Q1. Staring from the same point, two particles move along a circle of radius 10 m in opposite directions with speeds 5 m/s and 8 m/s. At the instant of crossing each other, their speeds are interchanged but not their directions. What would be the difference between their arrival times at the starting point?

(a) 0 s

(b) $\dfrac{3\pi}{8}$ s

(c) $\dfrac{13\pi}{8}$ s

(d) $\dfrac{20}{13\pi}$ s

Q2. In the given figures shaded areas are circtes. Ratio of the unshaded area in the square A to the unshaded area in the square B is
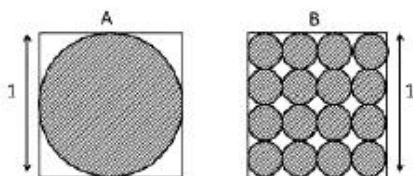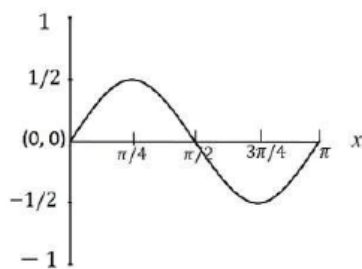

(a) 1 : 1

(b) 1 : 16

(c) 1 : 2

(d) 16 : 1

Q3. The equation $x^2 + y^2 + 2x = 0$

(a) a parabola

(b) a circle

(c) a pair of straight lines

(d) a hyperbola

Q4. Which of the following function is represented by the given graph:

(a) sin x

(b) sin 2x

(c) sin x cos x

(d) $\sin^2 x$

Q5. In which of the following options is the amount of gold identical in the two coins? (Pure gold is 24 carat)

(a) 24g coin of 22 carat and 22g coin of 24 carat

(b) 22g coin of 22 carat and 24g coin of 24 carat

(c) 22g coin of 22 carat and 22g coin of 24 carat

(d) 24g coin of 22 carat and 24g coin of 24 carat

**Q6.** The number of persons infected by a particular virus for the first 30 days was equal to the square of the number of days. After 30 days, the number of infected persons doubled every 4 days. At the end of 50 days, 3,800 persons had died and on subtracting their number from the total number of cases, the number of infected persons was found to double every 5 days. After how many days of the onset of the infection, did the number of infected persons become 4 lakh?

(a) 90

(b) 100

(c) 70

(d) 80

Q7. Of the employees of a company 60 are male and the rest are female. The overall average salary is Rs. 9,000; the average for the female employees is Rs. 12,000 and that of male employees is Rs. 7000. The difference between the numbers of male and female employees is

(a) 30

(b) 10

(c) 20

(d) 40

Q8. In the given rectangle ABCD, AE=EF=FB. What is the ratio of the area of triangle EFC to the area of rectangle ABCD?
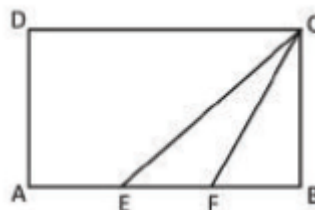
(a) 1 : 8

(b) 1: 6

(c) 1 : 3

(d) 1 : 9

Q9. An explorer starts from a place on the equator of the Earth, travels 1500 km towards the north, 500 km towards the east, then 1500 km towards the south and finally 500 km towards the west. He ends at a place

(a) exactly where he started.

(b) to the east of where he started.

(c) to the south of where he started.

(d) to the west of where he started.

Q10. The probability that team A wins a match against team B is 2/3. If teams A and B play 4 matches against each other, what is the probability that team A will win at least one match? (Assume that result of one match does not influence the rest.)

(a) 2/3

(b) 4/9

(c) 1

(d) 80/81

Q11. Among the children of a family, each boy has as many brothers as sisters but each girl has twice as many brothers as sisters. How many boys and girls are there in the family?

(a) 3 boys, 2 girls   (b) 2 boys, 2 girls

(c) 4 boys, 3 girls   (d) 4 boys, 2 girls

Q12. A student obtains 59, 60, 69 and 81% marks in 4 courses carrying weights in the proportion 4:3:2:2, respectively. The following table gives conversion of marks to grade points. What will be the Grade Point Average of the student?

| % marks	Grade Point
>89	9
80-89	8
70-79	7
60-69	6
50-59	5
<50	0

(a) 6.0   (b) 6.5

(c) 7.0   (d) 7.5

Q13. Hollow open-ended cylinders are made in two sizes, 1000 cm^3 and 250cm^3, using a metal sheet. The amount of material required to make the larger cylinder and the amount required to make four small cylinders

(a) have to be the same

(b) are always in the ratio of 1:2.

(c) can be the same.

(d) are always in the ratio of 1: 4.

Q14. An equilateral triangle APB is constructed on side AB of the square ABCD having a side of 1 unit. What is the radius of the circle passing through points C, P and D?
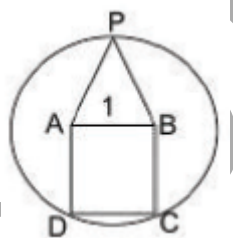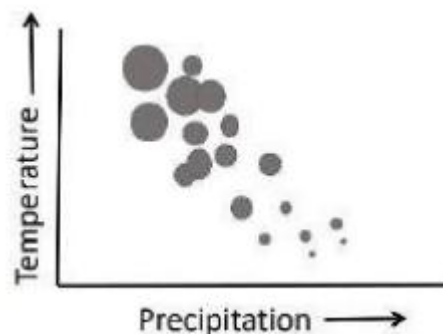

(a) 1   (b) 2

(c) 3   (d) $\sqrt{3/2}$

Q15. If n is an even number, then the sum of the first n natural numbers is divisible by

(a) both n and (n +1)

(b) n but not (n + 1)

(c) (n + 1) but not n

(d) neither (n + 1) nor n

Q16. The bubble plot shows an effect of temperature and precipitation on annual growth of trees of a certain species. The area of a bubble is proportional to the tree-growth. Based on the plot, the growth of the trees is

(a) directly proportional to both precipitation and temperature.

(b) directly proportional to precipitation but inversely proportional to temperature.

(c) inversely proportional to precipitation but directly proportional to temperature.

(d) inversely proportional to both precipitation and temperature.

Q17. The probability distribution of weights of a certain population is normal as shown in the figure. What is the probability that the weight of a person picked at random is more than 60 kg?
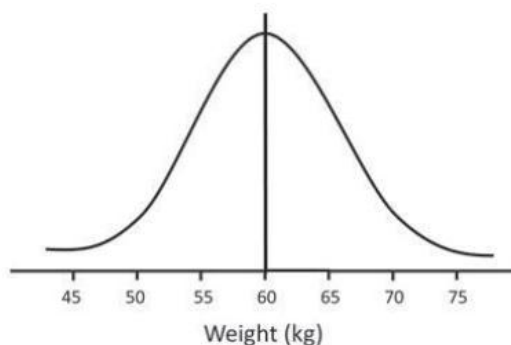
(a) ½   (b) 1

(c) 2/3   (d) 1/3

Q18. A clock takes 7 seconds to announce 7 o'clock by chiming seven times. How many seconds will this clock take to announce 10 o'clock by chiming 10 times?

(a) 10   (b) 9.5

(c) 10.5   (d) 11

Q19. There are several boulders of three types of rocks A, B and C. Each boulder of A, B and C weighs 600 kg, 300 kg and 80 kg, respectively. Each boulder of A is 8 times as valuable as that of C. Each boulder of B is 3 times as valuable as that of C. Which of the following combinations that can be carried using a truck of 4000 kg capacity, would be the most valuable?
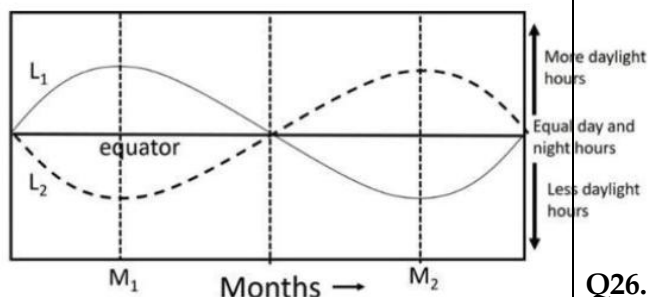
(a) 6 boulders of A and 1 boulder each of B and C

(b) 6 boulders of A, none of B and 5 boulders of C

(c) 5 boulders of A, 2 boulders of B and 5 boulders of C

(d) 5 boulders of A, none of B and 12 boulders of C

Q20. The graph shows daylight hour variations with months at two latitudes L_1 and L_2. Which one of the following can be true?

