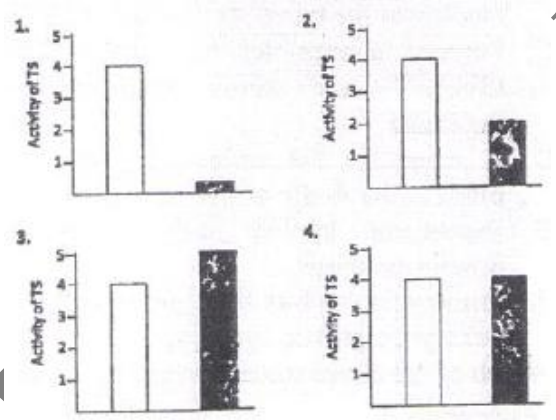
82. Which of the following statements best describe archaebacteria?

(1) Mostly autotrophic, cell was contains peptidoglycan, 60S ribosomes, live in extreme environment.
(2) Divide by fission, not susceptible to lysozyme, live in extreme environments, mostly autotrophic.
(3) Not susceptible to lysozyme, contain Golgi and linear chromosomes.
(4) Chitinous cell wall, obligate aerobic, circular chromosomes.

83. The following graph represents the expression of tryptophan synthetase (TS) in E coli cells in absence (□) or presence (■) of tryptophan in the medium



If the two trp codons in the leader sequence of trp operon is mutated to ala, which of the following graphs will best represent activity of TS in E. coli cells grown in the absence (□) or presence (■) of tryptophan?



84. Puromycin is an antibiotic used to inhibit protein synthesis. Given below are few statements about the antibiotic.

A. It enters the E-site of the ribosome where it prevents the release of deacetylated tRNA after the action of peptidyl transferase.
B. If blocks the tranlocation process by binding to the translocation factor EF-G.
C. Puromycin resembles the initiatior tRNA, $tRNA_i^{f-met}$ and binds exclusively to the P-site.
D. It resembles the aminoacyl tRNA and binds to the A-site of the ribosome.
E. Puromycin inhibits only prokaryotic protein synthesis.
F. Puromycin inhibits both prokaryotic and eukaryotic protein synthesis.

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

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

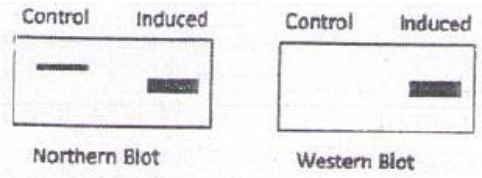
85. Following are certain statements related to eukaryotic DNA replication:

A. The genome of multicellular animals contain many potential origins of replication.
B. During early development, when embryos are undergoing rapid cell divisions, origin sites are uniformly activated.
C. "Pulse-chase" technique is used to label sites of DNA replication.
D. The rate of elongation of different DNA chains during genome replication varies drastically.

Which one of the following combinations of above statements is correct?

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

86. The expression of a hypothetical gene was analyzed by Northern and Western blot hybridizations under control and induced condition. The results are summarized below:



Expression of genes can be regulated by:

A. Control at transcription initiation
B. Alternative splicing
C. Control of translation initiation
D. Protein stability.

Which of the above regulatory mechanisms can explain the observations shown in the figures?

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

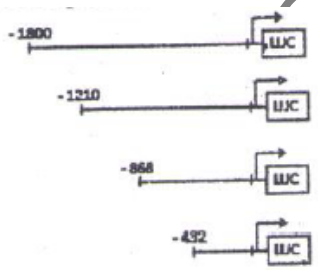
87. Total RNA was isolated separately from cytosol and nuclei of human cells growing in a cell culture. Each sample was mixed with a purified denatured fragment of a DNA corresponding to a large intron of a house keeping gene and incubated under renaturating condition. Given below are the statements made about the outcome of the experiment.

A. RNA isolated from nuclei will form RNA-DNA duplexes because of the presence of introns in the primary RNA.
B. Cytosolic RNAs usually will not form RNA-DNA duplexes.
C. Both cytosolic and nuclear RNA will not form RNA-DNA duplexes as transcription and splicing occur simultaneously.
D. Cytosolic RNA will form RNA-DNA duplexes because unspliced cytosolic RNAs are exceptionally stable.

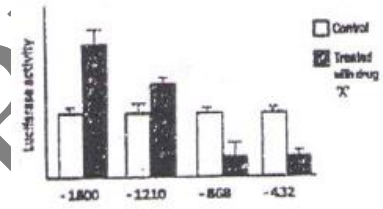
Which of the above statement(s) is/are most likely to be true?

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

88. A promoter deletion study was done in order to determine the binding sites for a transcription factor on the promoter, which is activated on treatment with the drug 'X'. The following constructs were made-



Luciferase assay revealed the following results



The following statements can be made.

A. Region between –1800 and –1210 contains a binding site for the activator.
B. Region between –868 and –1210 contains a binding site for a repressor.
C. Region between –868 and –432 contains a binding site for a repressor.
D. Region between –1210 and –868 contains a binding site for the activator.

