PART – A

Q1. The number $681^{32} - 319^{32}$ is divisible by

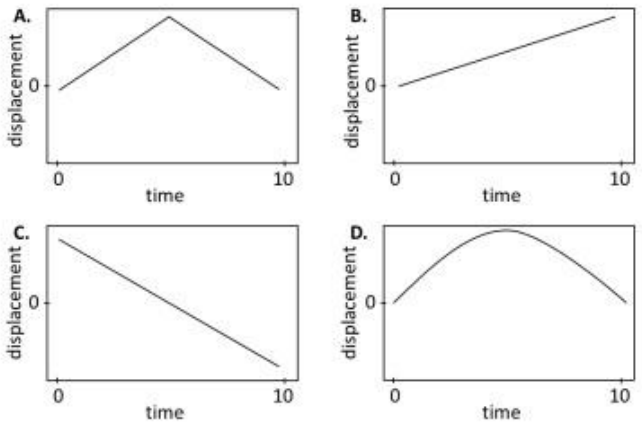
(a) both 362 and 1000

(b) 362 but not 1000

(c) 1000 but not 362

(d) neither 362 nor 1000

Q2. Which one of the following graphs represents the displacement vs time relation for the motion of a ball thrown upward and returning toward the ground, remaining in air for 10 seconds? (Ignore air resistance.)



(a) a

(b) b

(c) c

(d) d

Q3. Vehicle number plates have two letters out of the 26 letters of the English alphabet followed by four decimal digits. How many different number plates are possible if repetition of letters and digits is allowed?

(a) $26 \times 25 \times 10 \times 9 \times 8 \times 7$

(b) $26 \times 26 \times 10 \times 10 \times 10 \times 10$

(c) $(26 \times 25 \times 24 \times 23 \times 10 \times 9) / (4 \times 3 \times 2 \times 2)$

(d) $26 \times 25 \times 24 \times 23 \times 10 \times 9$

Q4. In a grid puzzle, each row and column in the 9x9 grid, as well as each 3×3 subgrid shown with heavy borders, must contain all the digits 1-9.

1					8			9
		2						8
	8		5	4	9			
	4		2			9		
3		9				2		1
		1		?	5		4	
			9	1	2		3	
7						1		
2			7					6

In the given partially filled grid, the digit in the square marked "?" is

(a) 3 (b) 9

(c) 8 (d) 7

Q5. In an examination 3 medals were awarded for each of 5 subjects. If three candidates won exactly four medals each, and no candidate won Just one medal, the total number of medal winners

(a) was exactly 4

(b) was exactly 5

(c) could be either 5 or 6

(d) was exactly 6

Q6. What is the difference, 11 hours after synchronisation, in the time shown by a standard watch and a watch whose hour and minute hands coincide every 64 minutes?

(a) 11 min (b) 16 min

(c) 22 min (d) 44 min

Q7. The sum of squares of four integers

(a) can never be divisible by 13

(b) can never be divisible by 15

(c) can be divisible by 17

(d) can never be divisible by 19

Q8. If ab : 5, bc = 7 and ca = 11, which of the following identifies is valid?

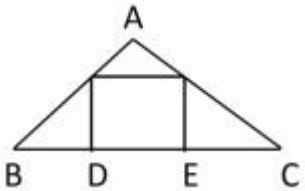
(a) $7a = 11b = 5c$

(b) $\sqrt{35}a = \sqrt{55}b = \sqrt{77}c$

(c) $\sqrt{7/5}a = \sqrt{5/11}b = \sqrt{11/7}c$

(d) $\sqrt{5/11}a = \sqrt{11/7}b = \sqrt{7/5}c$

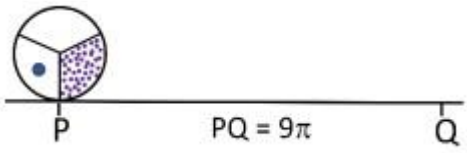
Q9. In the given triangle ABC, a square is drawn as shown. Given, ∠BAC = 90°, BC = a, BD = x and EC = y = which of the following is the area of the square?



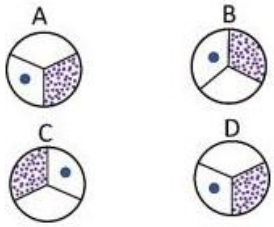
(a) (a – x)y (b) (a – y) x

(c) (a – x) (a – y) (d) xy

Q10. A circular disk of unit radius rolls along a straight line from P to Q.



Which of the following figures shows the orientation of the disk at Q?



(a) A (b) B

(c) C (d) D

Q11. A test consists of 20 questions. A correct answer fetches 4 marks and a wrong answer is penalised by deducting 1 mark. Unattempted questions fetch nothing. If a candidate with a few wrong answers secures 44 marks, how many questions were attempted?

(a) 15 (b) 16

(c) 17 (d) 18

Q12. On day 1, a boy puts one coin in his piggy bank. On successive days he adds coins so as to double the number of coins. In another piggy bank, a girl puts 2 coins on day 1 but adds coins on every alternate day so as to double the number of coins. On which day will they put the same number of coins in their piggy banks?

(a) Day 2 (b) Day 3

(c) Day 5 (d) on no day

Q13. Symbols Θ, ⊗, ⦸ represent mathematical operations (out of +, –, ÷, ×) which respect the relations

$8 \oslash 5 \Theta 9 = 53$

$9 \Theta 3 \otimes 2 = 25$

What is the value of $2 \otimes 13 \oslash 7$?

(a) –4 (b) 8

(c) –89 (d) 19

Q14. The shape of a country on a map is approximated by a kite with diagonals of length 300 km each. The minimum possible length of its boundary will be closest to

(a) 1696 km (b) 1131 km

(c) 848 km (d) 600 km

Q15. In the following finite sequence of integers, how many 9s are divisible by the integers immediately preceding them?

8, 3 ,4, 9, 3, 5, 9, 5, 9, 9, 9 ,4, 5, 9, 5, 6, 3, 3, 5, 7, 2, 3, 9, 9, 8, 9, 3, 9, 1, 9, 4

(a) 3 (b) 4

(c) 5 (d) 6

Q16. A rectangular paper of sides in the ratio 3:4 is folded in half across the longer side. The process is repeated several times. After how many foldings will the ratio of the sides be 3:4? (Ignore the finite thickness of the paper.)

