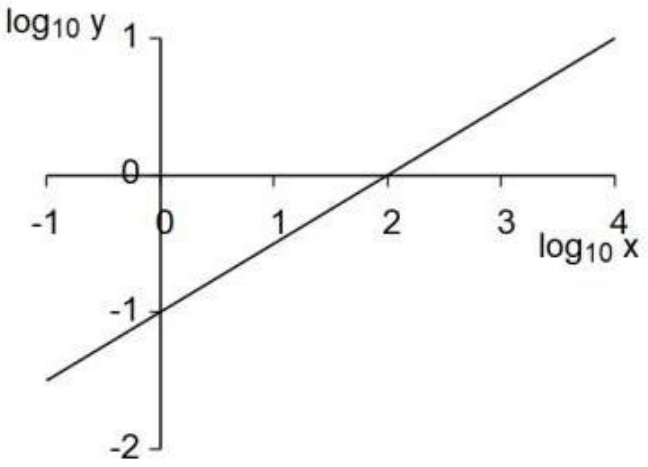
PART – A

Q1. Which of the following equations represents the graph shown?



(a) log y = (log x) -1

(b) logy=(logx)/2-1

(c) log y= (log x) - log(1)

(d) logy=(logx)/2 + 1

Q2. Starting at the same time policewomen A and B chase thief T. They all run in the same direction at constant speeds. A runs twice as fast and B thrice as fast as T. If A and B catch up with T at the same time, B must have started

(a) half as far behind T as A did

(b) 1 ½ times as far behind T as A did

(c) twice as far behind T as A did

(d) 3 times as far behind T as A did

Q3. Among A, B, C and D, one is a doctor, one is a teacher, one is an engineer, and the other is a lawyer. The teacher is older to B but younger than D. B is older to the doctor and younger than C. Which among the following is a conclusive inference?

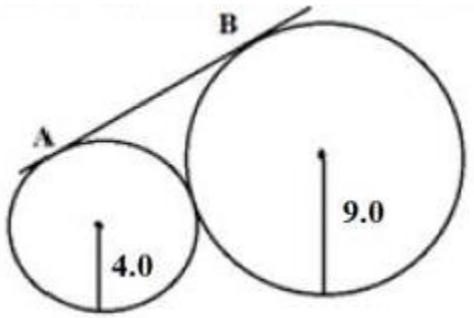
(a) A is the engineer

(b) B is the lawyer

(c) C is the teacher

(d) D is not the doctor

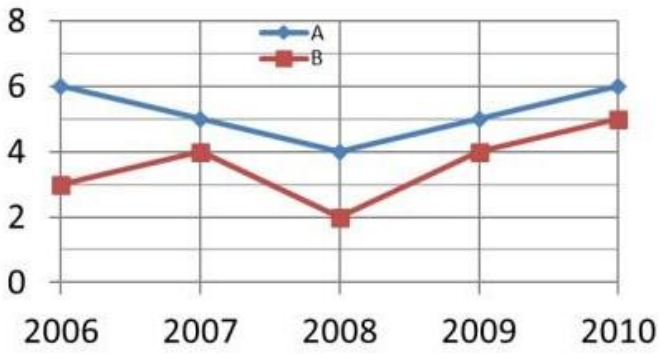
Q4. Two circles of radii 9.0 units and 4.0 units touch each other externally as in the figure. Then the length (in units) of their common tangent AB is



(a) 673 (b) 13

(c) 12 (d) $12\sqrt{2}$

Q5. Incomes (in lakhs) of two persons A and B, over the years 2006- 2010 are shown in the graph.



Which of the following statements is true?

(a) Over the years, trends of income of A and B are the same.

(b) The largest difference in incomes of A and B is in the year 2008.

(c) During the given period, the average income of A is higher by 1.8 lakh compared to B.

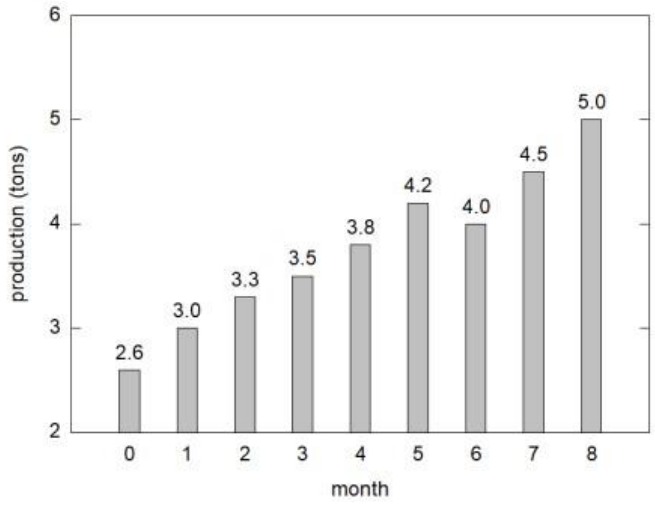
(d) During the given period, the annual income of A was below its average more than twice.

Q6. Four villages form the vertices of a rectangle of dimensions 8.0 km x 6.0 km. Roads are to be laid connecting the villages such that the distance by road between each pair of villages is the same. The shortest such road distance (in km) between any pair of villages will be

(a) 10 (b) $10\sqrt{3}$

(c) $10\sqrt{2}$ (d) 14

Q7. The production of goods in a factory over 9 months is shown in the graph.



The average growth (in tons per month) over the period under consideration

(a) is 0.3

(b) is 0.4

(c) varies between -0.2 and +0.5

(d) varies between +0.2 and +0.5

Q8. 100 ml of alcohol from container A containing 1 L of alcohol is transferred to another container B containing 1 L of water and mixed well. From this, 100 ml is transferred back to container A. The amount of alcohol in container B would be

(a) the same as the amount of water in container A

(b) more than the amount of water in container A

(c) less than the amount of water in container A

(d) indeterminable

Q9. Angela travels from town A to town T, 10 km away. When she's halfway, Betty starts from town B for T, 15 km away. When Betty is half way, Charlie starts from town C for T, 30 km away. When he's half way, Dave starts from town D for T, 40 km away. If their speeds are uniform and in the ratio 1 :3:12:16, respectively, the last one to reach T will be

(a) Angela (b) Betty

(c) Charlie (d) Dave

Q10. The following 15 observations are heights (in inches) of 15 persons 65, 61, 63, 65, 61, 61, 60, 60, 65, 85, 65, 86, 61, 65, 62 Which of the following is true?

(a) Mean < Median < Mode

(b) Median< Mode< Mean

(c) Mode< Median< Mean

(d) Median < Mean < Mode

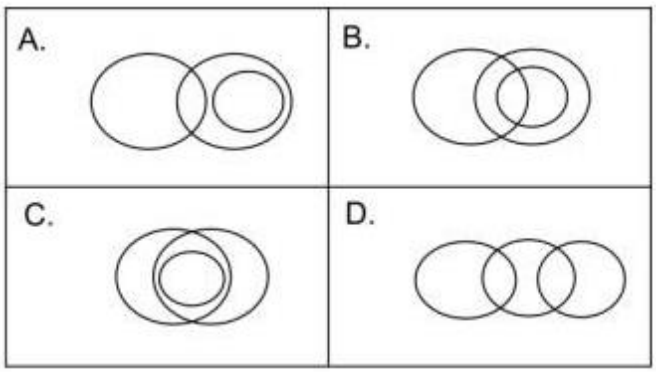
Q11. Four students Alpana, Behram, Ramesh and Doug joined a college in 1991 , 1992,

1993 and 1994 but not necessarily in that order. Each student joined one of the four departments, viz. Physics, Chemistry, Mathematics and Biology. No two students joined the same department. One of those who joined the college before 1993 joined Chemistry. No one joined the college after Ramesh. Doug joined Physics. Alpana joined one year after Doug but didn't join Chemistry. Then Behram joined the college in the year

(a) 1991 (b) 1992

(c) 1993 (d) 1994

Q12. Suppose some Basketball players play Cricket, all Tennis players play Cricket, and no Tennis player plays Basketball. Which one of the following Venn diagrams correctly represents the relationship among Basketball, Cricket and Tennis players' groups?



(a) A (b) B

(c) C (d) D

Q13. One letter is picked at random from each of the words LUNAR and LANDER.

The chance that the letters picked from both words belong to the word PRAGYAN is

(a) 3/10 (b) 3/7

(c) 1/2 (d) 7/10

Q14. A large rectangular paper having sides in the ratio of 3:8 is cut in half across the longer side. The process is repeated several times. At which stages of the repeated cuttings will the ratio of the sides be 3:8?

(a) Never (b) Every second cut

(c) Every third cut (d) Every fifth cut

Q15. Which one of the following represents the most precise measurement of a length?

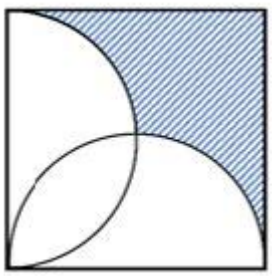
(a) 2.15 meter

(b) 215 centimeter

(c) 21.5 decimeter

(d) 2.150 meter

Q16. Two semicircles are drawn in a square with sides as diameters as shown. If the side of the square is 2 units, how much is the shaded area (in sq. units)?

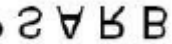


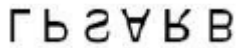
(a) 2- π/4 (b) 2- π/3

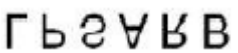
(c) 3- π/2 (d) 3- π/4

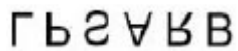
Q17. Consider a string a letters and a mirror placed below it as shown.

Which of the following is the correct reflection of the string?

(a) 

(b) 

(c) 

(d) 

Q18. A test consists of 20 questions. A correct answer fetches 4 marks and a wrong answer is penalised by deducting 1 mark. Un-attempted questions fetch nothing. The number of triplets of (#correct, #incorrect, #unattempted) which give a score of 40, is

(a) 1 (b) 2

(c) 3 (d) 4

Q19. Let $2^a3^b5^c$ = 1200 where a, b, care integers. Then a+ 2b + 3c is

(a) 7 (b) 8

(c) 11 (d) 12

Q20. In the following finite sequence of integers, how many terms are divisible by their immediate next terms?

8,3,4,9,3,5,9,5,9,9,9,4,5,6,3,3,5,7,2,3,9,9

(a) 7 (b) 4

(c) 5 (d) 6

PART - B

Q1. A researcher, while studying vernalization in plants, has made the following statements. Choose the INCORRECT one.

(a) Vernalization causes stable change in the competency of the meristem to form an inflorescence in some plant species.

(b) Vernalization causes changes in gene expression that do not involve alteration in the DNA sequence.

(c) Flowering is not altered under normal growth conditions in plants defective in vernalization.

(d) Vernalization alters the expression of FLC gene.