(a) L_1 is 40° N and M_1 is June

(b) L_1 is 40° S and M_1 is June

(c) L_2 is 40° S and M_2 is June

(d) L_2 is 40° N and M_2 is December

Q21. A plot with which one of the following axes is drawn to exhibit enzyme inhibition kinetics applying Dixon's plot?

(a) V_i vs [I]   (b) $\frac{1}{V_i}$ vs $\frac{1}{[I]}$

(c) $\frac{1}{V_i}$ vs [I]   (d) V_i vs $\frac{1}{[I]}$

Q22. Which one of the following enzymes present in erythrocytes helps bypass the first step of ATP formation in glycolysis?

(a) Bisphosphoglycerate mutase

(b) Phosphoglycerate kinase

(c) Glyceraldehyde 3-phosphate dehydrogenase

(d) Phosphofructose mutase

Q23. If the pyrollidine ring of proline is reduced to a linear form, the new amino acid will have

(a) constrained ϕ than proline

(b) constrained Ψ than proline

(c) relaxed ϕ than proline

(d) unaffected ϕ and Ψ

Q24. The following table lists names of scientists and advances made by them

Column A	Column B
A. Linus Pauling	(i) Myoglobin structure
B. Emil Fischer	(ii) Model of a-helix
C. John Kendrew	(iii) Lock and Key model
D. Christian Anfinsen	(iv) Sequence-structure relationship

Which one of the following options correctly matches contents of column A with column B?

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

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

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

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

Q25. Electron transfer from donors such as NADH and $FADH_2$ to O_2 occurs in

(a) membranes of ER, chloroplast and mitochondria

(b) chloroplast only

(c) mitochondria only

(d) organellar membranes which possess ATP synthase

Q26. Genome of an organism was analysed by Cot curve analysis. Highly repeated sequences represented 30% of the total genome fraction. The Cot value of the highly repeated sequence was found to be 0.001 moles nucleotide liter^{-1}. What would be the actual Cot value (in moles nucleotide liter^{-1}) of the highly repeated sequence?

(a) 0.003   (b) 0.001

(c) 0.0003   (d) 0.007

Q27. Which one of the statements given below is INCORRECT?

(a) The three common types of membrane lipids are cholesterol, phospholipids and glycolipids.

(b) Phosphoglycerides carry a glycerol backbone, two fatty acid chains, and a phosphorylated alcohol.

(c) Most phospholipids and glycolipids form bimolecular sheets rather than micelles in aqueous media.

(d) The common alcohol moieties in phosphoglycerides are glycerol, inositol, choline, ethanoiamine and tyrosine.

Q28. The translocation into which one of the organelles listed below DOES NOT depend on an amino acid sequence as a signal for import?

(a) nucleus

(b) Endoplasmic reticulum

(c) Lysosome

(d) Peroxisome

Q29. In Trypanosoma, some of the introns generate Y shaped structure in place of a lariat. Such structure is generated during

(a) cis-splicing

(b) trans-splicing

(c) alternate splicing

(d) RNA editing

Q30. Which one of the following ensures stable binding of RNA polymerase at the promoter site?

(a) DNA photolyase

(b) Sigma factor

(c) DNA glycosylase

(d) Rec A

Q31. Erythromycin is an inhibitor of protein synthesis. It acts by:

(a) binding to 30S subunit of bacterial ribosome, thus inhibiting binding of aminoacyl - tRNAs.

(b) binding to 50S subunit of bacterial ribosome, thus inhibiting translocation.

(c) inhibits peptidyl transferase activity of eukaryotic 60S ribosomal subunit.

(d) causes premature chain termination by acting as an analog of aminoacyl-tRNA in both prokaryotes and eukaryotes.

Q32. Which one of the following conditions will switch on Lac operon in E. coli ?

(a) + Glucose, + Lactose

(b) + Glucose, - Lactose

(c) - Glucose, - Lactose

(d) - Glucose, + Lactose

Q33. The immunoglobulin heavy-chain that is rearranged first and is displayed on the surface of early stages of B-cell development is associated with:

(a) class-II associated invariant chain peptide (CLIP).

(b) a surrogate light chain.

(c) β_2 - macroglobulin

(d) immunoglobulin-like cell adhesion molecule.

Q34. Given below are plots that show changing titres of natural killer cells (NK cells), cytotoxic T-lymphocyte specific to the virus (virus-specific CTLs) and interferon α/β during a virus infection.
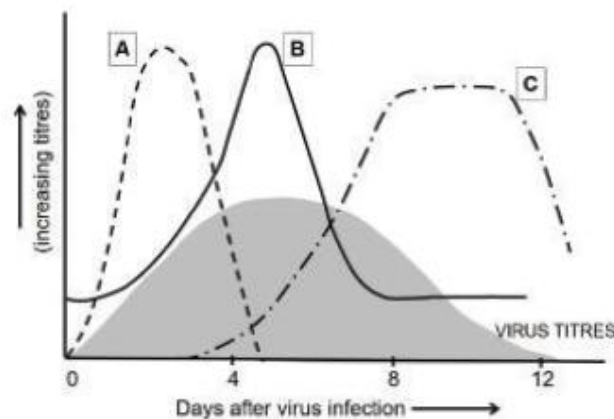
With respect to changing virus titers, select the plots that represent these factors correctly from the options given below.

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

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

(c) A: Interferon: B: NK cells; C: virus-specific CTLs

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

Q35. Dr. Ralph M. Steinman was awarded Nobel Prize for his discovery on:

(a) acquired immunological tolerance.

(b) role of major histocompatibility complex in antigen recognition by T-cells

(c) chemical structure of antibody

(d) role of dendritic cells in adaptive immunity

Q36. Which one of the following systems forms a chemical mediator that is involved in the mechanism of pain during inflammation?

(a) Activated blood clotting cascade

(b) Plasmin - Fibrinolytic system

(c) Kininogen - Bradykinin system

(d) B-cell activation

Q37. Human polysyndactyly (joining of extra digits) syndrome results from a homozygous mutation at

(a) antennapedia complex locus

(b) one of the genes of Hox D

(c) one of the genes of Hox C

(d) β-catenin locus

Q38. Which one of the following statements regarding double fertilization in plants is correct?

(a) The same sperm cell fuses with both egg cell and central cell

(b) Two sperm cells fuse with the egg cell.

(c) One sperm cell fuses with the egg cell and second with the central cell.

(d) Two sperm cells fuse with the central cell

Q39. Which one of the following statements regarding amphibian development is correct?

(a) The Nieuwkoop centre is formed on the dorsal side of the embryo due to accumulation of β-catenin which helps activate the siamois and twin genes

(b) The ectodermal cells form neural tissues in the presence of BMP molecules.

(c) Brain formation requires the activation of both Wnt and BMP pathway.

(d) There is a gradient of Nodal-related protein across the endoderm with low concentration on the dorsal side of the embryo

Q40. Sonic hedgehog (Shh) specifies the anterior-posterior axis during limb development. Which one of the following statements regarding it is correct?

(a) Shh secreting cells undergo apoptosis after performing its function.

(b) Descendants of Shh secreting cells become the bone and muscle of the anterior limb

(c) When the genes for Shh and Gli3 are conditionally knocked out in the mouse limb, the resulting limbs do not form any digit

(d) Specification of the digit is primarily dependent on the amount of time the Shh gene is expressed and to a small extent on the concentration of the Shh protein that other cells receive.

Q41. Spermidine represents which of the following group of compounds:

(a) jasmonic acid

(b) polyamine

(c) auxin

(d) strigolactone

Q42. Suppression of VPE (Vascular Processing Enzymes) gene expression in Nicotiana benthamiana plants will NOT

(a) abolish hypersensitive response

(b) enhance TMV (Tobacco Mosaic Virus) infection

(c) reduce caspase-like activity

(d) reduce DNA fragmentation

Q43. In which one of the following subcellular organelles is serine synthesized during the oxidative photosynthetic carbon (C_2) pathway?

(a) Chloroplast

(b) Mitochondria

(c) Peroxisome

(d) Rough endoplasmic reticulum

Q44. Artemisinin and Dhurrin belong to which two respective groups of the plant natural compounds?

(a) Alkaloids and Terpenes

(b) Flavonoids and Alkaloids

(c) Cynogenic glycosides and Flavonoids

(d) Terpenes and Cynogenic glycosides

Q45. Receptor for which one of the following proteins spans the plasma membrane of target cells but DOES NOT contain intrinsic protein kinase activity?