(a) Never (b) Every second fold

(c) Every third fold (d) Every fifth fold

Q17. Six years ago. the ages of three persons were in ratio o 3:5:8. If the sum of their ages 8 years from now would be 122, what are their present ages (in years)?

(a) 15, 25, 40 (b) 21, 31, 46

(c) 15, 25, 30 (d) 21, 26, 37

Q18. Four students Adil, Billy, Ramesh and Diana 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. Diana joined Physics. Adil joined one year after Diana but didn't join Chemistry. Who Joined the college in the year 1993?

(a) Adil (b) Billy

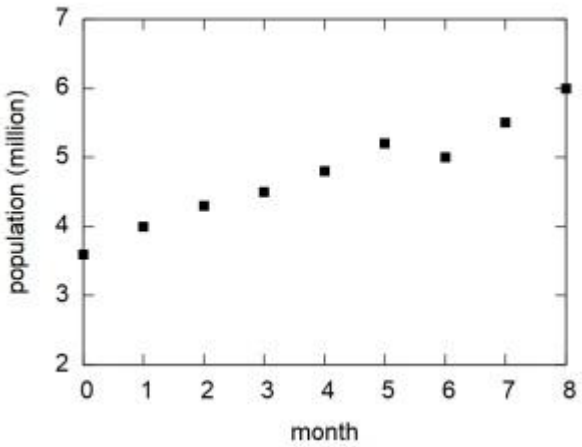
(c) Ramesh (d) Diana

Q19. Suppose each of my brothers has the same number of children as I have sisters, each of the sister having the same number of children as I have brothers. If my siblings have a total of 12 children, none of them an only child, the number of my siblings is

(a) 3 (b) 5

(c) 6 (d) 7

Q20. The population of a species (Y) changes with the month (x) as shown in the graph. Which of the following equations best describes the population curve?



(a) $y = 3x + 3.2$

(b) $y = 0.96 (x - 4)$

(c) $y = 0.3 x^2 + x + 3.6$

(d) $y = 0.3x + 3.6$

PART - B

Q1. During animal cell culture , which one of the following cell types would NOT require trypsin for passaging?

(a) Epithelial cells

(b) Hematopoietic cells

(c) Fibroblasts

(d) Myoblasts

Q2. Which one of the following pairs of metabolic intermediates does NOT provide

a backbone carbon skeleton for the synthesis of amino acids?

(a) Succinate and citrate

(b)3-phosphoglycerate and phosphoenolpyruvate

(c) Ribose 5-phosphate and erythrose 4-pihosphate

(d) α-ketoglutarate and oxaloacetate

Q3. Which one of the following four plant families has the largest number of species?

(a) Brassicaceae (b) Cucurbitaceae

(c) Cactaceae (d) Rosaceae

Q4. During replication over-winding of DNA is caused by_____and removed by .

(a) primase, topoisomerase

(b) primase, single stranded binding protein

(c) helicase, gyrase

(d) helicase, DNA polymerase

Q5. Which one of the following combinations of excitation light and objectives gives the best lateral resolution in a fluorescence microscope?

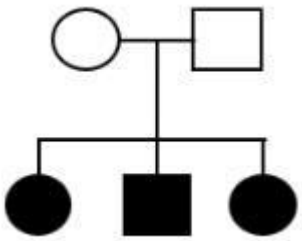
(a) 480nm, 63X, 1.4NA

(b) 650nm, 63X, 1.4NA

(c) 550nm, 100X, 1NA

(d) 480nm, 100X, 1.1NA

Q6. In a mutagenesis experiment, the following pedigree was obtained. All progeny had the same phenotype. The mutation is most likely to have occurred



(a) during maturation of the egg cell.

(b) in the maternal somatic cell.

(c) in the mother in the precursor to all germ cells.

(d) in the embryo during development.

Q7. Which one of the following geological events in the Cretaceous had a massive impact on the climate and biodiversity of India?

(a) Origin of Tibetan plateau

(b) Deccan Trap volcanic activity

(c) Formation of Lonar Lake

(d) Origin of Himalayan mountains

Q8. Which one of the following options contains only those types of mapping populations that are characterized by 'true-breeding' individuals?

(a) RILs and F2 populations

(b) F2 populations and BC1F2

(c) Doubled haploid populations and BC1F2

(d) Doubled haploid populations and RILs

Q9. Monogamy in sexually reproducing animals ;is seemingly paradoxical given that males must maximize their number of matings for higher fitness. Yet, many birds are known to be monogamous. Which one of the following statements represents a scenario where monogamy in birds ls LEAST likely to evolve?

(a) Poor quality of habitat wherein resources are hard to find

(b) Males guard females after mating with them

(c) Mates are scattered and hard to find

(d) Offspring do not require elaborate parental care

Q10. Kaposi's sarcoma is caused by

(a) Epstein-Barr virus

(b) HIV and HHV-8

(c) HTLV type1

(d) HPV

Q11. In which of the following ecosystems would the largest percentage of Net Primary Productivity (NPP) be taken up by the grazing food chain?

(a) Tropical rainforest

(b) Temperate deciduous forest

(c) Algal seabed

(d) Open ocean

Q12. The defect in a major semi-dwarfing gene of rice, sd-1, leads to cultivar with short, thick culms and improved lodging resistance. The gene is related to which one of the following phytohormones?

(a) Gibberellins (b) Abscisic acid

(c) Jasmonic Acid (d) Salicylic acid

Q13. In the model plant Arabidopsis thaliana, methionine is a precursor amino acid in the biosynthesis of

(a) Alkaloids (b) Glucosinolates

(c) Phenolics (d) Terpenoids

Q14. One strand of a palindromic dsDNA is composed of 5' - CCGCGGCGG - 3'. Which one of the following forms of nucleic acid structures will be adopted in water if sense and antisense strands are mixed in equal proportion followed by annealing?

(a) A-form of double-stranded nucleic acid

(b) B-form of double-stranded nucleic acid

(c) Z-form of double-stranded nucleic acid

(d) Both will remain as single strands

Q15. Which one of the following techniques allows the study of all three types of interactions namely, protein:protein, protein:DNA, and protein:RNA?