Q2. While developing genetic maps, Alfred Sturtevant proposed that genetic distances are additive. From test crosses involving two genes, if the genetic distance between genes A and B was observed to be 15 cM and between B and C was 10 cM, then the percentage of recombinants observed between A and C would be 25, given that the arrangement is A-B-C. This will be observed only when there is:

(a) No interference

(b) Complete interference

(c) Negative interference

(d) Variable interference

Q3. Monozygotic and dizygotic twins are used to study the onset of mental illness. The influence of genetic factors on these diseases can be done by calculating the:

(a) Mutation rate

(b) Concordance rate

(c) Phenotype variation

(d) Environmental effect

Q4. Which one of the following statements about determination of ABO blood types is INCORRECT?

(a) ABO blood types are determined by three alleles of one gene.

(b) Four blood group phenotypes are produced by six genotypes.

(c) Parents with a type A and a type B could produce a type O child.

(d) Universal donors with O blood type do not carry antibodies against A and B.

Q5. Which microscope is typically used to detect a single fluorescent molecule?

(a) DIC microscope

(b) Epifluorescence microscope

(c) TIRF microscope

(d) Phase contrast microscope

Q6. Which one of the following is the major antibody in the early stages of a primary immune response?

(a) lgA (b) lgM

(c) lgD (d) lgE

Q7. Which one of the following statements about human transposons is INCORRECT?

(a) LINEs are autonomous active transposable elements in humans.

(b) SINEs and LINEs are retrotransposons.

(c) Human genome contains many more copies of retrotransposons than DNA transposons.

(d) LINEs and SINEs contain LTR elements that initiate transcription.

Q8. Which one of the following strategies will generate the most precise mutation at the predetermined location of a plant genome?

(a) CRISPR/Cas9 editing

(b) T-DNA insertion mutagenesis

(c) Transposon mutagenesis

(d) Targeting Induced Local Lesions in Genomes (TILLING)

Q9. Which one of the following statements is correct for early embryonic development in terms of differentiation?

(a) The first stage of commitment is termed as specification, while the second stage is determination.

(b) If a specified cell is transplanted to a region of differently specified cells, the fate of the specified cell remains unchanged.

(c) A cell or tissue is said to be determined when it shows reversible fate under the influence of the surrounding cells or tissue.

(d) The first stage of specification is termed as commitment when a cell develops autonomously.

Q10. Using patch-clamp technique, one can find the ligands that could influence specific ion channel. How many molecules of acetylcholine are required to open an acetylcholine receptor ion channel in such an experiment?

(a) One (b) Two

(c) Three (d) Four

Q11. Which one of the following hormones elicits its cellular response by producing cAMP as a second messenger?

(a) Calcitonin (b) Oxytocin

(c) Prolactin (d) Leptin

Q12. The meeting of sperm and eggs in a dilute concentration is one of the challenges of external fertilization. Which one of the following proteins helps in overcoming the challenge?

(a) Bindin (b) Resact

(c) lzumo (d) Ovastacin

Q13. Which one of the following amino acids is present in vasopressin at position 3?

(a) Tyrosine (b) Phenylalanine

(c) Glutamine (d) Asparagine

Q14. Which one of the following statements about Anthrax is correct?

(a) This is an acute infectious disease caused by a gram-negative bacterium.

(b) The B subunit of anthrax toxin is known as the lethal factor.

(c) The A subunit of the lethal toxin is a protease that cleaves the members of MAP kinase kinase family.

(d) The lethal toxin and edema toxin consist of identical A subunits.

Q15. The mobile signal, florigen, that controls the flowering status of the plants in encoded by which one of the following?

(a) Flowering locus C (FLC)

(b) Flowering locus D (FD)

(c) Flowering locus T (FT)

(d) CONSTANS (CO)

Q16. Mammalian cells that have just crossed the Restriction Point of the cell cycle are likely to have:

(a) high levels of unphosphorylated retinoblastoma protein.

(b) an active anaphase promoting complex.

(c) low levels of mitotic cyclin B.

(d) condensed chromosomes.

Q17. The tri-snRNP particle is composed of:

(a) U1, U4and U3snRNPs

(b) U2, U4 and U3 snRNPs

(c) U3, U6 and US snRNPs

(d) U4, U6 and U5 snRNPs

Q18. To evaluate insulin-dependent diabetes, clinicians prefer evaluating mono-glycated hemoglobin, referred to as HbA1c, which occurs due to a nonenzymatic reaction between glucose and a few amino acids in hemoglobin. Which of the following amino acids are likely to be involved in the modification of hemoglobin?

(a) Asparagine and Glutamic acid

(b) Proline and Tryptophan

(c) Glutamine and Aspartic acid

(d) Valine and Lysine

Q19. Phelloderm is derived from :

(a) Cork cambium

(b) Fascicular cambium

(c) lnterfascicular cambium

(d) Provascular tissue

Q20. Which one of the following statements about clamp loader is NOT correct?

(a) The clamp loader is a five-subunit heteropentamer that helps in DNA replication.

(b) Clamp loading is an ATP-dependent process.

(c) In the absence of ATP, clamp loader attains a spiral shape to bind and open the damp.

(d) The clamp loader and DNA polymerase compete for the same C-terminal face of the clamp.

Q21. As per Aichi Target 11 of the Convention on Biological Diversity, what percentage of

geographical area was proposed to be protected for biodiversity conservation by the year 2020?

(a) Terrestrial and inland water 23%, coastal and marine areas 17%

(b) Terrestrial and inland water 23%, coastal and marine areas 10%

(c) Terrestrial and inland water 17%, coastal and marine areas 10%

(d) Terrestrial and inland water 17%, coastal and marine areas 7%

Q22. Which one of the following statements is a characteristic property of B cell epitopes on a protein?

(a) Amino acid sequences in the interior region are composed predominantly of hydrophobic amino acids.

(b) Amino acid sequences in the interior region are composed predominantly of hydrophilic amino acids.

(c) Protruding regions on the surface composed are predominantly of hydrophobic amino acids.

(d) Protruding regions on the surface are composed predominantly of hydrophilic amino acids.

Q23. A researcher measures the height of 50 teak trees in wet and dry habitats. Which one of the following options is an appropriate statistical test to determine if heights significantly differ in wet and dry habitats?

(a) Student's t-test

(b) Chi-square test

(c) Regression analysis

(d) Discriminant analysis

Q24. Using an analytical ultracentrifugation sedimentation velocity run, a researcher has calculated the S value (Svedberg units) of a part of the freshly purified 12 kDa enzyme to be ~1.83, corresponding to its monomeric state. However, during an identical run of the remaining protein after 2 days, the researcher finds that the S value increased to ~2.57. What would be the correct conclusion about the enzyme in question?

(a) The enzyme is aggregated and forms a homo octamer.

(b) The enzyme is monomeric but is now associated with the buffer components.

(c) The enzyme has undergone monomer to a homodimer transition.

(d) The enzyme has degraded due to autocatalytic activity.

Q25. Absence of dormant buds and absence of annual growth rings in a fossilized trunk specimen of a coal swamp plant indicates:

(a) long dry seasons.

(b) slow growth rate.

(c) highly fluctuating seasons.

(d) unvarying, seasonless climate.

Q26. Many signal transduction pathways work as molecular switches. On receiving a signal, they switch from an inactive form to an active form. They return to the inactive form when another signal switches them off. Which of the following processes does NOT directly involve a molecular switch?

(a) Proteasome degradation of HIF1a during normoxia.

(b) Regulation of Ras during cell proliferation.

(c) Regulation of AKT in response to growth signals.

(d) Growth cone collapse regulation by RhoA.

Q27. Which one of the following statements regarding the production of various reactive oxygen species during oxidative burst is INCORRECT?

(a) NADPH oxidase involved in this process is a plasma membrane-spanning protein.

(b) In Arabidopsis, NADPH oxidases are encoded by respiratory burst oxidase homolog (Atrboh) genes.

(c) Superoxide dismutase is an apoplastic enzyme involved in the formation of superoxide.

(d) FAD is involved in the formation of superoxide.

Q28. Which one of the following pollutants does NOT concentrate in organisms at higher trophic levels due to biomagnification?

(a) Mercury

(b) Phosphate

(c) Persistent Organic Pollutants (POPs)

(d) Selenium

Q29. Which one of the following statements about different cellular junctions is INCORRECT?

(a) Gap junctions are channel-forming junctions linking the cytoplasm of adjacent cells.

(b) Tight junction, desmosome, and gap junction together form the junctional complex.

(c) Hemidesmosome helps in anchoring intermediate filaments with extracellular matrix.

(d) Adherens junctions help in connecting actin filaments of adjacent cells.

Q30. The hematocrit of human blood is highest when collected from:

(a) jugular vein

(b) pulmonary vein

(c) right coronary artery

(d) brachial artery

Q31. What is the typical maximum sustainable yield for a fish population, given that its carrying capacity (K) is 20,000 and intrinsic growth rate (r) is 0.15?

(a) 1,333 (b) 1,500

(c) 3,000 (d) 6,666

Q32. Which one of the following statements about ATP generating mitochondria is TRUE?

(a) The outer membrane is permeable to protons.

(b) The inner membrane is not permeable to protons.

(c) The intermembrane space has high concentration of protons.

(d) The matrix has the highest concentration of protons.

Q33. The volume of the pleural fluid in a healthy human is:

(a) 55-60 ml (b) 35-40 ml

(c) 15-20 ml (d) 1-5 ml

Q34. The amount of energy required to break a single covalent bond is:

(a) 200-500 kJ/mol

(b) 80-150 kJ/mol

(c) 600-900 kJ/mol

(d) 20-70 kJ/mol

Q35. Which one of the following statements about the molecular clock hypothesis as proposed by Zuckerkandl and Pauling 1962 is CORRECT?

(a) DNA and protein sequences evolve at a relatively constant rate.

(b) DNA sequences evolve at a relatively slow rate when compared to proteins.

(c) Amino acid sequences evolve stochastically.

(d) Protein sequences do not evolve even when DNA evolves at a constant rate.

Q36. DNA from a strain of bacteria with genotype a^+ b^+ c^+ d^+ e^+ was isolated and used to transform a strain of bacteria that was a^- b^- c^- d^- e^-. The transformants were tested for the presence of donated genes. The following genes were co-transformed:

a^+ and c^+

b^+ and d^+

e^+ and d^+

c^+ and b^+

Which one of the following options given correct order of genes on the bacterial chromosome?

(a) a c d b e (b) a c b d e

(c) b d c a e (d) e d c a b

Q37. Which one of the following options represents parts of a tRNA that are involved in amino acid charging and interaction with the mRNA, respectively?

(a) 5' end and D-loop

(b) 3' end and T-loop

(c) 5' end and anti-codon loop

(d) 3' end and anti-codon loop

Q38. According to the latest IUCN Red List (2022), which one of the following groups has the highest percentage of assessed species that are threatened with extinction?