(a) Epidermal growth factor

(b) Insulin

(c) Insulin like growth factor

(d) Growth hormone

Q46. In both males and females, the gonads secrete a polypeptide hormone, called inhibin B, which inhibits

(a) luteinizing hormone

(b) follicle-stimulating hormone

(c) prolactin

(d) thyroid-stimulating hormone

Q47. Which one of the following routes is responsible for maximum amount of body heat loss in humans at an ambient temperature of 21°C?

(a) Radiation and conduction

(b) Respiration

(c) Urination and defecation

(d) Vaporization of sweat

Q48. Which one of the following is NOT released by sympathetic preganglionic neurons?

(a) Neurotensin

(b) Enkephalin

(c) Serotonin

(d) Substance P

Q49. The trait shown in the above pedigree is
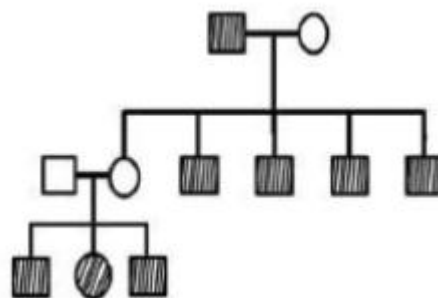
(a) X-linked recessive trait

(b) autosomal recessive trait

(c) Y-linked trait

(d) X-linked dominant trait

Q50. A plant that produces disc-shaped fruit is crossed with another plant that produces long fruit. All the F1 plants gave disc-shaped fruits. When the F1 were intercrossed, F2 progeny were produced in the following ratio: 9/16 plants with disc-shaped fruits; 6/16 plants with spherical fruits and 1/16 plants having long fruits. Which one of the following options gives correct genotype of spherical fruits obtained in F2?

(a) A_bb only   (b) aaB_ only

(c) A_bb and aaB_   (d) A_B_ and aabb

Q51. The maximum frequency of recombination that can occur between two loci is

(a) 25%   **(b) 50%**

(c) 75%   (d) 100%

Q52. A panel of six hybrid cell lines, each containing a different subset of human chromosomes, was examined for the presence of the gene product as shown below:

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

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

(a) Chromosomes 3, 4 or 5

(b) Chromosome 3

(c) Chromosome 3 or 4

(d) Chromosome 4

Q53. A gene was located on 10p 11. This means the gene was located on the

(a) short arm of chromosome 10 at G-sub band 1 of band 1

(b) short arm of chromosome 10 at G-band 11

(c) short arm of chromosome 10 much away from the centromere

(d) long arm of chromosome 10 at G-sub band 1 of band 1

Q54. Autogamy refers to

(a) self-abortion of gametes

(b) flower failing to open

(c) self-pollination of flowers

(d) cross-pollination of flowers

Q55. Which one of the following plant pathogens has largest genome size?

(a) *Phytophthora infestans*

(b) *Ustiiago maydis*

(c) *Botrytis cinerea*

(d) *Fusarium graminearum*

Q56. The 50 km wide Palghat Gap is the only major topographic breach in the Western Ghats. This gap continues as the Ranotsara Gap in the Angavo escarpment. Which country is the Ranotsara Gap located in?

(a) Sri Lanka

(b) Madagascar

(c) Mozambique

(d) Kenya

Q57. A lectotype refers to

(a) a specimen of the opposite sex to the holotype and designated from among paratypes.

(b) an illustration based on which a new species is described.

(c) a specimen later selected from a group of syntypes to serve as the type specimen for a species, after its original description was published.

(d) a substitute specimen selected to serve as the type specimen of a species after its original description was published, when an original holotype has been lost or destroyed.

Q58. Given below are the survivorship curves showing the proportion of individuals surviving over time or age. Three generalised types of curves (a, b and c) are depicted below. Which of the following represent the correct survivorship curve for the given organisms?
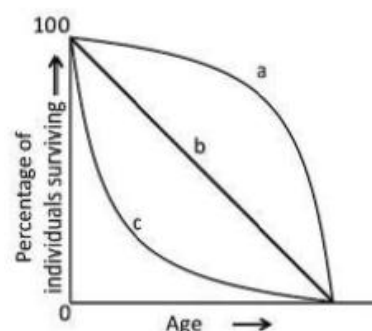
(a) a = Elephants; b=Lizards; c= Oysters

(b) a = Oysters; b = Elephants; c = Lizards;

(c) a = Lizards; b= Oysters; c= Elephants

(d) a = Oysters; b= Lizards; c= Elephants

Q59. According to Hamilton's rule, 'r' is the coefficient of relatedness between two interacting individuals, 'B' is the benefit to the recipient and 'C' is the cost to the donor. Which of the following relationships will result in an altruistic behaviour?

(a) rB = C   (b) rC – B = 0

(c) r > C/B   (d) rC – B > 0

Q60. Which one of the following statements is correct with reference to ecotones?

(a) Ecotones are rich in endemic species and only contain species not found in surrounding ecosystems.

(b) Ecotones refer to areas that are under habitat degradation and contain endangered species that are not found in the neighbouring communities.

(c) Ecotones are species poor habitats due to scarcity of soil nutrients and availability of resources.

(d) Ecotones are transition areas between two ecosystems and have greater number of species than either of the neighbouring communities.

Q61. Two populations of squirrels evolved across two regions separated by a large geographic barrier. Over a long period of time these populations are reproductively and geographically isolated from each other. This is an example of

(a) sympatric speciation

(b) allopatric speciation

(c) artificial speciation

(d) anagenesis

Q62. The term "abominable mystery" was used by Darwin in the context of origin and diversification of

(a) angiosperms   (b) microorganisms

(c) beetles   (d) birds

Q63. If bird song is selected to maximize broadcast range and to minimise degradation, then according to the "Acoustic Adaptation Hypothesis" which of the following combination of features is likely to be shown by birds singing in dense forests?

(a) Low frequency with narrow bandwidth

(b) High frequency with narrow bandwidth

(c) Low frequency with wide bandwidth

(d) High frequency with wide bandwidth

Q64. In Africa "AS" represents a carrier of sickle cell anaemia, where A is the allele for normal haemoglobin and S for sickle cell haemoglobin. If the allele S is maintained at a high frequency in some populations, this represents a case of

(a) homozygote advantage

(b) heterozygote advantage

(c) dominance

(d) genetic drift

Q65. In mammals, the primary circadian clock is located in which of the following parts of the brain?

(a) Occipital lobe of cerebrum

(b) Amygdala

(c) Suprachiasmatic nucleus

(d) Frontal lobe of cerebrum

Q66. In Agrobacterium mediated transformation, which one of the following approaches is more likely to generate transgenic plants with INCOMPLETE transfer of the passenger gene?

(a) Placement of selection marker gene towards left border and passenger gene towards right border of T-DNA

(b) Expression of selection marker gene under constitutive promoter and passenger gene under tissue-specific promoter

(c) Placement of passenger gene towards left border and marker gene towards right border of T-DNA

(d) Expression of both selection marker gene and passenger gene under constitutive promoters

Q67. A student added DMEM culture medium which was pink in colour to growing liver cells. Three days later the medium colour was yellow. This indicated

(a) change in cell morphology

(b) change in pH of the medium

(c) depletion of nutrients in the medium

(d) lack of antibiotics in the culture

Q68. Given below is a schematic representation of a Southern blot performed to identify single copy integration events of the T-DNA among six transgenic plants ($T_1 – T_6$).

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

(a) T_1, T_5 and T_6

(b) T_2 and T_3

(c) T_4 only

(d) T_1 only

Q69. In the enzyme-linked antibody used in ELISA, the interaction between the enzyme and antibody is stabilized by

(a) hydrogen bond

(b) ionic bond

(c) covalent bond

(d) van der Waal's interactions

Q70. Amongst the following, which one is the most appropriate strategy to sequence and assemble highly repeated regions of a genome?

(a) Shot gun sequencing

(b) Illumina sequencing

(c) 454 sequencing

(d) Sequencing of BAC libraries

Q71. The Hill equation and its plot describe the following enzyme kinetic behaviours

A. Saturation Kinetics

B. Cooperative Kinetics

C. Log $V_i/(V_{max} - V_i)$ versus Log[s]

D. Log$(V_{max} - V_i)/V_i$ versus Log[s]$^{-1}$

Which one of the following combination represents correct descriptions?

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

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

Q72. In regulating the quantity of enzyme, its degradation plays a pivotal role. Following statements are made to represent the degradation of enzymes in the 26S proteasome.