Which of the above is/are true?

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

89. A researcher wanted to immunize individuals of a particular area with viral infections. The researcher developed to different vaccine types (A and B) with the following properties.

(i) When vaccine type A specific for a viral strain is administered to individuals, they develop strong neutralizing antibody response with very poor immunological memory. Hence it has to be administered in repetitive doses.
(ii) When vaccine type B specific for a viral strain is administered to individuals, they fail to develop circulating antibody response at the time of infection but they develop strong immunological memory.

If two viral strains V1 (incubation period-2 days) and V2 (incubation period-15 days) are likely to infect the area, which of the following vaccine combination would provide maximum immunization?

(1) V1 specific type A and V1 specific type B
(2) V1 specific type A and V2 specific type B
(3) V2 specific type A and V1 specific type B
(4) V2 specific type A and V2 specific type B

90. A pharmacy student designed a drug to specifically target the receptors for retinoic acid in order to prevent stem cell differentiation. After in vitro trial, the investigator found that the cells underwent differentiation and the drug seemed to be ineffective. The following reasons were given by the student.

A. The size of the drug exceeded the size of molecules that could cross the membrane.
B. The drug was small in size but hydrophobic in nature.
C. The drug did not bind to its receptors.

Which of the above could be the probable reason for drug ineffectiveness?

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

91. Which one of the following statements about cell-cell interactions is NOT true?

A. Cadherins are transmembrane linker proteins which carry out Ca^{2+}-mediated adhesion between adjacent cells.
B. Integrins are transmembrane adhesion proteins that mediate homophilic adhesion through actin and intermediate filaments.
C. Selectins are cell surface lectins that mediate a variety of transient, cell-cell adhesion interactions in the bloodstream.
D. ICAMs (interacellular cell adhesion molecules) and VCAMs (vascular cell adhesion molecules) are members of immunoglobulin (Ig) superfamily.

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

92. You have isolated a short chain polypeptide from a bacteria which upon administering to animal cells in culture is demonstrated to get transported to mitochondria and to cause mitochondrial membrane disruption. This peptide is being considered for its therapeutic effects on cancer and is to be tested for its anticancer properties in the following models of the disease.

A. Cancer with Apaf-1 mutation
B. Cancer where Bax genes are inactivated
C. Cancer where Bak genes are inactivated

Which of the following is likely to provide best effect (i.e. induce apoptosis)

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

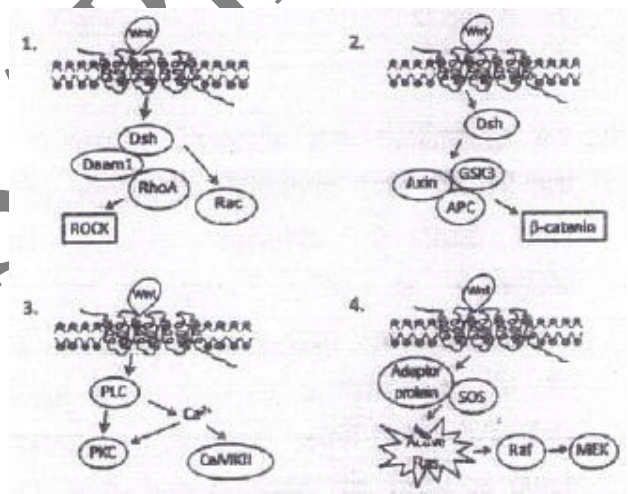
93. A technician wanted to make rabbit antiserum specific for mouse IgG. The technician injected rabbit with purified mouse IgG but obtained antiserum which reacted strongly with each of the other mouse isotypes. Which of the procedures mentioned below will allow him to make antiserum specific for IgG only?

(1) Injecting rabbit with purified $F(ab)'_2$ region of the IgG antibody.
(2) Injecting rabbit with purified heavy chain of the IgG antibody.
(3) Injecting rabbit with purified light chain of the IgG antibody.
(4) Injecting rabbit with purified F(ab)' region of the IgG antibody.

94. In order to precipitate a particular protein by its specific antiserum, it was found that the protein formed cross-linked lattice with specific polyclonal antiserum but failed to precipitate with specific monoclonal antiserum. Which of the following would accurately justify the reason for this behavior?

(1) The protein has multiple copies of the same epitope specific for the monoclonal antibody.
(2) The protein has multiple distinct epitopes but each has a single copy.
(3) There is total absence of epitopes in the protein.
(4) The protein has multiple copies of different epitopes.

95. Activation of the Wnt signal transduction pathway is extremely important during early development. Of the various pathways, which one of the following is most likely to induce cytoskeletal changes, like cell shape and movement?