(a) Differential display

(b) Phage display

(c) ChIP assay

(d) Southwestern blotting

Q16. Which one of the following is true for Genome-wide association study (GWAS)?

(a) There is a need to make controlled crosses or work with human families with known parent-offspring relationship.

(b) All alleles in the population are assayed at the same time.

(c) Single nucleotide polymorphisms (SNPs) cannot be used for such studies.

(d) Knowledge about candidate genes is essential.

Q17. Which one of the following floral homeotic genes is transcribed in all four whorls during flower development?

(a) AP1 (b) AP2

(c) AP3/PI (d) AG

Q18. Which one of the following statistical methods compares the means of the populations?

(a) t-test

(b) Chi-square test

(c) Analysis of Variance

(d) Principal Component Analysis

Q19. Which one of the following statements is correct for dosage compensation in human?

(a) X-chromosome inactivation in female occurs in a zygote immediately after fertilization.

(b) X-chromosome inactivation is non-random, in some individuals maternal X is inactivated while in others paternal X-chromosome is inactivated.

(c) Y-chromosome of males is seen as Barr body.

(d) The body of female is a mosaic of cells, some having paternal X- and others having maternal X-inactivated.

Q20. Which one of the following anthropogenic activities contributes the most nitrogen to the global nitrogen cycle?

(a) Industrial production of fertilizers

(b) NOx production due to combustion of fossil fuels

(c) Nitrogen fixation by soyabean farming

(d) Nitrogen fixation by cultivation of legumes (excluding soyabean)

Q21. Which one of the following statements regarding the developmental potential of cells in embryo is INCORRECT?

(a) The cells of the 4-cell stage mouse embryo are totipotent.

(b) The cells of inner cell mass of the mouse blastocyst differentiate into trophectoderm , mesoderm and endoderm.

(c) Spermatogonial stem cells in testis are unipotent.

(d) Haematopoietic stem cells which can differentiate into blood cells are multipotent.

Q22. Phosphatidylinositol (Pl) is unusual among membrane lipids because it can undergo reversible phosphorylation at multiple sites on the inositol head to generate a variety of phosphorylated Pl lipids called phosphoinositides. In a cell signaling event, the enzyme that directly converts $Pl(4,5)P_2$ to $Pl(3,4,5)P_3$ is:

(a) PI 3-Kinase (b) PLCβ

(c) PTEN (d) Protein Kinase B

Q23. Which one of the following options lists landmasses that were au a part of the ancient Gondwana supercontinent?

(a) Australia, New Zealand, and North America

(b) Africa, Europe, India, New Zealand, and South America

(c) Africa, Europe, India, Madagascar, and North America

(d) Africa, Australia, Antarctica, India, Madagascar, and South America

Q24. Which one of the following statements about distribution of chromosomes within the interphase nucleus of a mammalian cell is correct?

(a) Chromosomes are randomly distributed within the nuclear volume.

(b) The gene-poor chromosomes tend to locate towards the nuclear envelope.

(c) The larger chromosomes tend to locate at the nuclear periphery.

(d) Centromeric region of all the chromosomes tend to concentrate at the center of the nucleus.

Q25. Which one of the following statements is INCORRECT regarding plant phytochrome (PHY), cyanobacterial phytochrome1 (Cph1) and bacterial phytochrome like protein (BphP)?

(a) PHY has two PRO domains in the C-terminal moiety.

(b) Cph1 and BphP has histidine kinase domains at the N-terminal moiety.

(c) GAF domain is present in N-terminal moiety of PHY, Cph1 and BphP.

(d) Cysteine residue that forms the linkage is located in the GAF domain in canonical phytochromes such as PHY and Cph1.

Q26. What type of electromagnetic radiation is used in biomolecular NMR spectroscopy?

(a) Radio waves

(b) Beta emissions

(c) X-ray waves

(d) Microwaves

Q27. Select the species that was thought to be extinct because of climate change and habitat loss, but was recently rediscovered in the year 2022.

(a) Nicobar Wart Frog

(b) Harlequin Frog

(c) Nilgiri Cricket Frog

(d) Lemur Leaf Frog

Q28. Choose the INCORRECT statement:

(a) Tetanospasmin is associated with Tetanus

(b) Tetanospasmin is a neurotoxin

(c) Tetanospasmin facilitates the release of gamma-aminobutyric acid at synapses

(d) Immunization with toxoids is used for the prevention of tetanus.

Q29. Aldosterone is synthesized exclusively in zona glomerulosa due to the presence of enzyme in addition to a dehydrogenase.

(a) 11 β-hydroxylase

(b) 17 α-hydroxylase

(c) 18-hydroxylase

(d) 21-hydroxylase

Q30. Column X represents the type of junctions and column Y represents the proteins associated with the junctions.

Column X	**Column Y**
A. Anchoring junction	i. Claudins
B. Occluding junction	ii. Delta-Notch
C. Channel-forming junction	iii. Desmoglein
D. Signal-relaying junction	iv. Connexin

Which one of the following options is a correct match between terms of Columns X and Y?

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

(b) A-iv, B-i, C-iv, D-Hi

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

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

Q31. Sometimes similar traits or characteristics evolve in two distinct lineages independently, such as venoms in scorpions and snakes. This process can be described as:

(a) Convergent evolution

(b) Microevolution

(c) Macroevolution

(d) Divergent evolution

Q32. How much hemoglobin is present approximately in each normal human red blood cell?

(a) 19 pg (b) 29 pg

(c) 39 pg (d) 49 pg

Q33. Fifteen spontaneous Ara- mutants of E.coli that were not able to utilize arabinose as a sole carbon source ln minimal synthetic medium at 42°C were isolated. However, interestingly all these mutants were able to use arabinose as the sole carbon source at 30°C. Based on the above information, which one of the following options represents the most likely type of the mutations?

(a) Deletions

(b) Inversions

(c) Frameshift mutations

(d) Missense mutations

Q34. Which one of the following statements is NOT correct about collenchyma?

(a) Collenchyma cell walls are thick and they require more glucose for their production.

(b) Collenchyma cells are rigid.

(c) Collenchyma is usually produced in shoot tips and young petioles.

(d) Collenchyma is generally not present in subterranean shoots and roots.