A. The active sites of proteolytic subunits face exterior of the proteasome cylinder

B. The active sites of proteolytic subunits face interior of the proteasome cylinder

C. Degrading enzymes are targeted to exterior of proteasome by covalent attachment of one or more molecufes of ubiquitin

D. Degrading enzymes are targeted to interior of proteasome by covalent attachment of one or more molecules of ubiquitin

Which one of the following combinations of statements represent correct mode of enzyme degradation?

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

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

Q73. In classical Anfinsen's protein folding experiment the enzymatically active ribonuclease is treated with β-mercaptoethanol and 8 M urea. Following which, the preparation was

A. dialyzed to remove the β-mercaptoethanol and 8 M urea

B. the sample was completely oxidized in 8M urea after dialysis

C. trace amounts of β-mercaptoethanol was added to the dialyzed sample

D. 8M urea was added to the dialyzed sample

Which one of the following steps will lead to regaining of the full enzymatic activity of ribonuclease ?

(a) A followed by C   (b) A followed by B

(c) A followed by D   (d) A alone

Q74. The following statements were made regarding the role of protein modifications

A. Attachment of acetyl groups to the amino termini of proteins makes it more resistant to degradation.

B. Attachment of hydroxyl groups to proline residues stabilizes fibres of newly synthesized collagen

C. Addition of sugars (glycosylation) makes protein more hydrophilic enabling protein-protein interactions

D. Addition of sugars (glycosylation) makes protein more hydrophobic enabling protein folding

Which one of the following combinations represents all correct statements?

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

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

Q75. The following statements were made to describe the role of Gibbs free energy

A. Reaction can take place spontaneously if ΔG is negative

B. Reaction can take place spontaneously if ΔG is positive

C. ΔG provides no information about the rate of a reaction

D. ΔG estimation provides the rate of a reaction.

Which one of the following represents all correct statements?

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

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

Q76. The following statements describe the propensity and role of amino acids in the secondary structure of proteins

A. Alanine has a high frequency of occurrence in α-helices

B. Proline has a high frequency of occurrence in α-helices

C. The χ_1 does not affect the helix propensity of serine, threonine and valine

D. Peptide bonds involving 'N' of proline may display cis-trans isomerism

Choose the correct combination.

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

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

Q77. For an exponentially growing culture of bacteria where N_0 is the initial population number and N_t is the population number at time t, the mean growth rate constant (K) is expressed as

(a) $\dfrac{\log N_t - \log N_0}{0.301t}$ (b) $\dfrac{\log N_t - \log N_0}{0.301}$

(c) $\dfrac{\log N_t - \log N_0}{t}$ (d) $\dfrac{\log N_t}{0.301t}$

Q78. The following statements are made with reference to membrane fusion reactions in vesicle transport catalyzed by transmembrane SNARE proteins.

A. The SNARE transmembrane proteins exist as complementary sets, with v-SNARES on vesicle membranes and t-SNARES on target membranes

B. A v-SNARE is usually composed of 3 proteins and t-SNARE is a single polypeptide chain

C. The v-SNARE and t-SNARE proteins of a pair interact via helical domains possessed by the two proteins, resulting in formation of a stable two-helix bundle

D. Membrane fusion is catalysed by the energy that is freed when the interacting helices wrap around each other to pull the membrane faces together, concurrently squeezing out water molecules from the interface.

Which one of the following combinations represents all correct statements?

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

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

Q79. The mammalian protein HP1 plays a major role in heterochromati-nization and silencing. The following mutations are proposed to negatively impact HP1 function.

A. Mutation inactivating the deacetylase that targets H3K14Ac

B. Mutation inactivating HP1 bromo-domain

C. Mutation inactivating HP1 chromo-domain

D. Mutation inactivating the KMT1A methyltransferase whose target site is H3K9

Which one of the following combinations represents all correct statements?

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

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

Q80. The statements given below refer to the lambda phage.

A. Clear plaques are formed in Q mutants

B. No plaques are formed in nut mutants

C. Clear plaques are formed in cll mutants

D. Turbid plaques are formed in integrase mutants

E. Clear plaques are formed in P mutants

F. No plaques are formed in cl mutants

Which of the following combination of statements is correct?

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

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

Q81. The table below lists cell cycle regulatory proteins and their known functions

	Cell Cycle regulatory proteins		Function
A	Cdk - activating kinase (CAK)	(i)	Suppresses G1/S-Cdk and S-Cdk activation in G1; helps cells withdraw from cell cycle when they terminally differentiate; phosphorylation by Cdk2 triggers its ubiquitylation by SCF.
B	Wee1 kinase	(ii)	Suppresses G1/S-Cdk and S-Cdk activities following DNA damage
C	p27 {mammals}	(iii)	Phosphorylates inhibitory sites in Cdks: primarily involved in suppressing Cdk1 activity before mitosis
D	p21 (mammals)	(iv)	Phosphorylates an activating site in Cdks

Which one of the following options represents the correct match between cell cycle regulatory proteins with their known functions?

(a) A-(iv), B-(iii), C–(i), D-(ii)

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

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

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

Q82. The following statements are being made about the archaeal cell wall/membrane:

A. Archaeal cell walls could stain Gram +ve or Gram -ve depending on the genus

B. Archaeal are characterized by Gram +ve staining of the cell wall

C. Archaeal cell walls are susceptible to degradation by lysozyme

D. Archaeal cell membranes possess branch chain hydrocarbons linked to glycerol by ether links

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

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

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

Q83. Given below are few statements related to DNA replication:

A. Replication in eukaryotic chromosomes from the origin(s) is initiated multiple times in each cell cycle while it is initiated only once in each cell cycle at the origin in bacterial chromosomes

B. Improper reinitiation of replication in a eubacterial chromosome is prevented by hemi-methylation status of the bacterial origin

C. DNA polymerase III is the major replication polymerase responsible for de novo synthesis of both leading and lagging strands of DNA in E. coli

D. Rolling circle mode of replication produces multiple units of the original molecule

Which one of the following options represents INCORRECT statement(s)?

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

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

Q84. Given below are four sentences with blanks (labelled X, Y, Z and L).

A. RNA Pol I transcribes ___X___.

B. miRNA genes are transcribed by ___Y___.

C. The RNA polymerase found only in plants is ___Z___.

D. tasiRNAs are synthesized by ___L___.

Which one of the following options would present the combination of all terms (in the order X, Y, Z and L) to complete the above sentences correctly

(a) X-mRNAs; Y- RNA Pol II; Z- RNA pol IV; L- RNA Pol III

(b) X - tRNAs; Y - RNA Pol III; Z - RNA pol V; L - RNA Pol I

(c) X - 45S rRNA; Y - RNA Pol II; Z - RNA pol V; L - RNA Pol II

(d) X - 18S rRNA; Y - RNA Pol V; Z - RNA pol IV; L - RNA Pol I

Q85. Given below is a partial coding sequence of a gene:

5'-A A T G G A C G C A T G T G T C G A T G G –3'

Which one of the following polypeptides CANNOT be produced by transcription and translation of the above DNA sequence in any of the three possible reading frames?

(a) Asn - Gly - Arg - Met - Cys - Arg - Trp

(b) Asn - Ala - Cys - Phe - Ser - His

(c) Met - Asp - Ala - Cys - Val - Asp

(d) Trp - Thr - His - Val - Ser - Met

Q86. Expression of gene 'A' is a regulated by Mg^{2+}. The expression of gene 'A' in untreated (UN) and cells treated with Mg^{2+} (T) was analysed by Northern hybridization (N) and Western blotting (W). A similar exercise was done for a mutant (Mut) which was isolated with a 6 bp deletion in 5'UTR of the transcript of gene 'A'. The following are summary of four possible results that are hypothesized to be obtained
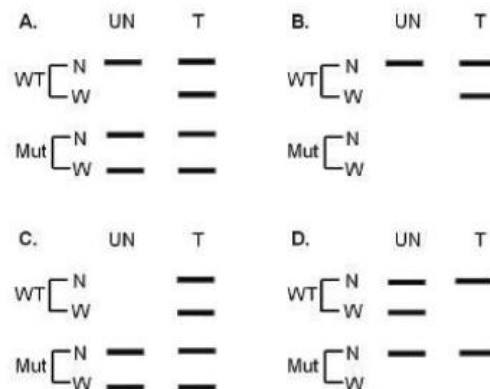
UN = Untreated Cells, WT = Wild type cells, T = Cells treated with Mg^{2+}, Mut = Cell with mutation in gene A, N = Northern hybridization, W = Western blotting

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

(a) A only (b) D only

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

Q87. The following statements are made with reference to the replication of DNA.