96. For successful fertilization in sea urchin, interaction between the surface of the egg and acrosomal proteins, specifically a 30.5 kDa protein called bindin, is necessary. The following factors could affect this interaction and prevent fertilization:

A. Removal of egg jelly polysaccharides.
B. Removal of bindin receptors on the egg vitelline membrane.
C. Removal of bindin receptors from the egg jelly.
D. Removal of binding receptors from a single cluster on the vitelline membrane.

Which one or the combination of the above statements is correct?

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

97. A two-celled embryo is made of blastomeres A and B. If the two blastomeres are

experimentally separated, the 'A' blastomere generates all the cells it would normally make. However, the 'B' blastomere in isolation makes only a small fraction of cells it would normally make. Based on the above observations only, which one of the following conclusions is correct?

(1) 'A' blastomere is autonomously specified while 'B' blastomere is conditionally specified.
(2) 'A' blastomere is conditionally specified, while 'B' balstomere is autonomously specified.
(3) Descendents of 'A' blastomere are autonomously specified.
(4) Descendents of 'B' balstomere can either be autonomously specified or conditionally specified.

98. A mutant embryo of Drosophila in which one of the major sex determining gene, sex lethal, can only undergo default splicing, was allowed to develop. The following statements are towards explaining the determination of sex of the embryo:

A. The embryo will develop into a male fly.
B. The embryo will develop into a female fly.
C. Sex lethal gene product directly regulates sex specific alternate splicing of double sex RNA.
D. Sex lethal gene product regulates sex specific splicing of transformer RNA which is turn regulates splicing of double sex RNA.

The correct combination of the above statements to explain sex determination of the given embryo is:

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

99. A mutant was experimentally generated which had wings reduce to haltere like structure. The following statements are put forward regarding this phenotype:

A. *ultrabithorax* gene ectopically expressed in second thoracic segment.
B. *antennapedia* gene ectopically expressed in second thoracic segment.
C. A homeotic mutation.
D. A mutation in gap gene

The following combination of statements will be most appropriate explaining the molecular basis of mutant phenotype:

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

100. Following are certain statements regarding the activities of homeotic genes of classes A, B and C involved in floral organ identity:

A. Activity of A alone specifies sepals.
B. Activity of B alone specifies petals.
C. Activities of B and C form stamens.
D. Activity of C alone specifies carpels.

Which one of the following combinations of above statements is correct?

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

101. A transgenic lettuce plant was generated by over-expressing isopentenyl transferase (IPT) gene under the control of the promoter of senescence activator gene (SAG12).

Following are some statements regarding this transgenic plant. The transgenic plants.

A. exhibit delayed senescence.
B. exhibit fast senescence.
C. have higher amount of cytokinin during senescence.
D. have higher amount of gibberellins during senescence.

Which one of the following combinations of above statements is correct?

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

102. Following are certain statements regarding secondary metabolites found in plants:

A. All terpenes are derived from a six-carbon element.
B. Alkaloids are nitrogen containing compounds.
C. Pyrethroids, a monoterpene ester found in the leaves and flower of *Chrysanthemum* species, show insecticidal activity.
D. Limonoids are groups of alkaloids and have antiherbivoral activity.

Which one of the following combinatsion of above statements is correct?

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

103. Light is crucial for plant growth and development. Following are certain statements related to photoreceptors in model plant *Arabidopsis thaliana.*

A. Among the five phytochrome genes, representing a gene family, PHYB plays a predominant role in red-light perception.
B. Cryptochromes are involved in the regulation of flowering time and hypocotyls length.
C. phy A photoreceptor is predominantly involved in far-red light perception.
D. The LOV domain of phytochrome C (PHYC) is an important domain for signal transmission.

Which one of the following combinations of above statements is correct?

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

104. One of the important functions of program cell death (PCD) in plants is protection against pathogens. PCD also appears to occur during the differentiation of xylem tracheary elements that leads to nuclei and chromatin degradation. These changes result from the activation of certain genes. Following are certain genes encoding

A. Topoisomerase B. Nuclease
C. RNA polymerase D. Protease

Which one of the following combinations of the above is involved in differentiation of xylem tracheary elements?

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

105. Following are certain statements regarding C_3, C_4 and CAM plants?

A. The ratio of water loss to CO_2 uptake is higher in CAM plants than it is in either C_3 and C_4 plants.
B. The rate of photosynthesis attains maximum rate of lower intracellular CO_2 partial pressure in C_4 plants than in C_3 plants.
C. The compensation point in C_3 plants are always lower than C_4 plants.
D. Plants with C_4 metabolism need less rubisco and C_3 plants to achieve a given rate of photosynthesis.

Which one of the following combinations of above statements is correct?