(a) Amphibians

(b) Birds

(c) Mammals

(d) Reptiles

Q39. Which one of the following exhibits ATPase and helicase activities for promoter opening and Clearance?

(a) TFIID (b) TFIIH

(c) TFIIF (d) TFIIE

Q40. The base composition of the genome of a newly identified virus is given below: Adenine: 25%; Cytosine: 35%; Guanine: 30%; Thymidine: 10% Based on this information, the genome of this virus is:

(a) double-stranded DNA.

(b) single-stranded DNA.

(c) double-stranded RNA.

(d) single-stranded RNA.

Q41. An herbivore eats food that provides 1,000 kJ of energy of which, 500 kJ is lost in faeces, 350 kJ is used in cellular respiration, and 150 kJ is used for growth. The percent production efficiency of the herbivore is:

(a) 50 (b) 35

(c) 30 (d) 15

Q42. In which one of the following organelles does glycine decarboxylase complex and serine hydroxymethyltransferase convert two molecules of glycine into one molecule of serine during photorespiration?

(a) Endoplasmic reticulum

(b) Chloroplast

(c) Mitochondria

(d) Peroxisome

Q43. Mutants and transgenic models have played a pivotal role in understanding development. Which one of the following statements is true?

(a) A transgenic DNA chimaera experiment involves the transplantation of cells from a genetically modified organism to another embryo.

(b) Interspecies chimaera are the easiest and most common model systems to study developmental processes.

(c) A transgenic female mouse (XX) expressing Sry (sex-determining region of the Y-chromosome) induces the production of Y-chromosome-carrying ovum in the mouse.

(d) A transgenic animal model is exclusively utilized to study gene function by deletion of a gene.

Q44. An enzyme "X" converts a L-amino acid to a racemic mixture of D- and L- forms. Which one of the following coenzymes is utilized by enzyme X for this conversion?

(a) Pyridoxal phosphate

(b) Thiamine pyrophosphate

(c) Flavin adenine dinucleotide

(d) Tetrahydrofolate

Q45. Juvenile hormone is secreted by which one of the following glands?

(a) Corpus allatum (b) Pituitary

(c) Pineal (d) Labial

Q46. As per the ENVIS database, approximately how much of India's landmass is designated under various categories of protected areas for biodiversity conservation, as of January 2023?

(a) 23.08% (b) 17.51%

(c) 11.62% (d) 5.28%

Q47. Which one of the following is NOT an example of learning?

(a) Imprinting

(b) Fixed action pattern

(c) Operant conditioning

(d) Habituation

Q48. Which of the following is a co-translational amino acid modification, rather than a post-translational modification?

(a) Phosphate added to a serine.

(b) Selenium added to a cysteine.

(c) Acetyl added to a lysine.

(d) Methyl added to an arginine.

Q49. Which one of the following statements about biological membranes is INCORRECT?

(a) Lipid molecules can diffuse freely in the plane of the bilayer.

(b) The ratio of the size of head group to fatty acyl chain of phospholipids contributes to the curvature properties of lipid membranes.

(c) Individual lipid molecules rapidly rotate along their :long axis.

(d) Phospholipids freely diffuse from one leaflet of bilayer to another.

Q50. Which one of the following statements about the guardee protein, that plays an important role during plant-pathogen interactions is correct?

(a) It is a bacterial protein that guards the host cell components.

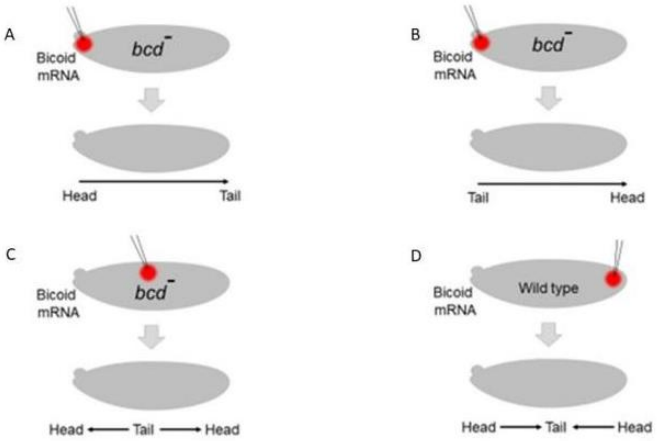
(b) It is secreted by the type Ill secretion system of the pathogenic bacteria.

(c) It imparts disease resistance in plants that lack, cognate R protein.

(d) Degradation of guardee protein can activate the defense response.

PART - C

Q1. Bicoid was identified as a head morphogen in Drosophila and embryos lacking Bicoid could not form a head. In an experiment, bicoid mRNA was introduced in different regions of bicoid-deficient (bcd) or wild type embryos and development of the head and tail (as indicated by arrows) was followed.



Which one of the following options represents the correct developmental pattern?

(a) A and C (b) B and C

(c) B and D (d) A and D

Q2. Lung surfactant is composed of phospholipids and proteins and plays an important role in lowering the surface tension of alveoli when they are small in size. The following statements suggest the structure and functions of proteins in lung surfactant:

A. Surfactant protein B (SP-8) and surfactant protein C (SP-C) are the key protein members of monomolecular film of surfactant.

B. Surfactant protein A (SP-A) is a large glycoprotein and has a collagen like domain within its structure.

C. SP-A does not play any role in the feedback uptake of surfactant by the type II alveolar epithelial cells.

D. The formation of phospholipid film lining the alveoli is inhibited by the proteins in surfactant.

Which one of the following options represents the combination of correct statements?

(a) A and B (b) B and C

(c) C and D (d) A and D

Q3. Following statements are made regarding heterosis breeding in plants.

A. Heterosis is always lowest in a cross between two genetically diverse parents.

B. Cytoplasmic Male Sterility (CMS) may be used in heterosis breeding to eliminate emasculation.

C. The A-line (CMS) and B-line (used for maintenance of CMS) are isogenic lines, differing at only a specific locus.

D. Heterosis can be retained in the F2 generation.

Which one of the following options represents the combination of all correct statements?

(a) A, B, and C (b) B, C, and D

(c) B and C only (d) C and D only

Q4. The following statements are made regarding diverse strategies adopted by fungal pathogens:

A. HC toxin inhibits histone deacetylase of the host plant.

B. Oxalic acid produced by fungal pathogens suppresses early plant defense responses.

C. Oxalic acid produced by fungal pathogens induces callose deposition in the infected tissues.

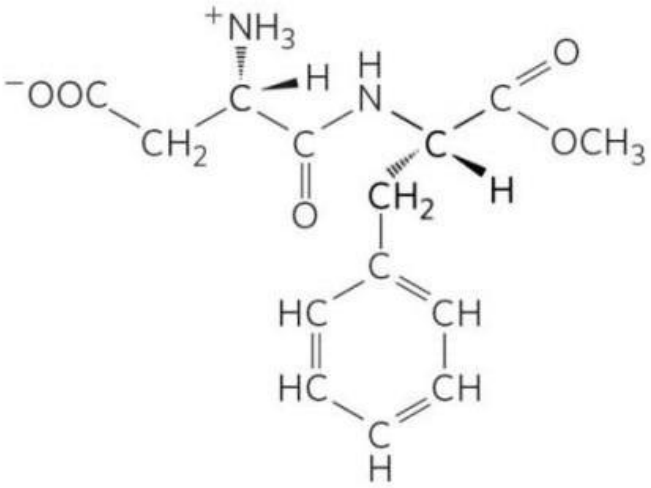
D. HC toxin targets plasma membrane-localized H^+-ATPase in the host plant.

Which one of the following options represents all correct statements?

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

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

Q5. Which one of the following options correctly depicts the stereo-conformation of the dipeptide derivative of Aspartic acid and Phenylalanine?



(a) L-Aspartyl-L-phenylalanine methyl ester

(b) D-Aspartyl-L-phenylalanine methyl ester

(c) D-Aspartyl-D-phenylalanine methyl ester

(d) L-Aspartyl-D-phenylalanine methyl ester

Q6. As depicted in the figure below, the sequence of trypanosomal mitochondrial cytochrome oxidase subunit II (COX II)

mRNA does not match the sequence of the COX II gene. The mRNA contains four additional U's (highlighted) which are not represented by 'T's in the gene, and these four U's are presumably added to the RNA by editing.

COX II DNA: ···GTATAAAAGTAGA G A ACCTGG···

COX II RNA: ···GUAUAAAAGUAGAUUGUAUACCUGG···

The following statements were made about RNA editing:

A. RNA editing can add or remove U's from the target mRNA.

B. Editing occurs in the 5' - 3' direction by successive action of one or more guide RNAs.

C. A terminal uridylyl transferase (TUTase) facilitates addition of extra UMPs (uridylates) to the mRNA during editing.

D. The proteins required for editing are encoded by the mitochondrial DNA, while the required guide RNAs are encoded in the nucleus and imported into the mitochondria.

Which one of the following options shows the combination of all correct statements?

(a) A and B (b) A and C

(c) B and C (d) B and D

Q7. The loci for three mutations on X-chromosome, yellow body colour (y), cross-vein less (cv), and forked bristles (f) are shown

The interference between these genes is zero.

A male fly with yellow body, cross-vein less and forked bristles was crossed with virgin female flies homozygous for the wild type phenotype. The F1 flies were sib-mated and a total of 1000 F2 progeny flies were obtained.

Which one of the following options represents a correct conclusion from the analysis of F2 progeny? ?

(a) Parental type - 585, Single cross over between y and cv-95, Single cross over between cv and f-275, Double cross over - 45.

(b) Parental type - 540, Single cross over between y and cv-140, Single cross over between cv and f-320, Double cross over - 0.

(c) Parental type -1000, no other class of flies because interference is 0.

(d) Parental type - 540, Single cross over between y and cv-275, Single cross over between cv and f-140, Double cross over - 45.

Q8. During metaphase to anaphase transition, complete removal of cohesin allows sister chromatids to separate and move to opposite poles of the spindle. Given below are a few proteins/protein complexes involved in mitotic progression.

A. Cdc20 B. APC/C

C. Separase D. CyclinA

Which one of the following options represents the protein(s)/protein complexes involved in cohesin removal at the onset of anaphase during mitosis?

(a) C only (b) A only

(c) A, B, and C (d) B, C, and D

Q9. The following statements were made with reference to the strategies used to identify the organizer molecules like Noggin:

A. A cDNA library was prepared from a lithium chloride treated amphibian gastrula. The organizer molecule was identified from a clone whose mRNA could rescue the phenotype of a UV-irradiated 1 - cell embryo and allow normal development.

B. Clones of cDNA whose mRNA was present in dorsalized but not in ventralized embryo were tested by injecting them into ventral blastomeres and seeing whether they induced a secondary axes.