A. The eukaryotic counterpart of the bacterial β-clamp protein is proliferating cell nuclear antigen (PCNA)

B. Mutation inactivating one of the subunits of the Mcm 2-7 complex negatively affects the initiation of DNA replication in eukaryotes, but has no effect on elongation of the replication fork

C. All DNA polymerases responsible for replicating the eukaryotic genome catalyze DNA chain extension in a DNA template-dependent manner.

D. The FENI protein plays a role in the synthesis of the lagging strand during DNA replication as well as in base excision repair

Which one of the following options represents INCORRECT statement(s)?

(a) B only **(b) B and C only**

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

Q88. The following statements are related to transcription in bacteria/ eukaryotes.

A. During concurrent promoter sequence recognition and melting, melting commences with base flipping where two bases are flipped out into pockets of the primary sigma factor

B. Binding of a-amanitin to RNA polymerase II permits entry of nucleotides into RNA pol II active site and synthesis of RNA, but prevents translocation

C. RNA polymerase I can use upstream promoters with 3 consensus sequences, as well as internal promoters having a bipartite structure

D. FACT is associated with RNA polymerase during transcriptional elongation and helps displace histone octomers during transcription

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

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

Q89. Suresh was bitten by a poisonous snake and was immediately treated with anti-venom human immunoglobulin and was saved. A year later he was bitten by the same type of snake second time. Predict his response to the venom from second bite from the following:

(a) He will be fully protected from the effects of the poison second time because he developed adaptive immunity after first snake bite.

(b) He will be equally sensitive as first encounter because there would be no recall of the first encounter.

(c) There are residual cells or anti-venom antibodies that were involved in the original/first encounter, hence he will be protected.

(d) There will be memory cells made after the first encounter hence he will be more sensitive.

Q90. An antigen was injected into a mouse. Macrophages and antigen primed T_H cells were isolated from this mouse to perform the following in vitro experiments:

A. Macrophages were treated with the antigen for an hour and then incubated with T_H cells.

B. Macrophages were treated with paraformaldehyde first and then treated with the antigen for an hour. These macrophages were then incubated with T_H cells.

C. Macrophages were treated with paraformaldehyde first then treated with the digested (proteolytrcally cleaved) antigen for an

hour. These macrophages were then incubated with T_H cells.

D. Macrophages were treated with the antigen for an hour and then treated with paraformaldehyde. These macrophages were then incubated with T_H cells.

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

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

Q91. Three strains of pathogenic bacteria were found to express proteins mimicking human proteins associated with compiement pathway. Bacterium 'X' expressed on its surface proteins mimicking Decay Accelerating Factor (DAF) and Complement Receptor 1 (CR1). Bacterium 'Y' secreted a protein that mimicked protein S of humans and bacterium 'Z' secreted protein that mimicked Factor I activity.

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

(a) Bacterium X will prevent formation of C3 convertase on its surface by alternate and classical pathways.

(b) Bacterium Y will prevent formation of C3 convertase on its surface by lectin pathway.

(c) Bacterium Z will be susceptible to complement attack by Membrane Attack Complex (MAC) despite secreting Factor l-like protein to cieave C3b and C4b.

(d) Bacterium Y will prevent formation of Membrane Attack Complex (MAC) on its surface.

Q92. Pathogens continuously evolve strategies to evade host immune responses. For each of the following evasion strategies (listed in column X) match the pathogen (listed in column Y) which adopts it:

	Column X		Column Y
A	Changing the antigen expressed on their surface	(i)	Influenza virus
B	Increasing phagocytic activity of macrophage	(ii)	Neisseria
C	Developing resistance to complement-mediated tysis	(iii)	Gram +ve bacteria
D	Secreting proteases to inactivate antibodies	(iv)	No bacteria
E	Allowing point mutations in		

surface epitopes resulting in antigenic drift	

Choose the correct match

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

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

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

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

Q93. Following are the statements which explain why patients with a-linked hyper-IgM syndrome express normal genes for other antibody subtypes but fail to produce IgG, IgA, or IgE:

A. CD40 expressed on B cells is defective

B. CD40L mediates binding of B-cells to T-cells and sends co- stimulatory signals to the B-cells for class switching

C. Without CD40 on macrophage, class switching does not occur

D. CD40L mediates binding of B-cells to macrophages and sends co-stimulatory signals to the B-cells for class switching.

Select the option with correct combination.

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

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

Q94. PR proteins play important role during plant-pathogen interactions. Column X represents some of the PR family proteins and column Y represents their main properties.

Column X		Column Y	
A	P R - 2	(i)	Defensin
B	PR- 5	(ii)	Thaumatin-like
C	P R - 12	(iii)	Lipid transfer protein
D	PR - 14	(iv)	β-1, 3-glucanase

The correct match of column X with the property in column Y is

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

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

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

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

Q95. Dreisch performed the "pressure plate experiment1' to alter the distribution of nuclei in a 8-cell sea urchin embryo. He obtained normal larvae from these embryos. Following possible conclusions could be drawn:

A. Prospective potency of the blastomeres is less than the actual prospective fate.

B. Sea urchin embryo is a "harmonious equipotential system" implying that cell interaction is critical for normal development.

C. Prospective potency of the blastomere is greater than the actual prospective fate.

D. Prospective potency of the blastomere is equal to the prospective fate.

Which one of the following combinations of statements represents the correct inference from the experiment?

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

(c) B only   (d) D only

Q96. The continued expression of engrailed and wingless is maintained by interactions between the Engrailed- and Wingless-expressing cells. The following statements are given towards the initiation of the cascade of events that occur for this interaction:

A. The engrailed gene is expressed in cells where neither even skipped nor fushi tarazu gene is active.

B. The wingless gene is expressed in those cells that contain high concentration of either Even skipped or Fushi tarazu.

C. Wingless is a secreted protein, diffuses to the surrounding, binds with the Frizzled and Lrp6 receptor proteins and activates engrailed gene via Armadillo.

D. Hedgehog protein activates the transcription of engrailed and also activates its own transcription.

E. Hedgehog protein diffuses from ceils and binds to Patched receptor on neighbouring cells and enables transcription of wingless gene.

Which combination of above statements correctly represent the maintenance of engrailed and wingless expression?

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

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

Q97. In C. elegans, activation of the CED-3 and CED-4 proteins are essential for the apoptosis pathway. In addition, gain-of-function mutations in the ced-9 gene cause its protein to be made in cells that would normally die, resulting in survival of those cells. Given these facts, which one of the following diagrams correctly represents a cell death pathway?

(a)

(b)

(c)

(d)
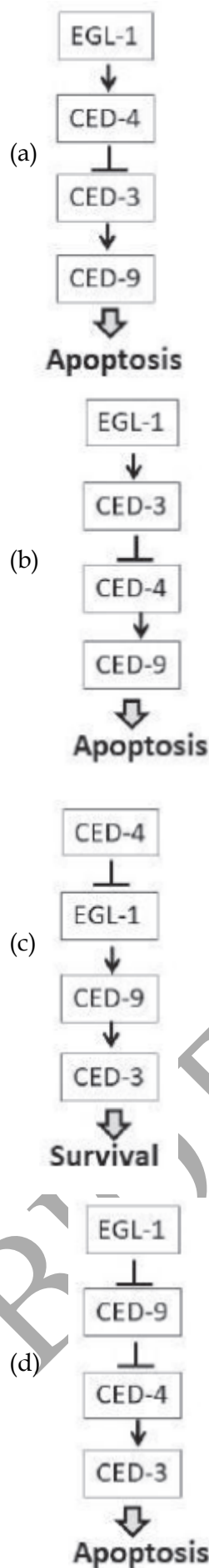
Q98. Several marine organism release their gametes into the environment, where sperm attraction and subsequent events lead to successful fertilization. With reference to sea urchins, which one of the following statements is NOT true?

(a) Addition of resact into a drop of seawater containing sperms specifically attracts sperms of A. punctulata.

(b) IP_3 is formed initially at the site of sperm entry and releases sequestered Ca^{2+}.

(c) Ca^{2+} prevents docking of cortical granules of the egg to the cell membrane.

(d) Inhibitors that specifically block PLCy can be circumvented by microinjecting IP_3 into the egg.

Q99. The major structural characteristic of avian gastrulation is the primitive streak, which becomes the blastopore lips of amniotic embryos. Migration through the primitive streak is controlled by Fgf8. What would happen if the Fgf8 protein, which repels migrating cells away from the streak, is over expressed in the primitive streak?

(a) The yolk sac will be deformed.

(b) Wnt signalling will be activated and orientation of the primitive streak will change.