Q35. Which one of the following is NOT required in the blood glucose biosensor?

(a) Glucose oxidase as biologically active component

(b) Electrode as electrochemical transducer

(c) Piezoelectric crystal as sensor

(d) FAD as coenzyme of glucose oxidase

Q36. Which one of the following enzymes does NOT catalyze the oxidation of substrate by reducing the electron acceptor, NAD^+?

(a) Lactate dehydrogenase

(b) Pyruvate dehydrogenase

(c) Succinate dehydrogenase

(d) lsocitrate dehydrogenase

Q37. Which one of the following correctly shows the total estimated biomass of the lifeforms on Earth given here, in increasing order?

(a) Bacteria < Viruses < Fungi

(b) Bacteria < Fungi < Viruses

(c) Viruses < Fungi< Bacteria

(d) Fungi < Viruses < Bacteria

Q38. Which cell cycle phase is typically the shortest in mammalian cells?

(a) G0 phase (b) G1 phase

(c) G2 phase (d) Mitosis

Q39. RNA polymerase is an enzyme that transcribes DNA sequences into RNA. Which one of the following is NOT a property of the RNA polymerase?

(a) RNA polymerases initiate RNA synthesis without primers that provide a free 3'OH group

(b) RNA polymerases have high fidelity due to the action of proof-reading endonuclease activity

(c) In eukaryotes, RNA that encodes ribosomal proteins is transcribed by RNA polymerase II

(d) RNA polymerases initiate RNA synthesis from defined regions of DNA

Q40. Which one of the following is ref erred to as tuberonic acid?

(a) Methyl jasmonate

(b) cis-jasmone

(c) Jasmonoyl-1-β-glucose

(d) 12-Hydroxy-(+)-7-isojasmonate

Q41. Porins, which are normally present on the outer mitochondrial membrane, reach their destination by

(a) direct synthesis of porins on mitochondria membrane by the mitochondrial protein synthesis machinery.

(b) synthesis on the ER and transport via vesicles to the mitochondria.

(c) synthesis in the cytosol, import by TOM complex and insertion from the inter-mitochondrial membrane space.

(d) synthesis in the cytosol, import by TIM complex and insertion in the membrane.

Q42. In a family, the father has an X-linked mutation causing a late-onset lethal disorder and the mother is not a carrier. Based on the above information, which one of the following statements about the children the couple may have is correct?

(a) There is a 50% chance that the son will show the disorder.

(b) No children will show the disorder.

(c) The probability that the parents have a daughter carrying a mutant allele is 25%.

(d) All daughters will carry the mutant allele.

Q43. Sperm_____, which helps in penetration of the egg during fertilization in mammals, contains_____.

(a) lysin, hyaluronidase

(b) fertilizin, hyaluronidase

(c) lysin, hyaluronic acid

(d) fertilizin, hyaluronic acid

Q44. The pH of endocytic vesicles is 5.2, and the pH of gastric juice is 2.0. The endocytic vesicle has a $[H^+]$ that is

(a) 15.85 times lower than that of gastric juice.

(b) 0.1585 times lower than that of gastric juice.

(c) 158.5 times lower than that of gastric juice.

(d) 1585 times lower than that of gastric juice.

Q45. P-bodies are discrete cytoplasmic collections of RNAs and proteins that are involved in:

(a) Deadenylation, decapping and mRNA degradation

(b) Deadenylation and mRNA degradation only

(c) Deadenylation and decapping only

(d) Decapping and mRNA degradation only

Q46. Which one of the following hormones has no supply store

(a) Catecholamines (b) Insulin

(c) T_3 and T_4 (d) Steroids

Q47. In the production of alcohol by fermentation, in the absence of oxygen, yeasts convert glucose to pyruvate and pyruvate to ethanol. Fermentation promotes glycolysis by

(a) Converting acetaldehyde to alcohol to prevent feed-back inhibition

(b) Generating NAOH for mitochondrial ATP generation

(c) Preventing toxicity of acetaldehyde

(d) Generating NAD^+ for glycolysis

Q48. Which one of the following is involved in the pinching-off of the neck of invaginating coated pit to form endocytotic vesicle at the pre-synaptic terminal?

(a) Synaptojanin (b) AP2

(c) Clathrin (d) Dynamin

Q49. Which one of the following functions is NOT facilitated by a tmRNA?

(a) Addition of a stop codon at the 3' end of a defective and/or truncated mRNA.

(b) Addition of a proteolysis-inducing tag at carboxyl terminus of unfinished polypeptide.

(c) Release of defective and/or truncated mRNA from the ribosome.

(d) Recycling of the stalled ribosomes.

Q50. Which one of the following terms describes the biological classification system based on common ancestry?

(a) Linnean taxonomy

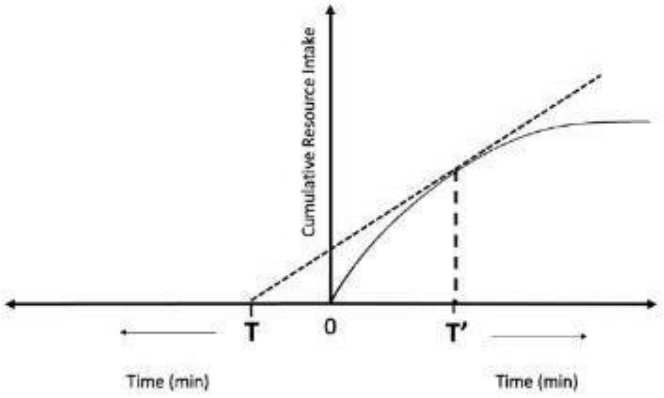
(b) Binomial nomenclature

(c) Phylogenetic classification

(d) Rank based classification

PART - C

Q1. The graph given below is based on the optimal foraging theory. If the Y axis represents "Cumulative Resource Intake" following the law of diminishing returns, what do T and T' stand for?



(a) T: Patch residence time, T': Travel time to reach patch

(b) T: Search time to find prey T': Handling time for a prey

(c) T: Travel time to reach patch, T': Patch residence time

(d) T: Handling time for a prey, T': Search time to find prey

Q2. The table below represents some protein modifications in Column X and their functions in Column Y.