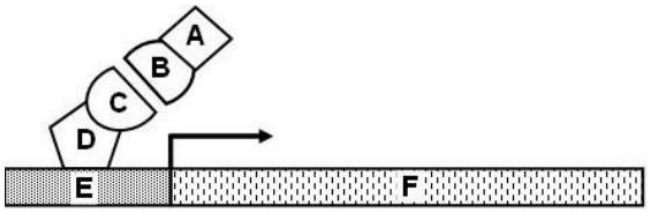
C. The molecule, an inhibitor of both Activin and BMPs, caused ectoderm to become a neural tissue.

Which one of the options is/are correct?

(a) A only (b) A and B only

(c) B and C only (d) A, B and C

Q10. Yeast two-hybrid system allows detection of interacting proteins. In the following schematic, various components of yeast two-hybrid system have been indicated by letters A-F. Which one of the following options provides a correct match of A to F and components of yeast two-hybrid system?



(a) A- Prey; B- Gal4 activation domain; C-Gal4 binding domain; D- Bait; E- Reporter gene; F- UAS element

(b) A- Gal4 binding domain; B- Bait; C-Prey; D-Gal4 activation domain; E-Reporter gene; F- UAS element

(c) A- Bait; B- Gal4 binding domain; C-Gal4 activation domain; D-Prey; E- UAS element;. F- Reporter gene

(d) A- Gal4 activation domain; B- Prey; C-Bait; D- Gal4 binding domain; E- UAS element; F- Reporter gene

Q11. The reproductive cycles of two populations (X and Y) of the silk cotton tree (Ceiba pentandra) were monitored for one year. A census was carried out and all plants were tagged and counted throughout this period and is reflected in the data sheet given below:

Parameter	Population X	Population Y
Initial number of plants (N_0)	500	300
Number of new seedlings established (B)	100	210
Number of initial plants that died (D)	20	27

Given that there is no seedling mortality, which one of the options correctly depicts the per capita rate of increase (r) for the two populations?

(a) X: 0.16, Y: 0.61 (b) X: 580, Y: 483

(c) X: 1.16, Y: 1.61 (d) X: 0.208, Y: 0.77

Q12. If the length of a single continuous a-helical polypeptide is 108 A, which one of the following statements is true?

(a) The α-helix contains 72 amino acids without Proline(s) and Glycine(s)

(b) The α--helix contains 76 amino acids without Alanine(s) and Valine(s)

(c) The α-helix contains 80 amino acids without Lysine(s) and Aspartic Acid(s)

(d) The α-helix contains 74 amino acids without Arginine(s) and Histidine(s)

Q13. Given below are inhibitors of electron transport (Column X) and their target enzymes (Column Y)

Column X		Column Y	
Inhibitors of electron transport		Respiratory chain complex enzymes	
A	Dicyclohexylcarbodiimide and Oligomycin	i	NADH coenzyme Q reductase
B	Rotenone and Demerol	ii	ATP Synthase
C	Thenoyltrifluroacetone and Carboxin	iii	Succinate coenzyme Q reductase
D	Cyanide and Azide	iv	Cytochrome c oxidase

Which one of the following options represents all correct matches between Column X and Column Y?

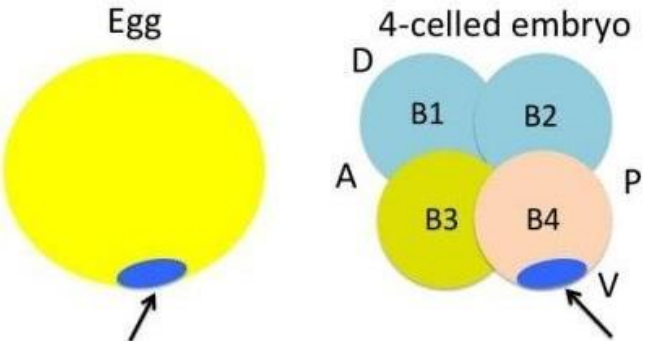
(a) A (iii), B (iv), C (i), D (ii)

(b) A (ii), B (i), C (iii), D (iv)

(c) A (iv), B (ii), C (i), D (iii)

(d) A (i), B (iii), C (iv), D (ii)

Q14. This is a hypothetical example. Sequencing of the genome of an organism led to the identification of several ORFs. One of them was found to code for a protein that showed sequence similarity to proteins known to have a role in early development. The protein was named as Brainy. The results of RNA in situ hybridization in egg and 4-celled embryo is schematically depicted below:



Further, based on fate map, it was proposed that the B4 blastomere gave rise to the notochord. Different experiments were carried out which led to the hypothesis that notochord developed autonomously by acquiring and retaining Brainy.

The following statements represent experiments that could support the above hypothesis and is also correctly matched with the outcome:

A. Microinjection of brainy mRNA in other blastomeres would lead to ectopic development of notochord.

B. If the 4 blastomeres were dissociated and allowed to develop individually, the B4 blastomere would cease to develop.

C. Treating the 4-celled embryo with lithium chloride would lead to the ventralization of the embryo.

D. Microinjection of morpholinos against brainy mRNA in B3 would convert the fate of B3 to that of B4.

Which one of the following options represents statements that support the hypothesis?

(a) A only (b) A and B only

(c) A and C only (d) A, B and D

Q15. The table below represents plant disease resistance genes, the protein type and race-specific nature:

Disease resistance gene		Protein type		Race-specific nature	
A.	*edr1*	a.	subunit of the general transcription factor TFIIA	i.	yes
B.	*mlo*	b.	Raf-like MAPKKK	ii.	no
C.	*xa5*	c.	a member of the NODULIN3 gene family of SWEET proteins		
D.	*xa13*	d.	plant-specific seven transmembrane helices protein		

Choose the correct combination of disease resistance gene, its protein type, and race-specific nature from the options given below.

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

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

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

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

Q16. A researcher captured 45 fish from a lake on day 1, tagged and released them back. On day 2 the researcher caught 50 fish out from the same lake, of which 15 were already tagged. Estimate the population size of fish in the lake with this information and pick the correct option.

(a) 150 (b) 135

(c) 166 (d) 75

Q17. Apart from the interaction of antigenic peptide with the TCR-CD3 complex (signal 1), T-cell activation requires another signal termed as "Co-stimulatory signal" (signal 2). Given below are a few statements regarding the co-stimulatory signal.

A. All three professional antigen-presenting cells (dendritic cells, macrophages, and B cells) possess the same capacity in respect to delivering the co-stimulatory signal.

B. Co-stimulatory signals are not antigen-specific.

C. The principal co-stimulatory molecules expressed on antigen presenting cells are B7-1 and B7-(b)

D. Unlike 87, CD28, the ligand for B7 which is expressed on T cells, is not a member of immunoglobulin superfamily.

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

(a) C only (b) B and C

(c) A and D (d) B only

Q18. Given below is a table listing selected extant molluscs (Column X) and a range of eye complexities (Column Y) found in them.

Column X	Column Y
A. Limpet	I. Complex camera lens-type eye

B. Marine snail	ii. Eyecup
C. Nautilus	iii. Eye with primitive lens
D. Squid	iv. Patch of pigmented cells
	v. Simple pinhole eye

Which one of the following options represents the correct match between Column X and Column Y?

(a) A-iv, B-v, C-ii, D-i

(b) A-iv, B-iii, C-v, D-i

(c) A-ii, B-i, C-v, D-iii

(d) A-v, B-ii, C-i, D-iii

Q19. Consider a disease caused by a recessive allele. In a study population, one out of every 500 individuals (0.20%) has the disease. Based on the Hardy-Weinberg equation, what is the percentage of individuals who are carriers of the recessive allele for the disease?

(a) 7.6% (b) 20.2%

(c) 1.5% (d) 30.5%

Q20. Western Ghats of India is considered as one of the global biodiversity hotspots because of some of the following characteristics:

A. High species richness

B. High endemism

C. Habitat loss

D. Large altitudinal range

Which one of the following options represents the correct combination of characteristics that qualifies the Western Ghats as a biodiversity hotspot?

(a) A, B and C (b) A, C and D

(c) A and B only (d) B and D only

Q21. Certain animal species use infrasound for acoustic signaling. In this context, consider the statements below:

A. lnfrasound signals propagate over several kilometers in deserts.

B. lnfrasound signals propagate over several kilometers in open oceans.

C. lnfrasound is employed only by mammals for acoustic signaling.

D. lnfrasound signal transmission is prone to scattering and attenuation.

Which one of the following options represents all correct combination about infrasound signaling?

(a) A and B only

(b) B and D only

(c) A, C and D

(d) A, B and C

Q22. Microtubule cytoskeleton utilizes some accessory proteins to regulate microtubule dynamics. Accessory proteins are given in column X and their typical functions in column Y.

Accessory protein (Column X)		Function (Column Y)	
A.	γ-TuRC	(i)	stabilizes plus end, promotes rapid microtubule growth
B.	XMAP215	(ii)	helps in microtubule branching
C.	Katanin	(iii)	nucleates assembly and remains associated with the minus end
D.	Augmin	(iv)	severs microtubules

Which one of the following options represents all correct matches between Column X and Column Y?

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

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

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

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

Q23. Following statements were made for fragile X syndrome:

A. It is caused due to increased numbers of CGG trinucleotide (>200 repeats) in the 5' UTR of FMR1 genes.

B. Unaffected people do not show any CGG repeats in the 5' UTR of the FMR1 gene.

C. Expanded numbers of CGG repeats in 5' UTR of FMR1 transcripts causes its premature degradation.

D. Expansion over 200 repeats leads to methylation of the FMR1 promoter.

E. Fragile appearance of X chromosome develops due to dissociation of non-histone proteins from the FMR1 locus.

Which one of the following options provides combination of all correct statements?

(a) A, B and E

(c) A and E only

(b) B, C and E

(d) A and D only

Q24. Some of the statements given below are related to species that show r- or k-selection strategies:

A. Maximum rate of increase of a population

B. Density of individuals supported by the environment at equilibrium

C. Life history evolution

D. Liebig's law of the minimum

E. Precociality and altriciality

Choose the option that contains all the correct statements related to r- and /(-selection strategies.

(a) A and B only

(b) A, B and C only

(c) C, D, and E only

(d) A, B, C and E only

Q25. Following are certain statements regarding the plant cell water potential

A. The major factors influencing the water potential in plants are potentials of solutes (Ψ_s), pressure (Ψ_p) and gravity (Ψ_g).

B. The solute potential (Ψ_s) increases the free energy of water by diluting the water.

C. Positive pressures raise the water potential while negative pressures reduce it.

D. The gravitational potential depends on the height of the water above the reference-state of water, the density of water and the acceleration due to gravity.

Which one of the following options represents all correct statements?

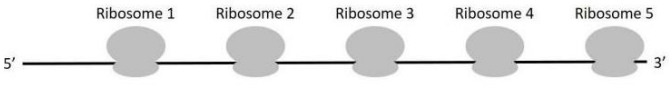
(a) A, B and C

(b) A, B and D

(c) B, C and D

(d) A, C and D

Q26. The eukaryotic mRNA shown schematically in the diagram below has five ribosomes carrying out translation.