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

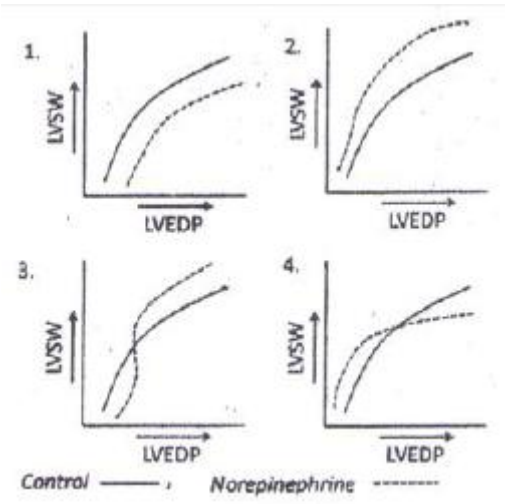
106. Following are some statements related to osmotic stress in plants.

A. The accumulation of ions during osmotic adjustment is predominantly restricted to the vacuoles.
B. In order to maintain the water potential equilibrium within the cell, other solutes called as compatible solutes or compatible osmolytes accumulate in the cytoplasm.
C. Galactose is one of the compatible osmolytes involved in osmotic stress in plants.
D. There are mainly four groups of molecules that frequently serve as compatible solutes.

Which one of the following combinations of above statements is correct?

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

107. The changes in left ventricular stroke work (LVSW) according to the different left ventricular end-diastolic pressure (LVEDP, which indicates the initial myocardial fiber length) in a dog, under control conditions, were recorded, which follows Starling's law of the heart. This LVSW-LVEDP relationship was investigated in the same dog after constant infusion of norepinephrine, and these two data sets were plotted. Which one of the following graphs correctly represents the results obtaind?



108. Different frequencies of sound were presented on the ear and the movement of basilar membrane was experimentally determined. The characteristics of movement of basilar membrane after

presentation of 100 Hz sound are described in the following statements:

A. The base of basilar membrane showed resonance.
B. The apex of basilar membrane showed resonance.
C. A wave travelled from the base to apex of basilar membrane but the maximum displacement was noted near the apex.
D. A wave travelled from the base to apex of basilar membrane but the maximum displacement was noted near the base.

Which of the following is correct?

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

109. When a nerve fiber is stimulated with increasing strength of stimulus, the action potential fails to generate even though the threshold level may be passed. The following statements may explain this accommodation of nerve fiber:

A. The critical number of open sodium channels required to trigger the action potential may never be attained due to slow depolarization.
B. Potassium channels open in response to slow depolarization, which makes the nerve fiber refractory to depolarization.
C. The low threshold sodium channels remain open, which increases the threshold of firing of action potential.
D. The efflux of sodium and influx of potassium due to operation of Na^+, K^+-ATPase oppose the depolarization.

Which one of the following is correct?

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

110. The heart rate shows variation during respiratory rhythm in most human subjects. Which one of the following statements describing the changes of heart rate during respiratory phases is true?

(1) The heart rate is accelerated during expiration, but no change occurs during inspiration.
(2) The heart rate is accelerated during inspiration and decelerated during expiration.
(3) The heart rate is accelerated during expiration and decelerated during inspiration.
(4) The heart rate is accelerated during inspiration and no change occurs during expiration.

111. Given below are few statements with reference to blood clot formation which results from triggered chain of reactions:

A. Conversion of fibrinogen to fibrin.
B. Activation of factor XIII, which stabilizes fibrin mesh work.
C. Activation of factor XII, which promotes plasmin activation.
D. Enhancement of platelet aggregation.

Which one of the following combination of statements is correct with reference to roles of thrombin in hemostasis?

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

112. At 17 years, a 7 feet tall human was diagnosed with gigantism caused by pituitary tumor. The condition was surgically corrected by removal of the person's pituitary gland. Doctors advised hormonal therapy. The possible hormonal therapies that would be required for survival are

A. Thyroid hormone B. Glucocorticoids
C. Glucagon D. Growth hormone
E. Insulin

Which one of the following combination can be used?

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

113. Autotetraploids arise by the doubling of 2n complement to 4n. There are three different pairing possibilities at meiosis is tetraploids as given below:

A. Two bivalents
B. One quadrivalent
C. One univalent + one trivalent

Which of the above pairings can lead to production of diploid gamete?

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

114. The following is the amino acid sequence of a part of a protein encoded by gene 'X'.

….. Phe Leu Val Pro Ser Tyr Cys ……

A mutant for gene 'X' is isolated following treatment with a mutagen. The amino acid

sequence of the same region encoded by the mutant gene is as follows:

….. Phe Leu Phe Arg Arg Ile …….

Which of the following mutagens is most likely to have been used?

(1) 5-bromouracil

(2) 2-amino-purine

(3) Ethyl methanesulfonate

(4) Acridine orange

115. In *Neurospora*, the mutant *stp* exhibits erratic stop-and-start growth. When a female of *stp* stain is crossed with a normal strain acting as a male, all progeny individuals showed stop mutant phenotype. However, the reciprocal cross resulted in all normal progeny individuals. These results can be explained on the basis of

A. maternal inheritance
B. sex limited inheritance
C. sex influence inheritance
D. *stp* mutation may be located in mitochondrial DNA

The most appropriate statement or combination of the above statements for explaining the experimental results is:

(1) A and C (2) C only

(3) A and D (4) B and D

116. A co-transduction experiment was performed to decipher the linear order of 4 genes: a, b, c and d. Three sets of experiments were done where transductants were selected for a (Set-1) or b (Set-2) or c (Set-3) and screened for co-transduction of the other markers.