Column X	**Column Y**
Protein modification	Function
a. Palmitoylation	i. Protein degradation
b. polySUMOylation	ii. Membrane anchoring
c. Glycosylphosphatidylinositol	iii. Lysosomal targeting
d. Mannose-6-phosphate	iv. Protein folding

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

(a) a-ii, b-i, c-iv, d-iii

(b) a-i, b-iv, c-ii, d-iii

(c) a-ii, b-i, c-ii, d-iii

(d) a-iv, b-iv, c-ii, d-i

Q3. The statements below attempt to describe a few characteristics of Alu repeats found in the human genome

A. Alu elements are a class of short interspersed elements (SINEs).

B. SINEs are autonomous transposons.

C. Alu repeat originated from cDNA copies of 7SL RNA.

D. Alu repeats have a relatively high AT content.

E. They are preferentially located in the gene-poor G chromosome bands.

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

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

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

Q4. Following are marker enzymes that would be used to identify correct subcellular fractions.

Column X	**Column Y**
ENZYME	FRACTION
A. Lactate dehydrogenase	i. Lysosomes
B. Acid phosphatase	ii. Microsomes
C. Glucose-6-phosphatase	iii. Cytosol
D Catalase	iv. Peroxisomes

Which one of the following options correctly pairs the enzymes With the subcellular fractions?

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

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

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

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

Q5. The table below lists phylogenetic reconstruction methods and the description of these methods, which includes both algorithmic and optimality-based methods or criteria.

Method (Column X)

A. Maximum parsimony

B. Minimum evolution

C. Bayesian

D. Neighbour Joining

Description (Column Y)

i. Tree length, that is sum of branch lengths, often estimated by least squares.

ii. Minimum number of changes, minimized over ancestral states

iii. Cluster algorithms to arrive at a single tree.

iv. Posterior probability, calculated by integrating it over branch lengths and substitution parameters

Select the option that best matches the tree reconstruction method (Column X) with its correct description in Column Y.

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

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

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

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

Q6. The cAMP-PKA-GREB pathway regulates many important biological processes, from hormone synthesis to inducing long-term memory ln the brain. The following

statements describe the effects of mutations in the components of the pathway on gene transcription by GREB.

A. Loss of function mutation in a cAMP binding site of the PKA regulatory subunit leads to the inactivation of gene expression.

B. Activating mutation in the GTP-binding domain of the a subunit of Gs leads to the activation of gene expression.

C. Inactivating mutation that prevents the regulatory subunit of PKA to bind the catalytic subunit leads to the activation of gene expression.

D. Inactivating mutation in the PKA phosphorylatlon site of GREB leads to the activation of gene expression.

Which one of the following statements is INCORRECT?

(a) Only A (b) A and D

(c) Only D (d) B and D

Q7. Which one of the following Newick trees represents the correct relationship between apes?

(a) ((((Orangutan, Gibbons), Gorillas), Chimpanzees), Humans)

(b) ((((Humans, Chimpanzees), Gorillas), Orangutan), Gibbons)

(c) (((Humans, Gorillas), Chimpanzees), Gibbons), Orangutan)

(d) ((((Humans, Chimpanzees), Gibbons), Orangutan), Gorillas)

Q8. Given below are statements about the Kallmann syndrome.

A. It is a condition of hypogonadotropic hypogonadism.

B. There is a loss of sense of smell in such individuals.

C. This syndrome is most common in women.

D. It happens due to mutation of the KALIG1 gene on X-chromosome that codes for an adhesion molecule necessary for the normal development of the gustatory nerve.

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

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

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

Q9. Mechanism of primary sex determination is best known in Drosophila and mammals. Given below are statements in regard of sex determination ln these two model systems.

A. In Drosophila, if sry gene product is present, it may block beta-catenin signaling and along with SF1, activate the sox9 gene.

B. In mammals, an alternate splicing of Sxl transcript that removes a stop codon and allows formation of a functional protein, is responsible for initiating the female sex determination.

C. A trans-splicing event in Tra transcript results in formation of functional Tra protein in Drosophila.

D. XO individuals in Drosophila are males while, XXY individuals are females.

Which of the above statements are correct?

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

(c) C and D (d) B only

Q10. Given below are species concepts (Column X) and their descriptions (Column Y):

Column X		Column Y	
A.	Typological species concept	i.	Single lineage of ancestor-descendant populations which maintains its identity from other such lineages
B.	Biological species concept	ii.	A species is a set of organisms that resemble one another and is distinct from other sets
C.	Evolutionary species concept	iii.	Species are groups of tnterbreeding natural populations that are reproductively isolated from other such groups
D.	Phylogenetic species concept	iv.	A group recognised by its monophyly

Which one of the following options represents all the correct matches?

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

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

(c) A-iii, B-ii, C-i, D-iv 4.

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

Q11. Selected human diseases and their vectors are listed below:

Column X Disease	Column Y Vector
A. Chikungunya	i. Aedes mosquito
B. Lyme disease	ii. Anopheles mosquito
C. Lymphatic filariasis	iii. Aquatic snails
D. Schistosomiasis	iv. Ticks

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

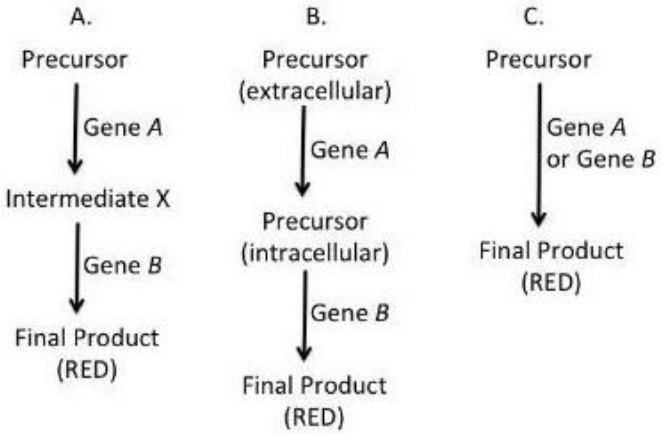
(a) A-ii, B-iii, C-iv, D-i

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

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

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

Q12. Epistasis is observed between different genes in flower color of sweet pea. A red variety on selfing yields red:white in ratio 9:7. The precursors and intermediates give white color. The following biochemical pathways were proposed for the above observations:



Which one of the options represents the correct pathway(s) that explains the observations?