Which one of the following statements about this polyribosome complex is true?

(a) The mRNA was being transcribed when the first ribosome started translation.

(b) Ribosome 5 is nearest to the initiation codon.

(c) The polypeptide attached to ribosome 4 is longer than that attached to ribosome (c)

(d) All the ribosomes have incorporated the carboxyl-terminal amino acid.

Q27. Protein transport into the ER is co-translational and proteins are inserted via an aqueous channel into the ER. This can be studied using microsomes in an in vitro translation set up. Statements given below are possible outcomes when salt conductance is measured in this system.

A. Microsomes do not show any conductance of salt ions when isolated from the cells.

B. Addition of puromycin will lead to increased salt conductance.

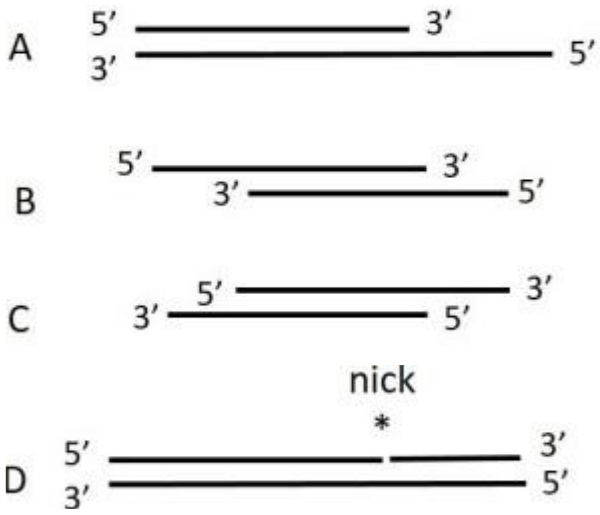
C. Addition of puromycin will have no effect on salt conductance.

Which one of the following options has the combination of all correct statements?

(a) A only (b) A and B

(c) B only (d) A and C

Q28. The following DNA molecules are provided as substrates for replication by DNA polymerase Ill.



Which one of the following options lists the molecules that CANNOT function as substrates for DNA polymerase Ill?

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

(c) C and D (d) C only

Q29. The table below summarizes various Hormones (in Column X) and induced cell responses mediated by them via Cyclic AMP (in Column Y).

Hormone (Column X)		Major Response (Column Y)	
(A)	Epinephrine	(i)	Increasing heart contraction
(B)	Vasopressin	(ii)	Progesterone secretion
(C)	Glucagon	(iii)	Water resorption
(D)	Luteinizing hormone	(iv)	Glycogen breakdown
(E)	Parathyroid hormone	(v)	Bone resorption

Match all correct combinations from the options given below:

(a) A-i; B-v; C-iv; D-ii; E-iii

(b) A-iv; B-iii; C-iv; D-ii; E-v

(c) A-iv; B-v; C-i ; D-ii; E-iii

(d) A-iv; B-v; C-iv; D-i; E-iii

Q30. Changes in cancer-critical genes/proteins in different human tumours were analyzed.

Gene amplification or deregulation leads to increased expression (X) while mutations, deletions, or recombination leads to inactivation (Y).

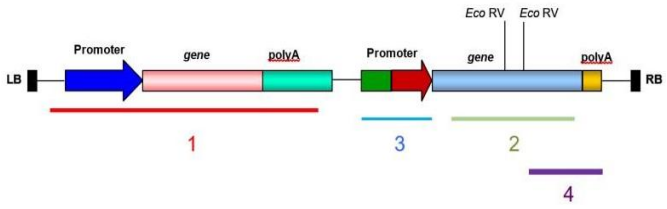
Column X		Column Y	
A	E-cadherin, Smad4, Ras, Myc	i	PTEN, APC, AKT, Her2
B	AKT, Ras, Myc, Her2	ii	PTEN, E-cadherin, APC, Smad4
C	AKT, Ras, Myc, Smad4	iii	PTEN, E-cadherin, APC, Her2
D	E-cadherin, AKT, Ras, Myc	iv	Her2, PTEN, APC, Smad4

Which combination of X and Y is most likely to be found in the tumours?

(a) A-i (b) B-ii

(c) C-iii (d) D-iv

Q31. Given below is a schematic representation of the T-DNA region of a binary vector used for genetic transformation of plants. The figure shows the presence of restriction sites for EcoRV and probes (labelled 1 - 4) for Southern hybridization to analyse copy number of T-DNA in the transaenic plants.



Given below are probes or combination of probes that were used by researchers for Southern blotting following digestion of genomic DNA with EcoRV.

A. Probe 3 and Probe 4

B. Probe 1 and Probe 3

C. Probe 1 only

D. Probe 2 only

E. Probe 1 and Probe 4

Which one of the following options represents the correct combinations of probes that would identify single copy integration events from BOTH flanks of T-DNA?

(a) A and Conly

(b) Band D only

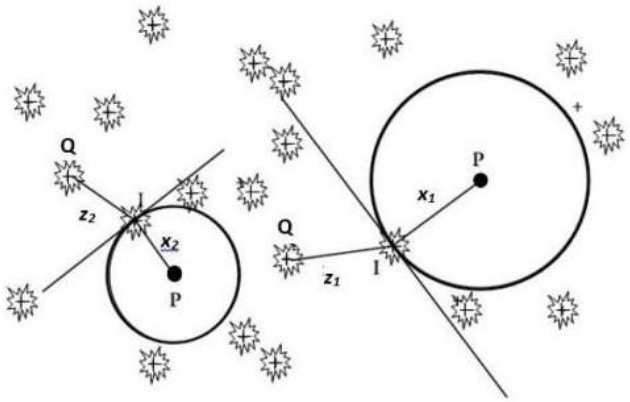
(c) A, D and E only

(d) B and E only

Q32. Plotless sampling techniques have been applied by plant ecologists when rapid estimates of the density of plants in a large region are needed. The image below depicts one of the techniques.

P is the sampling point, X_i and Z_i are distances measured from points P and I, Q, respectively. The canopy with the crossbar indicates the location of a tree.

Which one of the following options correctly identifies the technique?



(a) Point-centered quarter method

(b) Wandering-quarter method

(c) T-square method

(d) Basic distance sampling method

Q33. Which one of the following intermediate enzymatic reactions would be most

effective in facilitating ligation of a blunt-ended insert fragment with a vector digested with EcoRI restriction enzyme (G | AATTC)?

(a) Treatment of vector with Mung Bean Nuclease followed by treatment with Shrimp Alkaline Phosphatase

(b) Treatment of insert with Kienow DNA Polymerase and vector with Polynucleotide Kinase

(c) Treatment of vector with Polynucleotide Kinase and insert with Mung Bean Nuclease

(d) Treatment of insert with Kienow DNA polymerase followed by treatment with Shrimp Alkaline Phosphatase

Q34. The gametophytes of liverworts have the following types of apical cells, which contribute to different thallus forms:

A. Tetrahedral

B. Cuneate

C. Lenticular

D. Hemidiscoid

Which one of the following options correctly states the number of cutting faces (planes) each apical cell type has?

(a) A- Four, B - Three, C -Three, D - Two

(b) A- Three, B - Four, C - Two, D - Three

(c) A - Four, B - Two, C - Three, D - Three

(d) A- Three, B - Three, C - Two, D - Two

Q35. Various types of processed eukaryotic endogenous mRNA are mentioned below:

A. Unspliced and polyadenylated m RNA

B. Polyadenylated and capped, unspliced mRNA.

C. Polyadenylated, spliced, capped mRNA

D. Spliced, uncapped, polyadenylated mRNA.

Choose the option that identifies all the mRNA species that can be exported to the cytosol

(a) A, B, C and D (b) B, C, D only

(c) C only (d) B only

Q36. Certain statements are made below regarding radio-receptor assay technique.

A. It is a competitive protein binding method.

B. It is a non-competitive protein binding method.

C. Radioligand is present in excess of unlabelled ligand.

D. Unlabelled ligand is present in excess of radioligand.

E. Activated charcoal incubation and further centrifugation lead to separation of free ligand in the charcoal pellet.

F. Activated charcoal incubation and further centrifugation lead to separation of bound ligand in the charcoal pellet.

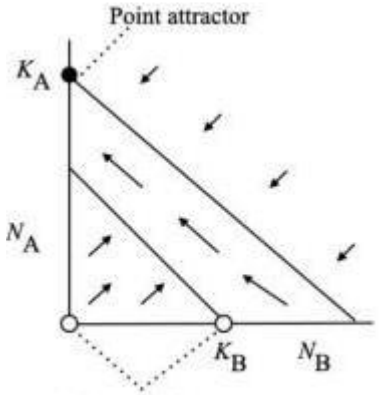
Which one of the following options is the combination of all correct statements?

(a) A, C and E (b) B, C and D

(c) A, D and E (d) B, C and F

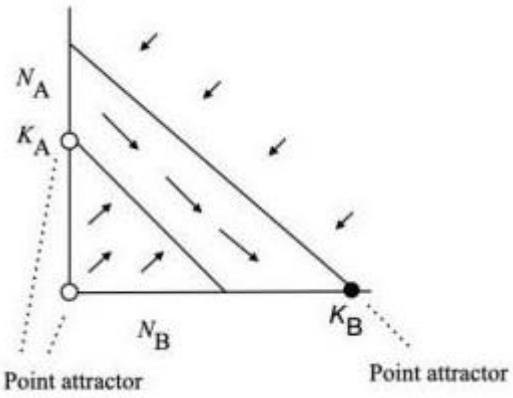
Q37. Competition between two species (A and B) can be represented as vector field graphs. Competition in its classic form can have four qualitative outcomes based on the

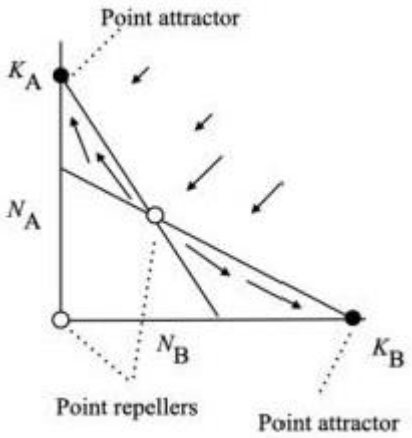
placement of linear isoclines in four qualitatively distinct patterns as shown in the graphs below. Here, when two isoclines cross each other at the equilibrium point, it is called an attractor. Select the correct graph where both species are expected to coexist for an extended period of time.