(c) Cells of the streak will not form the paraxial mesoderm.

(d) Cells generate mesodermal portions of the embryo.

Q100. Programmed cell death (PCD) plays an important role in development of barley aleurone. The following statements are made with respect to involvement of various phytohormones and signaling molecules.

A. Gibbereilic acid promotes PCD.

B. Abscisic acid postpones PCD.

C. Cyclic GMP signaling postpones PCD.

D. Nitric oxide scavenger delays PCD.

Which one of the following combinations of statements is correct?

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

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

Q101. Following are certain statements regarding nitrogen uptake and assimilation by plants:

A. Plant roots can take up nitrogen in the form of NO_3^- or NH_4^+

B. NH_4^+ taken up by plants can be directly assimilated into amino acids.

C. Amino acids are synthesized exclusively in plastids and chloroplast of roots and leaves, respectively.

D. NO_3^- can be stored in vacuole of both, roots and leaves.

Which one of the following combinations is correct?

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

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

Q102. Dark grown Arabidopsis seedlings when exposed to ethylene gas shows typical triple response. Following are certain statements regarding the triple response:

A. A dominant ethylene receptor mutant will not show triple response in the presence of ethylene.

B. Tightening of apical hook is one of the features of triple response.

C. Loss of function of multiple receptors will show triple response even in the absence of ethylene.

D. Increase in hypocotyl length is a feature of triple response.

Which one of the following combinations is correct?

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

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

Q103. Calvin-Benson cycle is divided into three phases, namely carboxyiation, reduction and regeneration. The following statements are related to the three phases of Calvin-Benson cycle:

A. The product of light reaction, ATP and NADPH is utilized in the carboxylation phase.

B. Six molecules of 3-phosphoglycerate is converted into six molecules of glyceraldehyde 3-phosphate in the reduction phase.

C. The action of aldolase enzyme for the production of fructose 1, 6-bisphosphate takes place in reduction phase.

D. Formation of seven carbon compound, sedoheptulose-7-phosphate takes place in the regeneration phase.

Which one of the following combinations is correct?

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

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

Q104. A researcher has treated pea leaves with p-chloromercuribenzene sulfonic acid (PCMBS), which inactivates plasma membrane transporters. It was observed that phloem loading of sucrose is inhibited.

Which one of the following interpretations is correct?

(a) Symplastic loading is eliminated

(b) Apoplastic loading is eliminated

(c) Both sympiastic and apoplastic loadings are eliminated

(d) Photosynthesis rate is reduced.

Q105. The NPR1 (non-expressor of pathogenesis-related genes 1) and two SA receptors (NPR3 and NPR4) are known to play important role in SA mediated plant defense. The following statements were made regarding their role in infected and non-infected tissues of the plants:

A. In the infected tissue, SA binds to NPR3 and induces degradation of NPR1 to promote cell death.

B. In the infected tissue, SA binds to NPR4 and blocks the degradation of NPR1 to promote cell death.

C. In the non-infected tissue, SA binds to NPR4 and blocks the degradation of NPR1 to favour cell survival.

D. In the non-infected tissue, SA binds to NPR3 and promotes degradation of NPR1 to favour cell survival.

Which one of the following combination of statements is correct?

(a) A only   (b) B only

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

Q106. A researcher developed a mutant of Arabidopsis plant where the function of SLEEPY 1 (SLY1) containing SCF complex has been disrupted. Which one of the following statements is INCORRECT in the developed mutant in relation to gibberellic acid (GA) signal transduction?

(a) GA will bind to GA-insensitive dwarf 1 (GID1) protein.

(b) A complex of GA-GID1 and DELLA protein will be formed.

(c) The DELLA protein will be ubiquitinated.

(d) The DELLA protein will not be degraded.

Q107. Loss of a large quantity of blood in an individual due to haemorrhage provokes many physiological changes which are compensatory and decompensatory in nature. The following statements describe few compensatory or decompensatory mechanisms operating in this condition.

A. The peripheral chemoreceptors are stimulated when arterial blood pressure is reduced below 60 mm Hg due to blood loss.

B. The cardiovascular centres in the brain stem become depressed in severe hypotension due to blood loss.

C. The mononuclear phagocytic system becomes depressed during the course of haemorrhagic hypotension.

D. Renin is secreted from juxtaglomerular apparatus in haemorrhagic hypotension.

E. Considerable quantity of interstitial fluid may be drawn into circulation due to lower hydrostatic pressure in capillaries resulting from blood loss.

Choose the option describing only the decompensatory mechanisms:

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

(c) C and D   (d) D and E

Q108. In high altitude, a number of compensatory mechanisms operate over a period of time to increase altitude tolerance in humans which is called acclimatization. The following statements propose these compensatory changes:

A. The initial increase of ventilation is relatively small in high altitude but the ventilation steadily increases over next few days.

B. Red blood ceil 2, 3-DPG is increased.

C. The blood pH becomes more alkaline.

D. The oxygen dissociation curve is shifted to the left.

E. The pH of cerebrospinal fluid is further increased.

Choose the option with both INCORRECT statements:

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

(c) C and D   **(d) D and E**

Q109. The electrical response of the afferent nerve terminal in a Pacinian corpuscle (PC), after application of different grades of pressure, are proposed in the following statements:

A. A non-propagated depolarizing potential or receptor potential is elicited when small magnitude of pressure is applied to PC.

B. The magnitude of receptor potential is increased as the pressure to PC is increased.

C. An action potential is generated when receptor potential attains a critical value.

D. The receptor potential shows all-or-none response.

E. The receptor potential is not a graded potential.

Choose the option with both INCORRECT statements:

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

(c) C and D   **(d) D and E**

Q110. cGMP is produced from GTP by the enzyme guanylate cyclase which exists in soluble and membrane-bound forms. Following statements are made related to signaling molecules that are associated with cGMP signaling cascade.

A. Atrial natriuretic factor causes natriuresis and diuresis by interacting with membrane-bound form of guanylate cyclase.

B. Nitroglycerin causes smooth muscle relaxation and vasodilation by interacting with soluble form of guanylate cyclase.

C. Nitroprusside causes smooth muscle relaxation and vasodilation by interacting with membrane-bound form of guanylate cyclase.

D. Atrial natriuretic factor causes natriuresis and diuresis by interacting with soluble form of guanylate cyclase.

Which one of the following combinations is correct?

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

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

Q111. Kallmann syndrome generally exhibits gonadal dysfunctions in males. Following statements are made relating to such males.

A. They mostly suffer from hypergonadism

B. They mostly suffer from hypogonadism

C. They have higher level of circulating gonadotropins

D. They have lower level of circulating gonadotropins

Which one of the following combinations of statements is correct?

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

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

Q112. The discharge patterns in a single afferent nerve fibre from carotid sinus at various levels of mean arterial pressure (MAP) are plotted against changes in aortic pressure with time in the following figure:
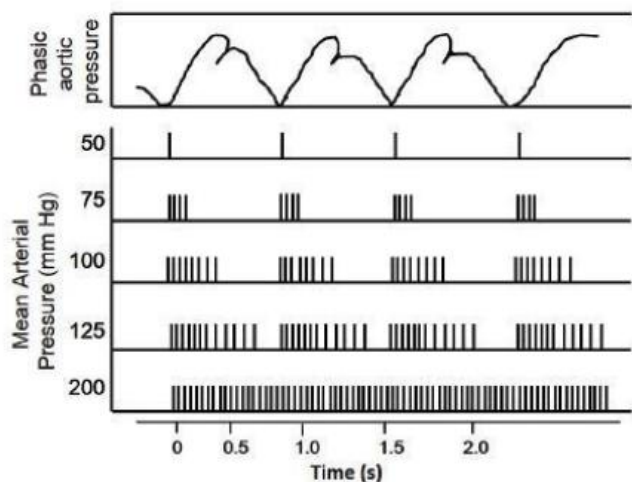
The following statements were proposed from the above figure:

A. Baroreceptors are more sensitive to phasic change of aortic pressure at normal MAP

B. The baroreceptor firing rate is reduced at lower MAP than in normal MAP

C. The phasic change in baroreceptor fibre is less prominent at lower MAP

D. A burst of action potentials appear in a single baroreceptor fibre during diastole at normal MAP

E. The discharge of baroreceptors even extends to systole at higher MAP

Choose the option with both CORRECT statements:

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

Q113. The figure below represents a profile of DNA markers in two parents (P1 and P2), progeny (F1) from a cross between P1 and P2 and that of gametes produced from F1. Eight different patterns (DH1 to DH8) were observed in case of gametes. The numbers below, DH1 to DH8 indicate the number of individuals observed in each case