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

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

Q13. The following table lists habitat type (Column X) and geographic regions (Column Y) where they can be found:

Column X	**Column Y**
Type of habitat	**Geographic region**
A. Mangroves	i. Western Ghats
B Terai	ii. Banni
C. Laterite plateaus	iii. Sunderbans
D. And grasslands	iv. Himalayan foothills
E. Shola	

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

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

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

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

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

Q14. In Bayesian statistics, A and A' correspond to different hypotheses, H1 and H2, and D corresponds to the observed data (X).

An equation for hypothesis H1 can be given as $P(H1 \mid D) = \frac{P(H1) \times P(X \mid H1)}{P(X)}$

Given below are statements related to the above equation:

A. The equation represents the conditional probability of hypothesis H1, given the data.

B. The equation represents the probability of the data, given the hypothesis.

C. P(X |H1) is called a prior probability, which is assigned to the hypothesis before the data is observed or analysed.

D. P(X | H 1) represents the likelihood under the hypothesis H1.

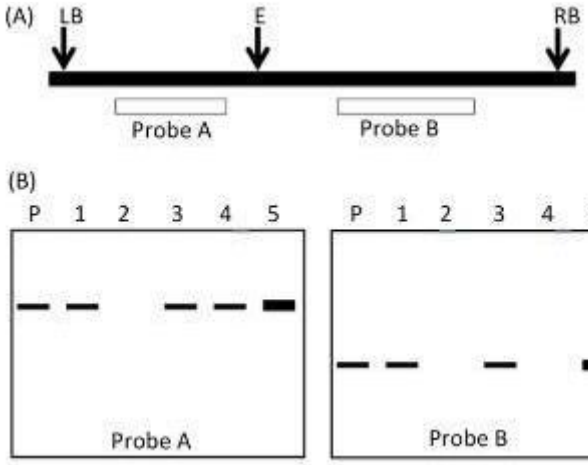
Select the option that represents an correct statements with respect to the equation above.

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

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

Q15. A transgenic line was developed in mustard. The T_0 transgenic line was selfed and the insertion of transgene was analyzed ln the parental (P) and progeny lines (1 to 5). The T-DNA reg ion (between left (LB) and right (RB) borders) used for transformation is outlined in Figure A. The pattern following Southern hybridization using probes A and B is represented in Figure B. Genomic DNA was digested with EcoRI (E). The thickness of band indicates the intensity of hybridization.

The following statements were made based on the above observation:



A. The developed transgenic line has a single copy of T-DNA.

B. The absence of band in progeny 4 is due to incomplete transfer of the T-DNA during transformation .

C. Progeny 2 is homozygous at the site of insertion.

D. All selfed progeny of line 5 is expected to show hybridization with both probes A and B.

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

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

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

Q16. Researcher plans to study protein trafficking into the endoplasmic reticulum (ER). For this purpose, they plan different experimental conditions shown below:

A. The cytosol is mixed with mRNA that codes for a secreted protein, followed by western blotting with antibodies against secreted protein.

B. The cytosol is mixed with mRNA that codes for a secreted protein and rough microsomes, followed by western blotting with antibodies against secreted protein.

C. The cytosol is mixed with mRNA that codes for a secreted protein and rough microsomes followed by protease treatment. Subsequently, western blotting with antibodies against secreted protein is done.

Consider that mRNA that codes for a secreted protein is added in abundant amount, which experimental control/s would be the best to confirm the polypeptide entry into the ER?

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

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

Q17. In birds and mammals, 3rd, 4th and 6th aortic arches persist in adult animals with some structural modifications. Which of the following modified organization is correct?

(a) In birds, 4th aortic arch forms systemic aorta on the left.

(b) In mammals,. 5th aortic arch forms pulmonary aorta.

(c) In birds, 3rd aortic arch forms systemic aorta.

(d) In mammals, 3rd aortic arch forms systemic aorta.

Q18. Iron (Fe) is taken up by cells via receptor-mediated endocytosis utilizing transferrin and transferrin receptor. In a cell fine with a mutation in the transferrin receptor that is unable to interact with transferrin at pH (4-6), which one of the following steps will be first affected in this pathway?

(a) Binding of transferrin to iron in plasma.

(b) Association of iron bound transferrin with transferrin receptor on the plasma membrane.

(c) Release of iron in the endosomes.

(d) Recycling of transferrin to the plasma membrane.

Q19. The following statements describe the developmental processes during different modes of reproduction in angiosperms:

A. In double fertilization, one sperm fuses with the egg and other with the central cell to form the zygote and endosperm, respectively.

B. In sporophytic apomixis, a diploid cell gives rise to the next generation thereby maintaining the maternal genotype.

C. In gametophytic apomixis, a reduced egg cell forms apomictic embryo through parthenogenesis.

D. In pseudogamy, the functional endosperm is formed without fertilization.

Which one of the following represents the combinations of CORRECT statements?

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

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

Q20. Figure A represents the sites for Ncol (N) in a binary vector pCSIR2023. The vector is 16500 bp in size. Figure B represents the fragments observed when the vector is either digested with Ncol (IN) or double digested with Hindlll and Ncol (H+N). The intensity of fluorescence of the 453 bp fragment is double that of the 516 bp fragment.

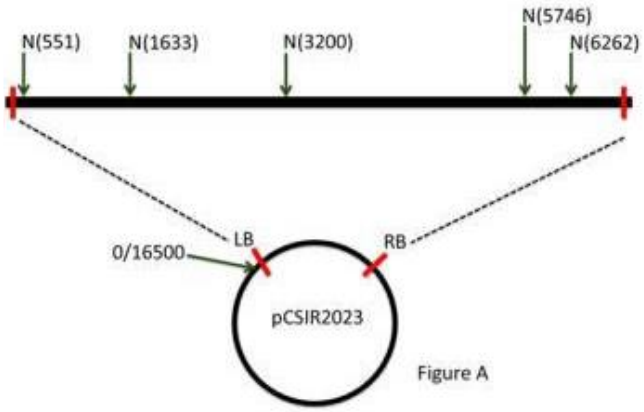


Figure A

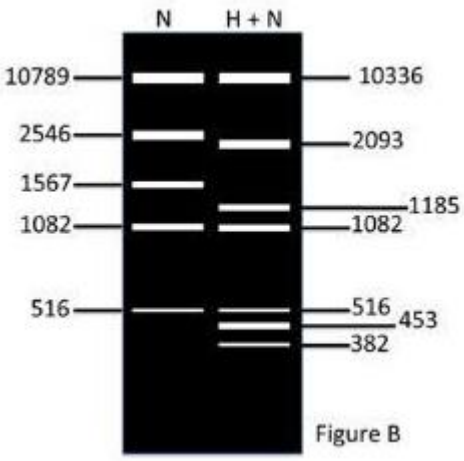


Figure B

Which one of the following statements regarding the numbers and location(s) of Hindlll site is correct?