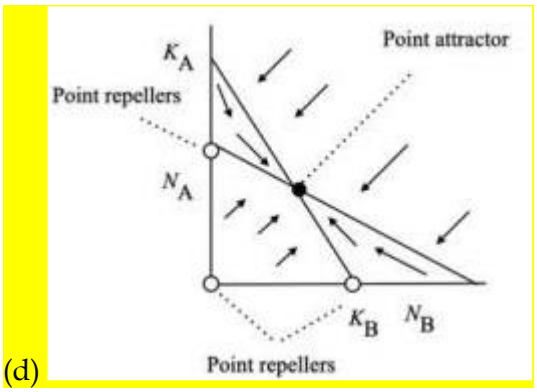
(a)

(b)





(c)



(d)

Q38. Endothelial cells which form the innermost layer of blood vessels secrete many vasoactive substances. The formation and functions of some of these vasoactive substances are proposed in the following statements:

A. Prostacyclin produced by the endothelial cells promotes vasoconstriction.

B. Inhibitors of the cyclooxygenase increase the production of prostacyclin.

C. When endothelial cells are stimulated by acetylcholine or serotonin, nitric oxide (NO) is released that causes relaxation of vascular smooth muscle.

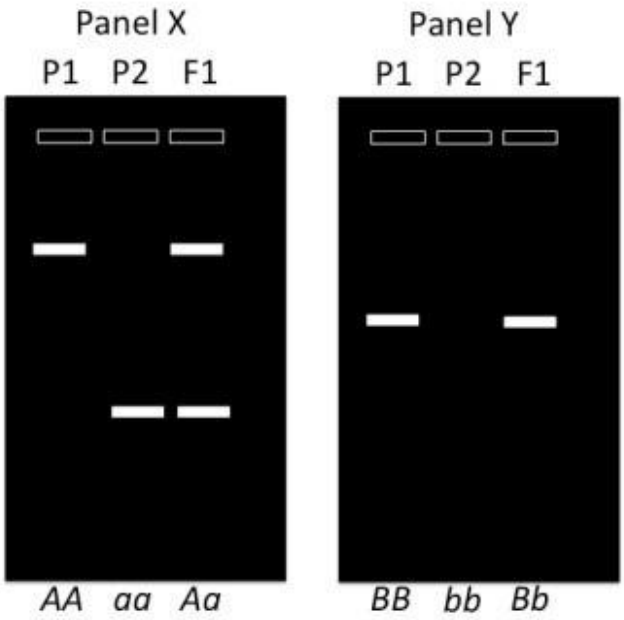
D. NO is short-lived and inactivated by haemoglobin.

Which one of the following options represents the combination of correct statements?

(a) A and B (b) A and C

(c) C and D (d) B and D

Q39. Given below are two figures (X and Y) representing molecular markers and their profiles in parental lines (P_1 and P_2) and F1 progeny. The following statements describe the nature or probable identity of markers in the above figure:



A. Panel X represents a codominant marker.

B. Panel X represents a dominant marker while Panel Y represents a codominant marker.

C. Panel X could be SSR marker while Panel Y could be a RAPD marker.

D. Panel Y represents a dominant marker.

Which one of the following options represents a combination of all correct statements?

(a) A and C only (b) B and D only

(c) A, C and D (d) A and D only

Q40. Newly identified proteins X, Y, and Z are associated with endoplasmic reticulum (ER) membrane fraction. The above ER membrane fraction is subjected to high salt treatment (buffer pH 7.4, 0.5 M KCI) followed by fractionation by centrifugation into soluble and insoluble pellet components. The following observations were made from the above experiment:

i. The proteins X and Y are fractionated into soluble components.

ii. Protein Z is fractionated into insoluble pellet components.

Based on these observations, the following inferences are made:

A. Proteins X and Y are peripheral membrane proteins

B. Protein Z is an integral membrane protein

C. Protein Z is a peripheral membrane protein

D. Proteins X and Y are integral membrane proteins.

Which one of the following options represents the combination of all correct statements?

(a) A and B (b) B and C

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

Q41. The insulin receptor is activated on binding insulin molecules. This .leads to the activation of the downstream Pl3K pathway that triggers AKT to phosphorylate and inactivate a FOXO transcription factor. The lipid phosphatase PTEN antagonizes the Pl3K pathway. A reduction of function mutation in the insulin receptor dramatically increases life span of an organism.

The following statements were made regarding the mutations and their outcomes.

A. A gain of function mutation in AKT makes the organism long-lived.

B. A FOXO deletion mutation suppresses the long life span of the organism with a reduction of function mutation in the insulin receptor.

C. A PTEN deletion mutation suppresses the long life span of the organism with a reduction of function mutation in the insulin receptor.

D. A loss of function mutation in the FOXO ortholog makes the worms long-lived.

Which one of the following options represents the correct combination of the statements?

(a) A and B (b) B and C

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

Q42. The table below lists terminologies (column X) and concepts (column Y) related to ecological niche.

	Column X		Column Y
A	Niche complementarity	i	Species distribution explained by trophic levels and biotic interactions.
B	Niche packing	ii	Tendency for coexisting species which occupy a similar position along at least one niche dimension.
C	Community niche	iii	Tendency for coexisting species to fill the available space along important niche dimensions.
D	Eltonian niche	iv	Composition of niches of all individual species niches that co-occur at the same site.

Which one of the following options represents the correct match between column X and column Y?

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

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

(c) A-ii, B-ii i, C-iv, D-I

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

Q43. Column X enlists some of the common animal viruses and column Y enlists cell surface proteins that serve as their receptors.

	Column X		Column Y
A.	Hepatitis A virus	i.	Immunoglobulin superfamily
B.	Rotavirus	ii.	Acetylcholine receptor on neurons
C.	Polio virus	iii.	Alpha 2-macroglobulin
D.	Rabies virus	iv.	Acetylated sialic acid on glycoprotein

Which one of the following options represents the correct match between columns X and Y?

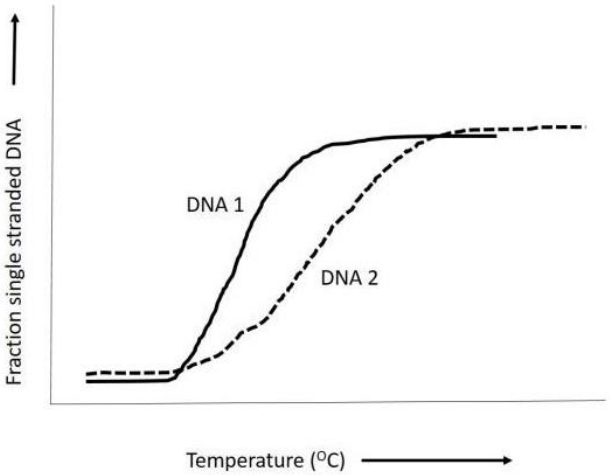
(a) A-iii, B-iv, C-i, and D-ii

(b) A-i, B-ii, C-iii, and D-iv

(c) A-ii, B-iii, C-iv and D-i

(d) A-iv, B-i, C-ii and D-iii

Q44. The melting curves shown below are of two double-stranded DNA molecules of the same length.



Which one of the following statements about these DNA molecules is correct?

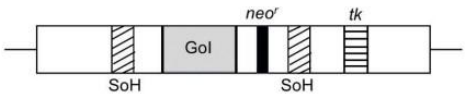
(a) DNA 1 has a lower AT content than DNA2

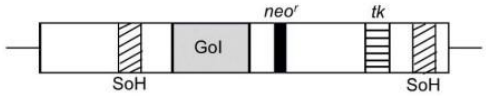
(b) DNA 1 has a lower GC content than DNA2

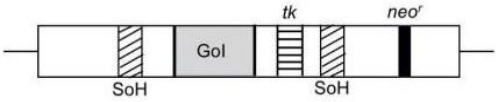
(c) DNA 1 solution has a sequence-independent dsDNA binding protein

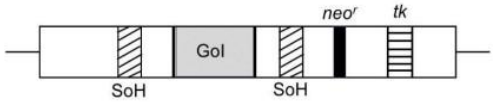
(d) DNA2 has a high number of mismatched nucleotides

Q45. A knock-in cassette was constructed in order to introduce the β-casein gene in an animal cell. The viable clones were selected using a double-marker system, with G418 (neomycin analog) and ganciclovir. Identify the correctly designed cassette from the options given below. (SoH - sequence of homology; Gol - gene of interest; neor - neomycin resistant; tk- thymidine kinase)

(a)


(b)


(c)


(d)


Q46. A cross was carried out between two strains of Neurospora carrying alleles 'A' and 'a', respectively. The cross led to the following octad patterns. The numbers in the last row indicate the number of octads observed with the given pattern.

In what percentage of meiocytes did segregation occur at Anaphase II?

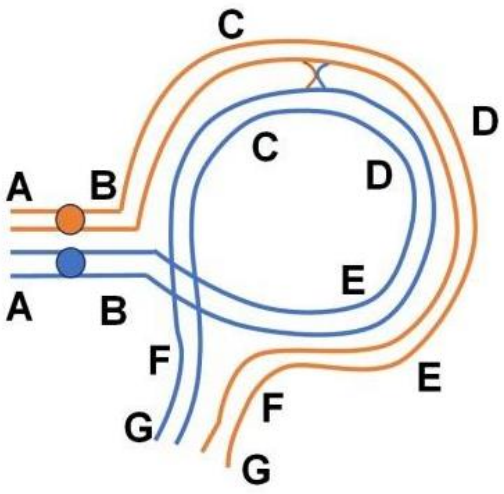
Octads					
A	*a*	*A*	*a*	*A*	*a*
A	*a*	*A*	*a*	*A*	*a*
A	*a*	*a*	*A*	*a*	*A*
A	*a*	*a*	*A*	*a*	*A*
a	*A*	*A*	*a*	*a*	*A*
a	*A*	*A*	*a*	*a*	*A*
a	*A*	*a*	*A*	*A*	*a*
a	*A*	*a*	*A*	*A*	*a*
165	175	14	12	16	18

Total = 400

(a) 1.5 (b) 15.0

(c) 8.5 (d) 85.0

Q47. The figure given below is of two homologous chromosomes paired during meiosis where one event of recombination occurred between two homologues:



The following interpretations were made:

A. The individual is heterozygous for an inversion

B. The figure depicts a paracentric inversion

C. After recombination at Anaphase I a dicentric and an acentric chromosomes will be formed

D. At Anaphase II the recombinant chromatids will have large deletion or duplication

E. Inversions are often considered as crossover suppressors because crossover product does not survive

Which one of the options given below has all correct answers:

(a) A and B only

(b) B, C and D only

(c) C, D and E only

(d) A, B, C, D and E

Q48. Synthesis of thyroid hormones (T_3 and T_4) takes place in a highly intricate manner in the thyroid gland. Following statements are made regarding synthesis of these hormones.