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

A. Markers 'b' and 'f' are likely to be allelic in nature

B Markers 'c' and 'd' are linked in trans with a map distance of 24 cM

C. Marker 'b' assorts independently from marker 'c'

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

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

Q114. A species of plant (species 1) is diploid ($2n = 6$) with chromosomes AABBCC and a related species (species 2) is also diploid ($2n = 4$) with chromosomes PPQQ. The following statements were given by students regarding the chromosome numbers involving these plant species:

A. Autotripioid of species 1 will have 12 chromosomes

B. Allotetraploid involving species 1 and 2 will have 16 chromosomes

C. A monosomy in species 1 will generate 5 chromosomes

D. A double trisomy in species 1 will generate 8 chromosomes

E. A nullisomy in species 2 will generate 2 chromosomes

The combination of statements with all correct answers is:

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

Q115. Curled wing (cu)r ebony body colour (e) and sepia eye (se) are three recessive mutations that occur in fruit flies. The loci for these mutations have been mapped and they are separated by the following hypothetical map distances:
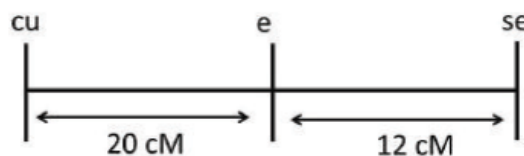
The interference between these genes is 0.4.

A mutant cu e se fly was crossed with a homozygous wild type fly. The resulting F1 females were test crossed that produced 1800 progeny. What number of flies in each phenotype class is likely to be obtained in the progeny of the test cross?

(a) Non recombinants will be 1250; single crossover between cu and e 334; single crossover between e and se 190; double cross over 26

(b) Non recombinants 1181; single crossover between cu and e 360; single cross over between e and se 216; double cross over 43

(c) Non recombinants 1198; single crossovers 576; double cross overs 26

(d) Non recombinants 1233; single crossover 524; double cross over 43

Q116. In some sheep, horns are produced by an autosomal allele, 'H', that is dominant in males and recessive in females. H+H+ individuals are hornless. A horned female is crossed with a hornless male. One of the resulting F1 females is crossed with a hornless male. What proportion of the male and female progeny of F1 will have horns?

(a) 50% of male and 50% of female progeny will be horned

(b) 50% of male progeny but none of the female progeny will be horned

(c) 25% of male and 25% of female progeny will he horned

(d) 100% of male progeny and 50% of female progeny will be horned

Q117. Body weight of rabbits is determined by pairs of alleles at two loci, 'a' and b', that are additive and equal in their effects. Rabbits with genotype $a^- a^- b^- b^-$ have average 1 kg body weight, whereas individuals with genotype $a^+ a^+ b^+ b^+$ have animals that average 3.4 kg in weight. A male rabbit with $a^- a^- b^- b^-$ is crossed with a female of genotype $a^+ a^+ b^+ b^+$. What will be predicted average weight of F1 progeny of this cross?

(a) 2.2 kg   (b) 1.6 kg

(c) 1.2 kg   (d) 2.8 kg

Q118. E coli cells were simultaneously infected with two strains of phage λ. One strain of λ had a mutant host range, is temperature sensitive and known to produce clear plaques (genotype h st c); another strain of λ carried the wild type alleles (genotype h^+ st^+ c^+). Progeny phages were collected from the lysed cells and were plated on bacteria. The following numbers of different progeny were obtained:

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

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

(a) $h \underline{}_{36cM} c \underline{}_{15cM} st$

(b) $c \underline{}_{21cM} h \underline{}_{15cM} st$

(c) $h \underline{}_{21cM} st \underline{}_{15cM} c$

(d) $h \underline{}_{36cM} c \underline{}_{\infty cM} st$

Q119. The three domain classification of life proposed by Carl Woese divides life forms on the basis of

(a) mitochondrial DNA and membrane structures

(b) ribosomal rRNA and protein sequences

(c) mitochondrial DNA and protein sequences

(d) presence of single or double membranes

Q120. Appendix masculina is found in

(a) second abdominal appendages of male palaemon

(b) second maxillipede of male palaemon

(c) maxilla of both sexes of palaemon

(d) mandibles of male palaemon

Q121. Select the correct statement. The bark of a woody plant is collectively made up of the following tissues:

(a) primary phloem, primary phloem fibres, pericycle and periderm

(b) primary xylem, primary phloem fibres, stem cortex, rays, and periderm

(c) vascular cambium, rays, pericycle and periderm

(d) secondary phloem, secondary phloem fibres, stem cortex, pericycle and periderm

Q122. Given below is a list of plant species and reproductive forms:

Plant species	Reproductive form
(i) Gingko (ii) Conifers (iii) Poplar	(a) Monoecious
(iv) Maize (v) Date palm (vi) Mango	(b) Dioecious

Which one of the following options correctly matches all the given plant species with their reproductive forms?

(a) a = (i), (iii), (v); b = (ii), (iv), (vi)

(b) a = (i), (ii), (v); b = (iii), (iv), (vi)

(c) a = (ii), (iv), (vi); b = (i), (iii),(v)

(d) a = (iii), (iv), (vi); b = (i), (ii), (v)

Q123. Given below is a list of natural disturbances.

A. Coral bleaching

B. Rising sea levels

C. Shifts in species distribution

D. Lowering of sea levels

E. Increase in glacial sheets

Which one of the following combinations of disturbances can be attributed to global warming?

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

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

Q124. To study the effect of temperature on seed germination, 16 seeds of a plant species were selected for an experiment. A total of four temperature treatments were provided to sets of four seeds to study the onset of germination. What would be the within, between and total degrees of freedom, respectively, in an analysis of variance?

(a) 3, 15and 18   (b) 16, 4 and 20

(c) 4, 16 and 20 **(d) 15, 3 and 18**

Q125. The following information refers to ecological interactions.

Column X	Column Y
A. Bass introduction into aquatic systems	(i) Bioaccumulation
B. Beavers	(ii) Aposematism
C. Sea bird (such as puffins)	(iii) Keystone species
D. Yellow and black stripes in a wasp	(iv) Trophic cascades

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

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

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

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

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

Q126. A large patch of forested area was devastated by raging fires. After some years, the area was found to recover its species. Which one of the following options best describes the process of re-establishment in the area?

(a) mosses and lichens → grasses → shrubs and small plants woody trees

(b) grasses → woody trees → herbs and shrubs →mosses and lichens

(c) woody plants → lichens and mosses → herbs and shrubs

(d) grasses → herbs and shrubs → woody trees

Q127. According to the classical Lotka-Volterra competition model, which of the following conditions allow for co-existence of two competing species?

(a) both species are equally capable of inhibiting each other

(b) intraspecific competition of each species > interspecific competition

(c) intraspecific competition < interspecific competition

(d) there is no intraspecific competition in either species

Q128. Co-existence of several species of birds in an area is possible under the following conditions

(a) High niche overlap and high niche differentiation

(b) Low niche overlap and high niche differentiation

(c) High niche overlap and low niche differentiation

(d) Low niche overlap and low niche differentiation

Q129. Given below are the possible reasons of high probability for extinction of species:

(i) Increased homozygosity of alleles

(ii) Increased heterozygosity of alleles

(iii) Decreasing population sizes

(iv) Increasing demographic stochasticity

(v) Decreasing environmental stochasticity

Which one of the following options represents the correct combination of reasons that can lead to the highest probability of extinction of species?
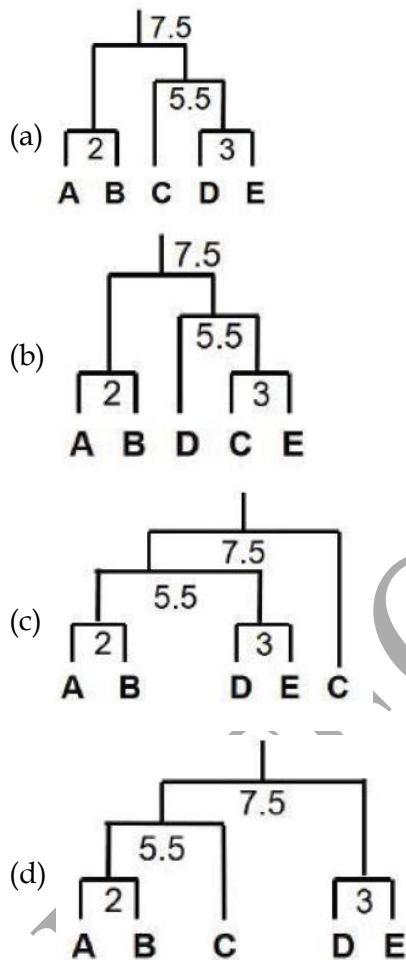
(a) (ii), (iii) and (v)   **(b) (i), (iii) and (iv)**