Set – 1		
Selected for	**Co-transduction**	**Frequency**
a	b	31
a	c	3
a	d	89

Set – 2		
Selected for	**Co-transduction**	**Frequency**
b	a	22
b	c	78
b	d	68

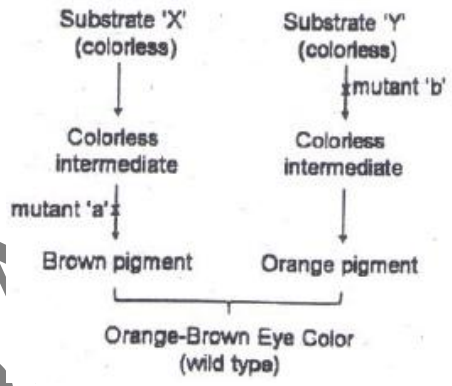
Set – 3		
Selected for	**Co-transduction**	**Frequency**
c	a	0
c	b	69
c	d	43

Based on the frequencies shown above, identify the most likely order in the genome.

(1) a b c d (2) b c d a

(3) c d a b (4) a d b c

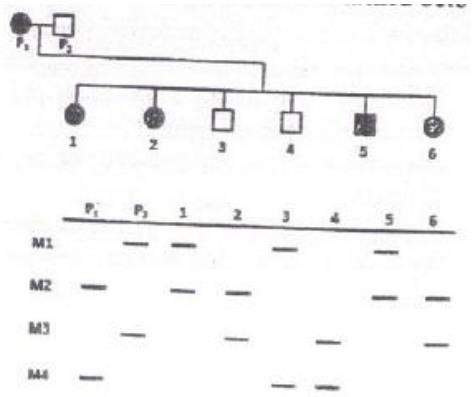
117. A hypothetical biochemical pathway for the formation of eye colour in insect is given below.



Two autosomal recessive mutants 'a' and 'b' are identified which block the pathway as shown above. Considering that the mutants are not linked, what will be the phenotype of the F_2 progeny if crosses were made between parents of the genotype aaBB × AAbb, and the F_1 progeny are intercrossed?

(1) 9 orange-brown : 3 orange : 3 brown : 1 colorless
(2) 9 orange-brown : 7 colorless
(3) 1 orange : 2 colorless
(4) 15 orange-brown : 1 colorless

118. An analysis of four microsatellite markers was carried out in a family showing a genetic disorder. The results are summarized below:



Based on the above, which of the markers shows linkage to the disorder?

(1) M1 (2) M2

(3) M3 (4) M4

119. In Group I are given 4 orders of class Insecta. Match each one with a common name (Group II) and its diagnostic characters (Group III)

Group – I	Group – II
Dermaptera (A)	Ant (E)
Ephemeroptera (B)	Mayfly (F)
Odonata (C)	Grasshopper (G)
Plecoptera (D)	Damselfly (H)
	Stonefly (I)
	Earwig (J)

Group III

(i) Elongate, membranous wings with netlike venation, abdomen long and slender, compound eyes occupy most of head, hemimetabolous metamorphosis.

(ii) Elongate chewing mouthparts, thread-like antennae, abdomen with unsegmented forceps-like cerci, hemimetabolous metamorphosis

(iii) Forewing long, narrow and leathery, hindwing broad and membranous, chewing mouthparts, hemimetabolous metamorphosis.

(iv) Elongate abdomen with two or three tail filaments, two pairs of membranous wings with many veins, forewings traiangular, short, bristle-like antennae, hemimethabolous metamorphosis.

(v) Adults with reduced mouthparts, elongate antennae, long cerci, nymphs aquatic with gills, hemimetabolous metamorphosis.

(vi) Wings membranous with few veins, well developed ovipositiors, sometimes modified into a sting, mount parts modified for biting and lapping, holometabolous metamorphosis

(1) A-J-(ii) (2) B-I-(vi)

(3) C-H-(v) (4) D-F-(i)

120. Which of the following is a correct match of the animal with its attribute?

Animal	Attribute
A-Rotifer	(i) Nauplius larval stage
B-Sea anemone	(ii) Radial symmetry
C-Barnacle	(iii) Pseudocoelomate body cavity
D-Sea urchin	(iv) Water vascular system

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

121. Which of the following characteristics make *Amborella* the most basal living angiosperm?

(1) Carpels fused by tissue connection and absence of vessel elements.
(2) Absence of carpels and presence of vessel elements.
(3) Carpels free and presence of vessel elements.
(4) Presence of carpels and absence of vessel elements

122. Which of the following statements is NOT correct?

(1) Stomata are present in mosses and hornworts but absent in liverworts.
(2) Only the lycophytes have microphylls and almost all other vascular plants have megaphylls.
(3) Monocot pollen grains have three openings whereas eudioot pollen grains have one opening.
(4) Monocots have fibrous root system whereas eudicots have taproot.