A. Iodine enters the thyroid follicular cells through a transporter.

B. Thyroid hormone synthesis takes place outside the follicular cells in the follicular colloid.

C. Thyroglobulin glycoprotein is composed of four large subunits.

D. Thyroglobulin glycoprotein is composed of two large subunits.

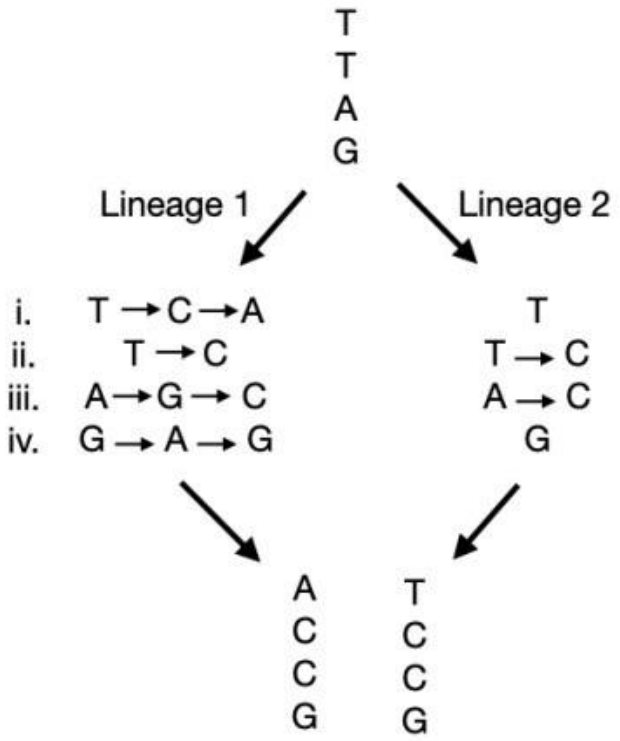
Which one of the following options has the combination of correct statements?

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

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

Q49. An ancestral sequence (TTAG) has diverged into two sequences and has since accumulated nucleotide substitutions along two lineages (1 and 2).

Match the type of substitutions observed in the two sequences with their correct names:



(a) i) convergent substitution, ii) parallel1 substitution, iii) multiple substitutions, iv) back substitution

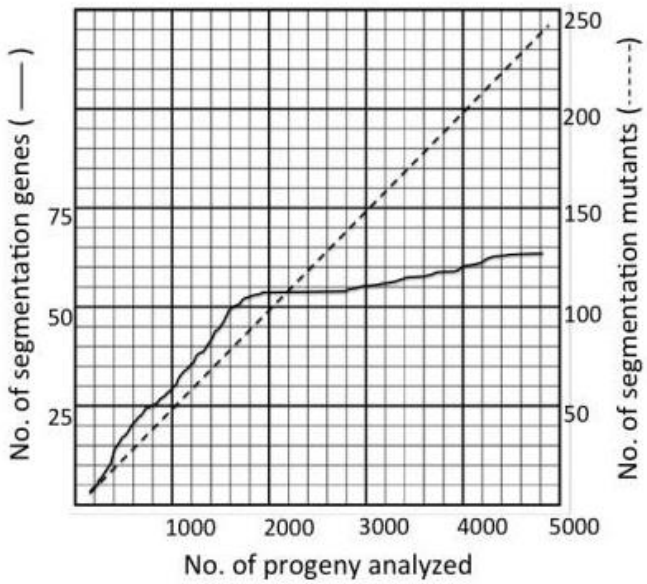
(b) i) multiple substitutions, ii) parallel substitution, iii) convergent substitution, iv) back substitution

(c) i) back substitution, ii) convergent substitution iii) parallel substitution, iv) multiple substitutions

(d) i) parallel substitution, ii) back substitution, iii) convergent substitution, iv) multiple substitutions

Q50. Christiane Nusslein-Volhard and Eric Wieschaus carried out an extensive mutation screen to identify all genes involved in segmentation of Drosophila. The graph shows results of analyzing mutations on chromosome (b)

Based on the above figure, which one of the following options is a correct statement?



(a) Analyzing 10,000 progeny would have led to identification of substantially more number of segmentation genes.

(b) Analysis of progeny beyond 2000 led to identification of new alleles of already identified genes rather than more new genes.

(c) More dominant mutations would have been observed in the first 1000 progeny.

(d) The curves would remain the same irrespective of the mutagen used.

Q51. Following statements are given regarding cell toxicity due to heavy metals in plants:

A. The uptake of heavy metals does not lead to accumulation of ROS.

B. They usually mimic essential metals (e.g. Ca^{2+}, Mg^{2+} etc.) and take their place in essential reactions.

C. Ion channels that transport essential metals do not participate in transport of heavy metals.

D. Heavy metals can directly interact with oxygen to form ROS.

Which one of the following options represents all correct statements?

(a) A and B (b) A and C

(c) C and D (d) B and D

Q52. G-protein-coupled receptors (GPCRs) form the largest family of cell surface receptors. The GPCRs activate G proteins. G proteins are usually composed of three subunits: α, β and γ. The typical features of these subunits and the receptor activation are:

A. G α is membrane-bound, and in an unstimulated state it binds to GDP.

B. G α is non-membrane bound, and in an unstimulated state it binds to GDP.

C. After binding to the ligand, GPCR acts like a guanine nucleotide exchange factor (GEF) and helps in Gα activation.

D. RGS proteins act as a-subunit-specific GTPase-activating proteins (GAPs)

Which one of the following combinations marks all correct statements?

(a) A, C, and D (b) B, C, and, D

(c) A, and C (d) A, and D

Q53. Given below are two figures (X and Y) representing the segregation of molecular markers in 12 individuals of a mapping population (1 to 12). P1 and P2 represent the parents, and F1 the hybrid.

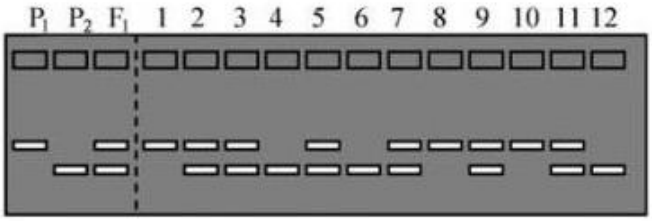


Figure X

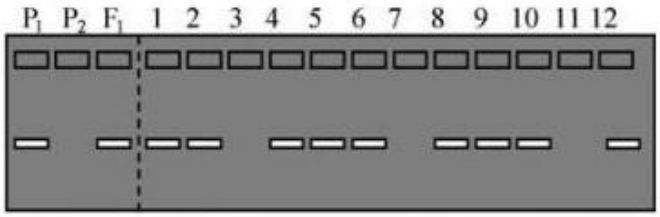


Figure Y

The following statements are made based on the above figures:

A. Figure X represents profile of a codominant marker in an F2 population.

B. Figure Y represents profile of a codominant marker in a doubled haploid population.

C. Figure Y represents profile of a dominant marker in an F2 population

D. Figure X represents profile of a dominant marker in a doubled haploid population.

Which one of the following options represents a combination of all correct statements?

(a) B and D only

(b) A and B only

(c) C and D only

(d) A and C only

Q54. Which one of the sequences given below is a portion of a potential microRNA precursor?

(a) 5'GTAGCGTAGCAGTAGTTAAGCGCTTAAGCU 3'

(b)5' AUUCUUGACGAUUAACGCGCAUMCCAUC 3'

(c)5'GUUUUCCCUAAAAUUUUGAGACCCCAUAG 3'

(d)5'UAGGGGUUUUUGCCUCCAACUGACUCCUA3'

Q55. Given below is a DNA sequence:

5' - ATGCGATGACGA

TTGACGATGACGATAGAC - 3'

In the absence of any other affecting parameters such as length, Tm, GC-content, which one of the following combinations of PCR primer sequences would be able to amplify the above fragment?

(a) 5'-TACGCTAC - 3' and 5'-CGATAGAC - 3'

(b) 5'- GTCTATCG - 3' and 5'-ATGCGATG - 3'

(c) 5'- ATGCGATG - 3' and 5'-CAGATAGC - 3'

(d) 5'-CATCGCAT - 3' and 5'-CGATAGAC - 3'

Q56. The critical micellar concentration (CMG) of a detergent is 5 mM. Choose the option that uses the minimum amount of detergent that can be used for cell lysis and is least likely to denature soluble proteins?

(a) 0.5 mM (b) 10 mM

(c) 6 mM (d) 2.5 mM

Q57. Columns X and Y list the terms associated with gametogenesis and fertilization.

Column X	Column Y
A. Primordial germ cells	i. Luteinizing hormone
B. Dictyate resting stage	ii. Posterior epiblast
C. Sodium channels	iii. Male pronuclei
D. Protamines	iv. Block polyspermy

Which one of the following options represents all correct matches?

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

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

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

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

Q58. The following statements are made regarding the defense signaling pathways locally activated following pathogen infection or pest attack.

A. When JA^{ILE} levels rise, the JAZ proteins interact with COl1 protein and get degraded by 26S proteasomal pathways.

B. Elevated reactive oxygen species levels enhance SA-mediated defense signaling.

C. Under normal (uninfected) conditions, NPR1 is preferentially localized into the nucleus

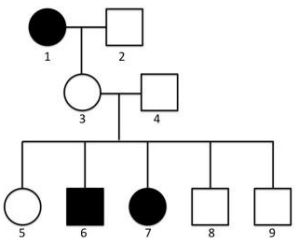
D. Gibberellic acid and abscisic acid cannot participate in plant defense signaling.

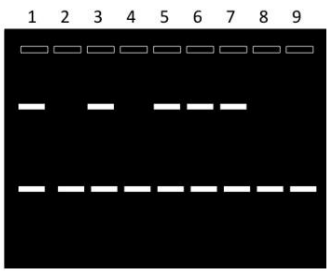
Choose the option with all correct statements:

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

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

Q59. This is a hypothetical example. The pedigree for a monogenic trait is given below. The shaded individuals show spotted skin color while the rest have uniform skin color. The individuals (1 to 9) in the pedigree were analyzed for a DNA marker (both fragments) that shows complete linkage with the skin color trait.





The following statements were made regarding the above observations:

A. Spotted skin color is a dominant phenotype.

B. Spotted skin color shows variable expressivity.

C. The DNA marker associated with the skin color trait is co-dominant.

D. The probability that the individual 5 will pass on the allele responsible for the

spotted skin color to the next generation is 0.25.

Which one the following options represents the combination of all correct statements?

(a) A and B (b) A and C

(c) B and C (d) C and D

Q60. Following statements were made about supercoiling of DNA:

A. DNA supercoiling acts as a regulator of gene expression, but not for genome organization.

B. Circular DNAs found in mitochondria, viruses and bacteria are invariably negatively supercoilled.

C. A moving RNA polymerase generates positive superhelical tension in the DNA in front of it, and negative helical tension behind it.

D. Human topoisomerase I cuts both the strands of supercoiled DNA to undergo a controlled rotation to relax the supercoiled DNA.

E. Human topoisomerase II makes a transient break in single strands of a DNA duplex which rotates around a phosphodiester bond in the intact strand to relax the supercoiled DNA.

Which one of the following options is a combination of all correct statements?