(a) There are two sites of Hindlll, one of which is located in the ~ 11 Kb fragment generated by Ncol digestion.

(b) There are three sites of Hindlll, one of which is located in the ~ 1.6Kb fragment generated by Ncol digestion.

(c) There are three sites of Hindlll, one of which is definitely at 2015 position.

(d) There are four sites of HindIll, one of which is at 2015 position.

Q21. Which one of the following statements about change in temperature with elevation is correct?

(a) Adiabatic cooling of air due to in creasing elevation leads to a drop of temperature by ~ 10°c for every 1,000 min elevation, irrespective of water vapor or cloud formation.

(b) Adiabatic cooling of air due to increasing elevation leads to a drop of temperature by ~ 10°C for every 1,000 m in elevation, as long as no water vapor or cloud formation occurs.

(c) A vertical ascent of 1km from the Earth surface produces a temperature change roughly equivalent to that brought about by an increase in latitude of 1,000 km.

(d) A vertical ascent of 600 m from the Earth surface produces a temperature change roughly equivalent to that brought about by an increase in latitude of 100 km.

Q22. In C. elegans, PAR proteins segregate at the cell cortex in the zygote to establish cell polarity. This is dependent on the regulation of the cortical actin cytoskeleton by RhoA. An investigator sought to directly inhibit actin polymerization to analyze the impact of this inhibition on PAR protein localization. Which one of the following chemicals would be the most suitable?

(a) Taxol (b) Colchicine

(c) Latrunculin (d) LY294002

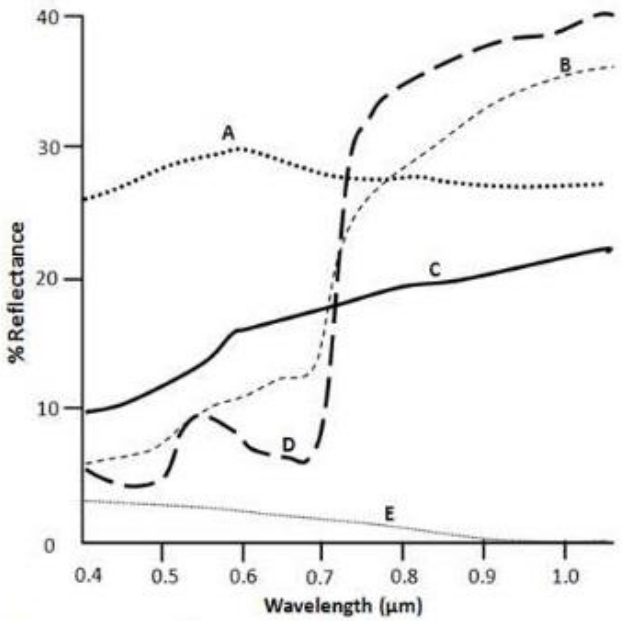
Q23. What is the V_0/V_{max} ratio for an enzymatic reaction when [S] = 3 Km and 9 Km, respectively?

(a) 0.65 and 0.83 (b) 0.55 and 1.0

(c) 0.93 and 1.2 (d) 0.75 and 0.9

Q24. The figure below depicts the reflectance curves of different features found in an urban ecosystem.

Which one of the options below correctly identifies the reflectance curves?



(a) A- Concrete road; B - Dry grass lawn; C - Asphalt road ; E - waterbody

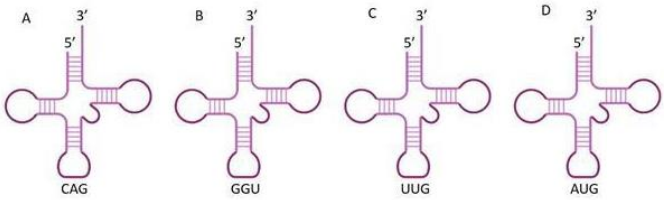
(b) A - Waterbody; B - live grass lawn; C - Dry grass; E - Asphalt road

(c) A - Asphalt road;. B - Dry grass lawn; C - Waterbody; D - live grass lawn

(d) B - Asphalt road; C - Concrete Road; D - Live grass lawn; E - Concrete road

Q25. A portion of an mRNA encoding a protein is shown below, with the start codon underlined. 5'... CCUCAAACAGACACCAUGUUGCACC UGACUCCU ... 3'

Which one of the following tRNAs is most likely used for translating the second codon in the open reading frame of the protein?



(a) A (B) B

(c) C (d) D

Q26. The amino acid sequence of tetrapeptides (P, Q, R) is shown below.

P) Asp-Gly-Asp-Ser

Q) Gly-Ser-Arg-Gly

R) Gly-Lys-Arg-Ala

i. Calculate the net charge on the above tetrapeptides at pH 7.0

ii. If the mixture of the above tetrapeptides is separated on a cation-exchange column at pH 7.0, which tetrapeptide will elute last? Choose the correct answer given below.

(a) i)P,-2;Q, +1 ;R, +2 and ii) R

(b) i) P, -3; Q, +2 ; R, +3 and ii) Q

(c) i) P, -1 ; Q, +1 ; R, +1 and ii) p

(d) i) P, -1 ; Q, +O ; R, +1 and ii) R

Q27. Unknown antigens can be detected or measured by a sandwich ELISA whereas Elispot assays measure the number of cells capable of secreting particular molecules such as cytokines which is considered as antigens. Which of the following is true for both assays?

(a) Reaction products in both the assays are soluble.