123. Following is a table showing selected characteristics of important fungal groups.

Fungal	Characteristic

Group	
A	No regularly occurring septa in thallus
B	Perforated septa
C	Forms arbuscular mycorrhizae on plant roots
D	Have zoospores with flagella

In the above table, the fungal groups A, B, C and D are, respectively.

(1) Chytridiomycetes, Ascomycetes, Glomeromycetes, Zygomycetes.
(2) Zygomycetes, Ascomycetes, Glomeromycetes, Chytridiomycetes
(3) Ascomycetes, Zygomycetes, Glomeromycetes, Chytridiomycetes
(4) Chytridiomycetes, Zygomycetes, Ascomycetes, Glomeromycetes

124. Which of the following is a correct statement?

(1) Euglenids have a spiral or crystalline rod inside flagella.
(2) Pheophytes have a spiral or crystalline rod inside flagella.
(3) Euglenids have a hairy and smooth flagella.
(4) Euglenids and pheophytes both have a spiral or crystalline rod inside flagella.

125. In life history evolution there is generally a trade-off between the size and number of offspring produced. Some conditions are listed below:

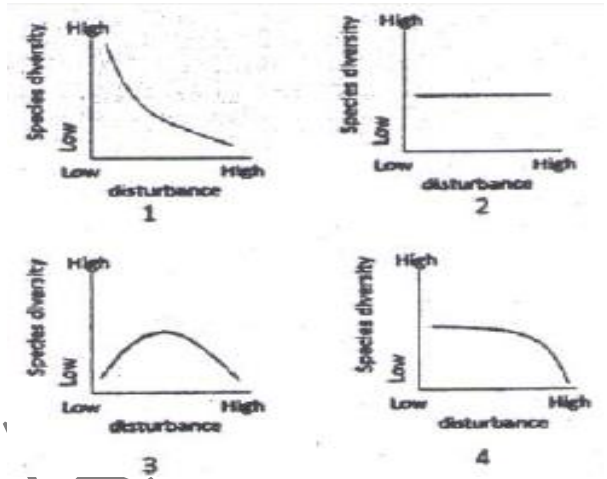
A. Scarcity of food during the early stages of life.
B. Provision of parental care
C. High mortality during early stages of life.
D. Predator's preference for large sized prey

What are the above two conditions that would favour the production of a small number of large-sized offspring?

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

126. The possible relationships between level of disturbance and species diversity in a biological community are that species diversity

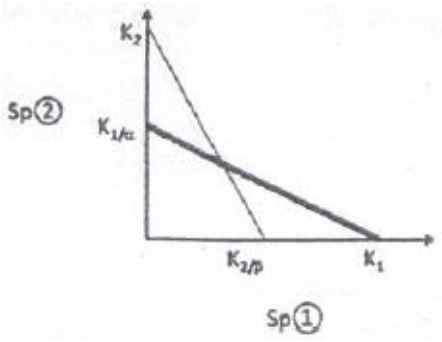
A. is unaffected by disturbance.
B. is highest at intermediate levels of disturbance.
C. decreases exponentially with increasing levels of disturbance.
D. starts decreasing only at higher levels of disturbance.



Match each graph with its corresponding statements above:

(a) 1-D, 2-C, 3-B, 4-D
(b) 1-C, 2-D, 3-B, 4-A
(c) 1-A, 2-B, 3-C, 4-D
(d) 1-C, 2-A, 3-B, 4-D

127. The diagram represents competition between species 1 and species 2 according to Lotka-Volterra model of competition.



Given the conditions in the diagram, the predicted outcome of competition is

(1) Unstable coexistence between species 1 and 2 because $K_1 > K_2/\beta$ and $K_2 > K_1/\alpha$
(2) Unstable coexistence between species 1 and 2 because $K_1 < K_2/\beta$ and $K_2 < K_1/\alpha$
(3) Stable coexistence between species 1 and 2 because $K_1 > K_2/\beta$ and $K_2 > K_1/\alpha$
(4) Stable coexistence between species 1 and 2 because $K_1 < K_2/\beta$ and $K_2 < K_1/\alpha$

128. Following four types of species were observed in a community:

A. Species A has a large effect on community because of its abundance.
B. Species B has a large role in community out of proportion to its abundance.
C. Status of species C provides information on the overall health of an ecosystem.
D. Significant conservation resources are allocated to species D which is single, large and instantly recognizable.

According to above description, species A, B, C and D are called respectively.

(1) Dominant, Keystone, Indicator and Flagship
(2) Keystone, Flagship, Dominant and Indicator.
(3) Keystone, Dominant, Indicator and Flagship
(4) Flagship, Dominant, Keystone and Indicator.