(c) (i), (ii) and (iii)   (d) (ii), (iii) and (iv)

Q130. Distance matrix of five species A to e is given below

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

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

(a)

(b)

(c)

(d)

Q131. The figure below shows a gene duplication event followed by a divergence event in species 1 and 2
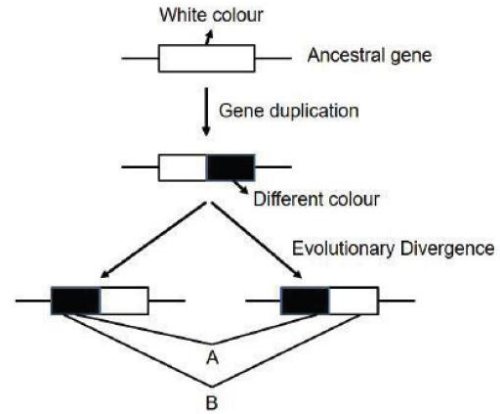
Based on the details given above determine what is represented by A and B

(a) A : duplicated genes; B : Ancestral genes

(b) A : paralogs; B : ancestral genes

(c) A : orthologs; B : paralogs

(d) A : paralogs; B : orthologs

Q132. Felsenstein zone in a phylogenetic tree refers to a region of tree space where

(a) maximum likelihood would be inconsistent

(b) lineages converge due to shared common ancestry

(c) outgroups relationship is influential

(d) maximum parsimony would be inconsistent

Q133. Creationism is rejected by evolutionary biologists because

(a) it offers no explanation about the origin of adaptation

(b) it suggests that all species descended from a common ancestor

(c) theologians have not settled on a data for the origin of life on earth

(d) supernatural events have not been shown to be very common

Q134. Given below are proposed analogous structures among organisms.

A. wings of birds and bats

B. wings of bats and tetrapod digits

C. tendrils of vitis and tendrils of pumpkin

D. tubers of potatoes and sweat potatoes

E. fins of fish and flippers of a whale

Which one of the following options correctly states the analogous structures?

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

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

Q135. An experiment was performed to introduce a transgenic trait in a crop plant of Agrobacterium – mediated transformation using a transgene construct in which the transgene was expressed using the CaMV 35S promoter. It was observed

that expression levels of the transgenic protein were very low in all transgenic plants while transgene mRNA levels were high and variable among different plants. Further, different transgenic lines contained different numbers of the T-DNA insert. The following statements were made to explain the above observation:

A. Variations in the number of T-DNA inserts in different transgenic plants is due to more number of host cells getting infected with the T-DNA

B. Low expression levels of the transgenic protein in all transgenic plants could be due to codon usage variations between the host plant and the heterologous source of the transgene

C. The coding sequence of the transgene contained sequences that destabilized the transgene mRNA

D. Variation in copy number of T-DNA in different transgenic plants is due to variation in the promoter used to express the transgene. Which one of the following options represents all correct statements?

(a) A only   (b) B and C

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

Q136. Given below are a few statements related to biological principles and / or techniques:

A. Genetic diversity plays an important role in the identification of combiners for heterosis breeding

B. Gentopying by sequencing (GBS) can be used to identify allelic diversity but is not useful for construction of linkage maps

C. Genome editing by sequence specific nucleases (SSNs) in the presence of guide RNAs would result in NHEJ – mediated knock outs and loss of function mutations.

D. In a comparison of synteny and colinearity between dipoloid and polyploid plant genomes. Colinearity is high but syntency is low.

Which one of the following options represents all correct statements?

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

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

Q137. Given below are some terms in column A and their corresponding properties / related terms in column B

Column A	Column B
A. Bulk segregant analysis	(i) QTL analysis of wider genetic diversity using fewer individuals
B. NILs	(ii) Mapping monogenic qualitative trails
C. Association mapping	(iii) Co-dominant markers
D. SNPs	(iv) Repeated backcrossing of Fi to recurrent parent

Which one of the following options represents the most appropriate match between all terms of column A and B?

(a) A – (ii); B – (iv); C – (i): D – (iii)

(b) A – (iii); B – (i); C – (iv); D – (ii)

(c) A – (iv); B – (iii); C – (ii); D – (i)

(d) A – (iii); B – (iv); C – (i); D – (ii)

Q138. Which one of the following statements is true with regard to drug metabolism?

(a) The therapeutic window is simply the range of plasma drug concentrations in which the drug has therapeutic benefits without causing extra safely risks due to drug toxicity

(b) Each individual drug molecule is metabolized by a specific drug – metabolizing enzyme that is dedicated to metabolism of that drug

(c) An ultrafast metabolizer is a person who metabolizes a drug too quickly and is at a risk of drug overdose

(d) A poor metabolizer is a person who cannot metabolize a drug properly and faces risk of underdose

Q139. Gene therapy is a promising tool for addressing several diseases in humans. With respect to the above, which one of the following statement is FALSE?

(a) Gene therapy involves the direct genetic modification of the cells / model to achieve a therapeutic goal.

(b) Current gene therapy is directed at modifying somatic cells

(c) The only successful gene therapies are those in which cells are removed from a patient, genetically modified, and then reintroduced into patients

(d) Recessively inherited disorders are good targets for gene therapy

Q140. A researcher intends to stimulate neurons via glutamate receptors in medial septum of an experimental animal. The following apparatus / instruments are available in the laboratory:

A. Stereotaxic apparatus

B. Slow perfusion pump

C. Microcannula

D. Radiofrequency lesion maker

E. Electrical stimulator

F. Nichrome coated bipolar steel electrode

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

(c) D and E only   (d) D, E and F

Q141. Given below are statements related to various molecular techniques

A. During molecular cloning of DNA fragments, a vector and inert molecule digested with two different enzymes can never be ligated with each other

B. Only 3' → 5' exonucleases and not 5' → 3' exonucleases can be used for digesting nucleic acids to generate blunt – ended fragments for cloning

C. In Sanger's dideoxy sequencing method, each reaction consists of a mixture of three dNTPs and one ddNTP.

D. Self – ligation of a vector with compatable ends can be prevented by treatment with alkaline phosphatase.

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

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

Q142. Given below are four DNA sequences and a set of a forward and reverse primers for PCR amplification.

Sequence	Primes
A. 5' – ACAATCGT…… ACTAGTAC – 3'	FP: 5'-TGTTAG-3' RP: 5'-TAGTAC-3'
B. 5' – AGTCTTA G……. ATGCCAGT - 3'	FP: 5'-AAGACT-3' RP: 5'-ACTGGC-3'
C. 5^1 – CTTGACTA……. GTACAGTCA- 3^1	FP: 5'-CTTGAC-3' RP: 5'-TGACTG-3'
D. 5' – GATCTAGC……. TCAAGCAGAC- 3'	FP: 5'-GATCTA-S' RP: 5'-CAGACG-3'

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

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

(c) Both C and D   **(d) C only**

Q143. A field biologist a sampling tree species in a forest area to estimate tree diversity. What method can be employed to decide if his sampling effort is adequate of estimate the tree diversity in the area?

(a) Quadrat method of sampling

(b) Saturation using species accumulation curves

(c) Frequency distributions

(d) Jaccard's dissimilarity coefficient

Q144. For a given immunological application [column X], select the type of antibody [column Y] that should be used:

Column X	Column Y
A. Bacterial agglutination	i. Only monoclonal
B. Western blotting	ii. Only polyclonal
C. Detection of a cytokine using a solid phase ELISA	iii. Either monoclonal or polyclonal
D. Diagnostic tissue typing	

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

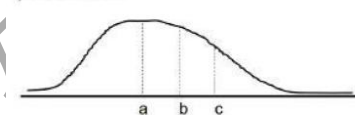(a) A – ii, B – i, C – iii, D – i

(b) A – iii, B – iii, C – i, D – i
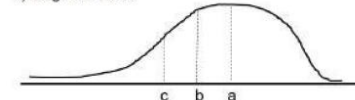
(c) A – iii, B – ii, C – i, D – i

(d) A –i, B – iii, C – i; D – ii

Q145. In the two graphs given above, what do a, b and c refer to:

i) Positive skew

ii) Negative skew

(a) a = mean, b = median, c = mode

(b) a = median, b = mode, c = mean

(c) a = mode, b = median, c = mean

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