(a) A, B, D (b) B, C, E

(c) A and E only (d) B and C only

Q61. The following steps/events represent the pathway of presenting extracellular pathogen to cytotoxic T cells:

A. Fusion of endosome membrane with the virus and escape of RNA and protein in the cytosol.

B. Assembly of class I MHC protein with bound viral peptide in Golgi apparatus.

C. Proteolysis of viral proteins by the proteasome.

D. Binding of the peptide to a chain and stabilization of the assembly of a chain and β_2-microglobulin.

E. Recognition of viral peptide by cytotoxic T cell.

Which one of the following options is the correct sequence of events?

(a) C-B-E-D-A (b) E-A-B-C-D

(c) A-C-D-B-E (d) A-D-C-B-E

Q62. Some of the sequence of events involved in phototransduction in rod cells upon illumination are given below:

A. Hyperpolarization

B. Activation of phosphodiesterase

C. Decreased release of synaptic transmitter

D. Activation of transducin

E. Decreased intracellular cGMP

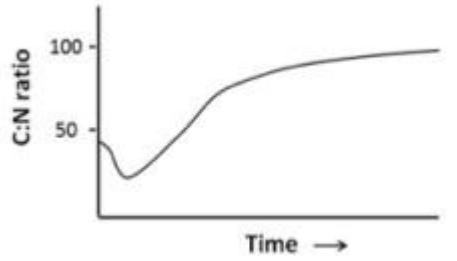
F. Conformational change in rhodopsin

Choose the correct sequence of events in visual transduction during light perception.

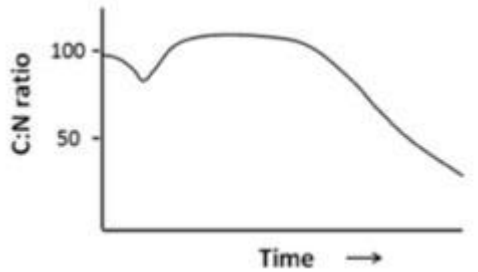
(a) F-B-D-A-E-C (b) D-F-E-C-A-B

(c) F-D-B-E-A-C (d) E-D-C-B-F-A

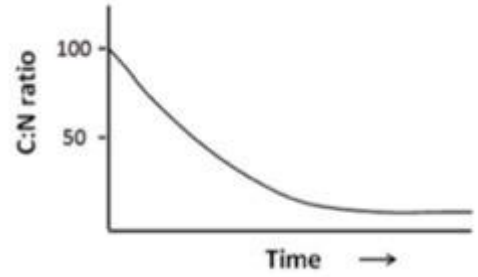
Q63. Which one of the following graphs typically represents the change in C:N ratio over time in decomposing leaf litter in temperate forests?



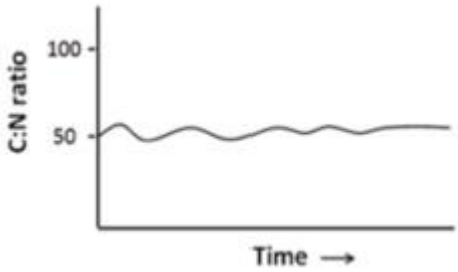
(a)



(b)



(c)



(d)

Q64. Two teams of researchers (I and II) extracted chromatin from nuclei and examined them with an electron microscope. The Team I found that isolated chromatin resembles beads on a string. In contrast, Team II found that isolated chromatin appears as a condensed fiber of 30 nm in diameter

Given below are a few reasons for these different outcomes.

A. Team I isolated the chromatin with low-ionic-strength buffer, and Team II isolated chromatin with an ionic strength of ~0.15M KCI (physiological ionic strength).

B. Team I isolated the chromatin with ~0.15M KCI and Team II did it with a low-ionic-strength buffer.

C. For Team II, the nuclear isolation method was not appropriate, and they had contamination from the cytoplasmic pool, leading to the appearance of the chromatin as a condensed fiber.

D. Team I chromatin got sheared during isolation, thus giving the appearance of beads on a string.

Among the statements given above, which statement/s most appropriately defines the divergent outcomes of Team I and Team II?

(a) A only (b) B only

(c) C and D (d) B and D

Q65. Following statements are made regarding the plant hormones, Gibberellins.

A. Gibberellins are ubiquitous in plants and are also present is several fungi.

B. GA1 is the most abundant gibberellin produced in the fungus Fusarium fujikuroi.

C. The exogenous application of gibberellin, GA3 stimulates dramatic stem elongation in the dwarf maize mutant but has little effect on the tall, wild-type plant.

D. The application of exogenous gibberellins causes upregulation of the GA20 oxidase and GA3 oxidase genes.

Which one of the following options represents the combination of all correct statements?

(a) A and B (b) B and D

(c) C and D (d) A and C

Q66. The functional connection between the cell body of neuron and its axonal terminal is achieved by axonal transport. Some features of axonal transport are suggested in the following statements:

A. Orthograde transport occurs from the axonal terminal to the cell body.

B. Orthograde transport has two components - fast axonal transport and slow axonal transport.

C. The rate of orthograde fast axonal transport is higher than that of retrograde transport.

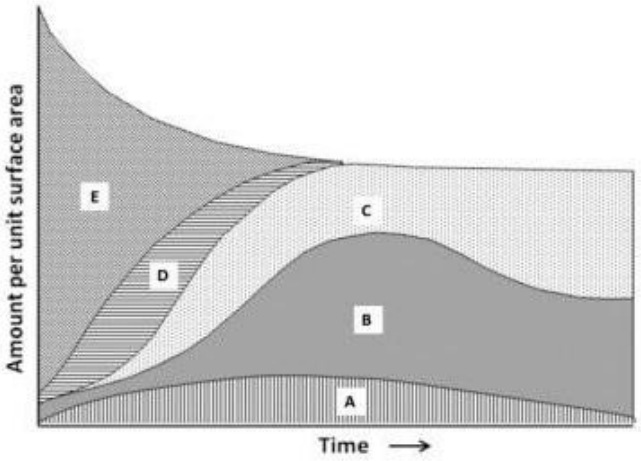
D. The molecular motor dynein is required for orthograde transport while kinesin is molecular motor for retrograde transport.

Which one of the following options represents the combination of correct statements?

(a) A and B (b) B and C

(c) C and D (d) A and D

Q67. Nutrients are gained or lost by ecosystems in a variety of ways. These nutrients may accumulate in different organic or inorganic pools over time. The different pools of phosphorus are



i. Mineral inorganic phosphorus

ii. Labile (available) phosphorus

iii. Occluded inorganic phosphorus

iv. Soil organic phosphorus

v. Plant organic phosphorus

The following graph shows the generalized change in phosphorus dynamics during primary succession:

Which one of the following options correctly matches the region (A to E) shown in the graph to the phosphorous pool?

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

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

(c) A-iii, B-ii, C-v, D-i, E-v

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

Q68. Following statements are made about DNA base excision repair (BER):

A. BER process begins with a DNA glycosylase, which extrudes a base in a damaged base pair, then clips out the damaged base.

B. In bacteria, DNA polymerase III fills in the missing nucleotide in BER.

C. Eukaryotic apurinic/apyrimidinic (AP) endonuclease (APE1) performs proofreading activities.

D. APE1 possesses 5'- 3' exonuclease activity.

Which one of the following options shows combination of all correct statements?

(a) A, Band D (b) A and C only

(c) A and D only (d) B and C only

Q69. The table given below contains some of the classes of phylum Arthropoda in Column X and their characteristic head structures in Column Y.

Column X		Column Y	
A.	Arachnida	i.	Head is distinct with a pair of compound eyes, a paired antennae, a paired mandibles and a paired maxillae
B.	Crustacea	ii.	Head is distinct having a pair of simple eyes, paired antennae and paired mandibles
C.	Myriapoda	iii.	Five segmented head with two pairs of antennae, two pairs of maxillae and one pair of mandibles
D.	Insecta	iv.	Cephalothorax with two chelicerae, two pedipalps

Which one of the following options represents the correct match between Column X and Column Y?

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

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

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

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

Q70. Following table shows cultivated crops (Column X) and the continents where their centers of origin (Column Y) are situated:

Column X	**Column Y**
A. Coffee	i. South America
B. Pineapple	ii. Africa
C. Banana	iii. Asia
D. Rubber	

Which one of the following options represents the correct match between column X and column Y?

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

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

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

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

Q71. Angiosperms have witnessed evolutionary changes which includes a few apomorphies. Which one of the following options depicts the correct apomorphy/apomorphies that has/have evolved in Eudicots?

(a) Endospory and retention of megaspore

(b) Tricolpate derived pollen

(c) Heterospory and atactostelic vasculature

(d) Ovules with two integuments

Q72. he following table lists selected concepts (Column X) in behavioral biology and their descriptions (Column Y):

Column X		Column Y	
A.	Allee effect	i.	Male–male interactions increase plasma testosterone and thus sustain subsequent aggressive behavior.
B.	Bateman's hypothesis	ii.	Parasites and pathogens play an important role in sexual selection when secondary sexual traits are costly and condition-dependent.
C.	Challenge hypothesis	iii.	A situation in which the fitness of individuals increases with increased population density.
D.	Hamilton-Zuk hypothesis	iv.	Female reproductive success is most strongly limited by the number and success of eggs that she can produce, while male reproductive success is limited by the number of matings he has.

Which one of the following options represents the correct match between Column X and Column Y?

(a) A-i, B-iii, C-iv, D-i

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

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

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

Q73. Given below are statements regarding the specialized embryonic structure of the grass family:

A. The scutellum forms the interface between the embryo and the starchy endosperm tissue.

B. Coleorhiza protects and covers the first leaf while buried in the soil.

C. Coleoptile forms a protective sheath around the radicle.

D. In some species such as maize, the upper hypocotyl has been modified to form a mesocotyl.

Which one of the following options represents a combination of all correct statements?

(a) A, B and C (b) A, B and D

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

Q74. The following table shows common millets (Column X) and their scientific names (Column Y):

Column X	**Column Y**
A. Ragi (Finger millet)	i. Eleusine coracana
B. Jowar (Great millet)	ii. Pa spa furn scroblculaium typhoides/ glaucum
C. Kodo millet	iii. Penniselum
D. Bajra (Pearl millet)	iv. Sorghum bicolor

Which one of the following options represents the correct match between Column X and Column Y?

(a) A-i, B-iii, C-iv, D-i

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

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

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

Q75. Nephrons are structural and functional units of the kidneys. Certain statements are made below about structure and function of a nephron.

A. P cells of the collecting duct are involved in Na+ reabsorption and vasopressin-stimulated water reabsorption.

B. P cells of the collecting duct are concerned with acid secretion and HCO3- transport.

C. I cells of the collecting duct are concerned with acid secretion and HCO3- transport.

D. The total length of the nephrons including collecting ducts ranges from 45 to 65 mm.

Which one of the following options has all correct statements?

(a) A and B only (b) B and D only

(c) A, C and D (d) B, C and D