129. Complete the following hypothetical life table of a species to calculate the net reproductive rate R_o:

Age class (x)	Number alive (n_x)	Number of dying (d_x)	Age-specific survivor-ship	Age-specific Fertility	$I_x m_x$
0-1	1000			0	
1-2	800			0	
2-3		200		0.5	
3-4	300	100		1.0	
4-5		200		1.0	

The calculated R_0 will be

(1) 0.75 (2) 1.00
(3) 0.65 (4) 1.15

130. Which of the following is the correct decreasing order for the rate of decomposition of litter constituents?

(1) Hemicellulose, cellulose, lignin, phenol
(2) Cellulose, hemicelluloses, phenol, lignin
(3) Hemicellulose, cellulose, phenol, lignin
(4) Lignin, phenol, hemicellulose, cellulose

131. Which of the following is NOT a benefit for the female adopting polyandry?

(1) Greater probability of getting all her eggs fertilized.
(2) Ability to receive more resources from the males.
(3) Ability of produce more offspring than normal.
(4) Improved chances of genetic compatibility with her own DNA.

132. Assume that individual A wants to do an altruistic act to individual B and that the benefit and cost of doing this act are, in 'fitness' units, 40 and 12, respectively. According to Hamilton's Rule, A should perform the altruistic act only if B is his

(1) nephew
(2) niece
(3) grandson or granddaughter
(4) daughter or son

133. Individual A performs to another individual a behavioral act which has a fitness consequence. Match the behavioral acts (a to e) with the correct fitness consequence ((i) to (iv)).

Behavioral act	**Fitness consequence to A**
Cooperation (a)	Gains direct fitness but after delay (i)
Adaptive altruism (b)	Loses inclusive fitness (ii)
Spite (c)	Gain indirect fitness (iii)
Deceit and manipulation (d)	Gains direct fitness but immediately (iv)
Reciprocity (e)	

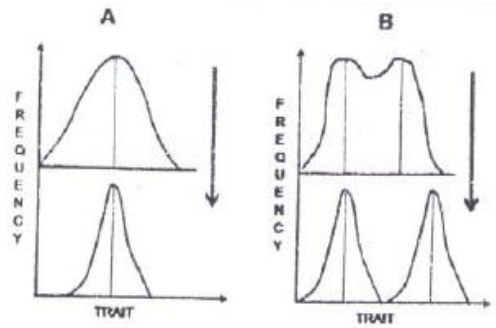
(1) a-(iv); b-(iii); c-(ii), d-(ii), e-(i)
(2) a-(i); b-(ii); c-(ii), d-(iii), e-(iv)
(3) a-(i); b-(iii); c-(ii), d-(ii), e-(iv)
(4) a-(ii); b-(ii); c-(iii), d-(i), e-(iv)

134. In a random sample of 400 individual from a population with alleles of a trait in Hardy-Weinberg equilibrium, 36 individuals are homozygous for allele a. How many individuals in the sample are expected to carry at least one allele A?

(1) 36 (2) 168

(3) 364 (4) 196

135. Two kinds of natural selection (A and B) acting on a trait are shown in the figure below. In each, the top graph shows the trait frequency before and the bottom graph frequency after the action of natural selection.



The kind of natural selection in A and B are

(1) A- Directional, B-Disruptive
(2) A- Neutral, B- Disruptive
(3) A-Stabilizing, B-Disruptive
(4) A-Disruptive, B-Stabilizing

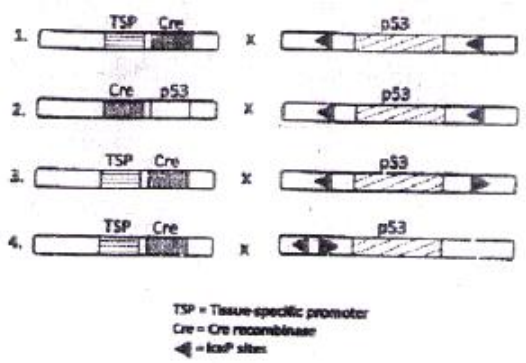
136. Which of the following statements is NOT correct regarding effect of genetic drift?

(1) It alters allele frequency substantially only in small populations.
(2) It can cause allele frequencies to change at random.
(3) It can lead to a loss of genetic variation within populations.
(4) It can cause harmful alleles to become eliminated.

137. During the production of alcohol by fermentation using budding yeast, oxygen supply is kept limited. Why?

(1) Budding yeasts are obligate anaerobes and cannot tolerate oxygen.
(2) Budding yeasts lose mitochondria in the absence of oxygen.
(3) Budding yeasts are facultative anaerobes.
(4) Alcohol is oxidized further in the presence of oxygen.

138. A student was asked to design a knockout cassette for specifically deleting the p53 gene from the prostate gland of mice. Which one of the following pairs of cassettes will ensure deletion of the gene?



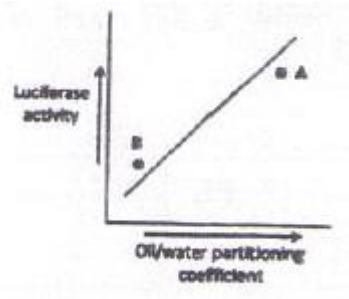
139. Following are certain statements regarding somatic hybridization, a technique used for plant improvement.

A. Protoplasts of only sexually compatible plant species can be fused.
B. Hybrids are produced with variable and asymmetric amounts of genetic material of parental species.
C. Protoplast fusion permits transfer of gene block or chromosomes.
D. Genes to be transferred need to be identified and isolated.

Which one of the following combinations of the above statements is correct?

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

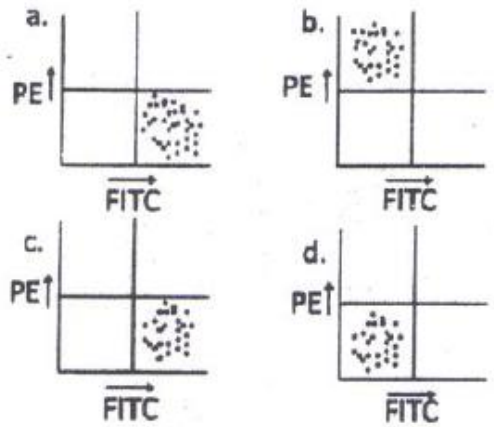
140. Small molecular weight compounds affect the activity of luciferase differently. The oil/water solubility of various compounds is one property important for its effect on luciferase. The straight line in the graph was obtained by plotting the activity data with 50 different compounds. The luciferase activity, of two new derivatives of Benzene (A and B) are shown below:



Which of the following statements is correct?

(1) A is phosphate and B is amine
(2) A is methyl and B is amine
(3) A is methyl and B is propyl
(4) A is amine and B is phosphate

141. A researcher was repeating a FACS experiment but somehow got confused with the labeling of the tubes. There are four tubes, one control, C (with no fluorescent label), one standard 1, S1 (with FITC label), one standard 2, S2 (with PE label) and the last one test, T (which should be FITC positive). Given below is the result of the FACS experiment.



What should be the correct labeling?

(1) a,S2; b,S1; c,T; d,C
(2) a,S1; b,T; c,C; d, S2
(3) a,S2; b,S1/T; c,C; d,S1/T
(4) a,S1/T b,S2; c,S1/T; d,C

142. Nichrome coated stainless steel electrodes were implanted in a rat brain for chronically recording the electrical activity of deep brain structures. During a study of 3 months the intensity of electrical signals gradually decreased. The following statements may explain the cause of this observation.

A. The deposition of metallic iron from the electrode tips caused degeneration of some neurons.
B. The gradual accumulation of microglia at the electrode tips increased the resistance of electrodes.
C. The neurons at the electrode tips were hyperpolarized gradually.
D. The threshold for firing action potential in the neurons at the electrode tips was increased due to prolonged presence of electrodes.

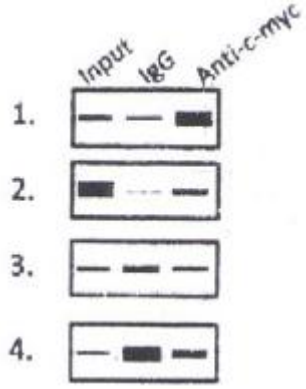
Which one of the following is correct?

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

143. In an attempt to detect protein expression profile in a cell, Western blot technique is employed. Expression of two new proteins is to be followed by probing with respective high affinity antibodies (raised in rabbit). Unfortunately, the two proteins were found to co-migrate in SDS-PAGE profile. Under this situation, using one dimensional SDS-PAGE and by Western blot, which one of the following is the best way to demonstrate the presence of both the proteins?

(1) Develop Western blots with their antibodies in the same gel.
(2) Prior to doing SDS-PAGE/Western blot, one protein could be removed by immune precipitating in the cell extracts.
(3) Silencing the expression of one protein at a time by siRNA and performing Western blotting.
(4) Subjecting the technique to stripping/reprobing of the gel after transferring to nitrocellulose membrane while doing Western blotting.

144. A chromatin immune precipitation (ChIP) assay was performed to determine specific transcription factor binding sites on the promoter of a gene. Pull down was done using either IgG or antibodies against c-myc. A DNA containing c-myc binding regions was used as a control for PCR amplification (input). Which one of the following PCR representations of DNA is correct?



145. The number of seeds in the fruit of a plant species, $H_0 : \mu = 30$. A random sample of 9 fruits gives the mean number of seeds as 24 with a standard deviation of 6.12. (a) What are the confidence limits for the sample mean? (b) Would your reject or accept the null hypothesis at 95% confidence level?

(1) (a) 18 and 30, (b) reject the hypothesis
(2) (a) 20 and 28, (b) reject the hypothesis
(3) (a) 20 and 28, (b) accept the hypothesis

(4) (a) 18 and 30, (b) accept the hypothesis