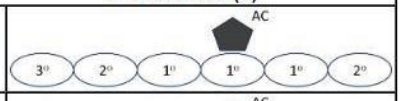
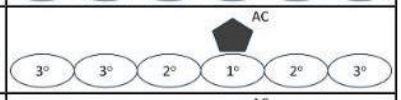
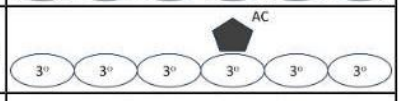
(b) Reaction products in both the assays are insoluble.

(c) Reaction products in sandwich ELISA are insoluble whereas those in Elispot assays are soluble.

(d) Reaction products in sandwich ELISA are soluble whereas those in Elispot assays are insoluble.

Q28. By expressing the EGF-like ligand LIN-3, the C. elegans anchor cell (AC) directly triggers vulval development. LIN-3 acts at a distance and has a graded action. The levels of LIN-3 can be controlled by using various genetic techniques.

Which one of the following options is a correct match between column I and column II?

Strain/condition (I)		VPC cell fate (II)	
A.	Wild type worms grown on empty vector RNAi	I.	
B.	*lin*-3 mutant with a stop codon in exon 3	II.	
C.	Wild type worms grown on *lin*-3 RNAi	III.	
D.	Wild type worms expressing a multi-copy extrachromosomal array of *lin*-3 gene	IV.	

(a) a-ii, b-iii, c-iv, d-i

(b) a-ii, b-iv, c-i, d-iii

(c) a-iv b-i1 c-ii, d-iii

(d) a-iii, b-iv, c-i, d-ii

Q29. The following proposed statements describe some aspects of thermoregulation.

A. The basal metabolic rate is rapidly adjusted in the thermoneutral zone to maintain temperature homeostasis.

B. The homeotherms who have the ability to hibernate ,. do not maintain normal physiological temperature range during hibernation.

C. The thermoregulation is not regulated by hypothalamus.

D. Warm-blooded animals require more food compared to cold-blooded animals of the same size and weight.

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

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

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

Q30. The central rod domain of keratin protein is 300 amino acids in length. What is the approximate length (in A) of the rod domain if the peptide consists of

i) distorted α-helix

ii) true α-helix

iii) anti-parallel β-sheet

(a) (i) 425 Å; (ii) 450 Å; (iii) 1041 Å

(b) (i) 450 Å ; (ii) 450 Å ; (iii) 840 Å

(c) (i) 425 Å ; (ii) 425 Å ; (iii) 1004 Å

(d) (i) 340 Å; (ii) 425 Å ; (iii) 104 Å

Q31. Certain statements are put forth on the regulation of renal blood flow and are given below.

A. Norepinephrine dilates the renal vessels.

B. Dopamine causes renal vasodilation and natriuresis.

C. Angiotensin II exerts a constrictor effect.

D. Prostaglandins decrease blood flow in the renal cortex and increase it in the medulla.

E. Acetylcholine produces renal vasodilation.

Choose the option with the combination of all correct statements.

(a) A, B and D

(b) B, C and D

(c) B, C and E

(d) A, C and E

Q32. In a mammalian cell undergoing active glycolysis, what would be the effect of a sudden increase in the concentration of metabolites, AMP, citrate, ATP, and glucose-6-phosphate?

A. Increased ATP inhibits glycolysis.

B. Increased AMP stimulates glycolysis.

C. Increased citrate and glucose-6-phosphate stimulate glycolysis.

D. Increased AMP and citrate inhibits glycolysis.

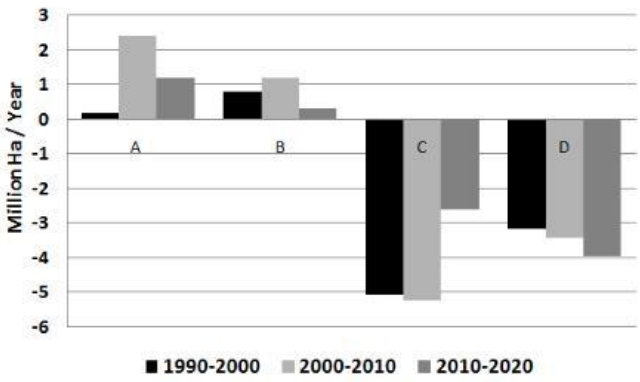
Which one of the following represents the combination of all correct statements?

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

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

Q33. The graph below depicts the net change in forest cover in four regions (AD) between 1990 and 2020, according to the FAO report - The State of World's Forests 2020.

Which one of the following options correctly identifies these regions?



(a) A - Asia, B - North and Central America, C - South America , D - Europe

(b) A- North and Central America, B -Africa , C - Asia, D - South America

(c) A - Asia, B - Europe, C - South America , D - Africa

(d) A - Europe, B - South America, C -Asia, D -Africa

Q34. In yeast, temperature-sensitive mutants of cell cycle regulators, cdc2 (the key cyclin-dependent kinase), cdc13 (required for telomeric DNA replication), and cdc13 rad9 (that carries an additional mutation in the DNA damage sensor) were isolated. When grown in non-permissive temperature for a few hours, different phenotypes were observed in these mutants. Choose the option that correctly describes the most likely phenotype for all of these mutants.

(a) The cdc2 mutants will arrest in G1/S, cdc13 in M and cdc13 rad9 in S-phase.

(b) The cdc2 mutants will arrest after a few divisions in G1 , cdc13 in M and cdc13 rad9 in S-phase.

(c) The cdc2 mutants will arrest in G1/S, G2 and M, cdc13 in G2 and cdc13 rad9 will continue to divide for a few generations.

(d) The cdc2 mutants will arrest in G1/S, G2 and M, cdc13 in G1 and M and cdc13 rad9 in all phases of the cell cycle.

Q35. Given below are the list of plant hormones (Column X) and their biosynthesis precursors (Column Y).

Column X	**Column Y**
A. Auxins	(i) Geranylgeranyl diphosphate
B. Cytokimns	ii. Adenosine moiety
C. Ethylene	iii. Tryptophan
D. Gibberellins	IV. 1-aminocyclopropane 1-carboxylic acid

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

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

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

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

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

Q36. The sensory nerve fibers (Column X) and the sensory receptors connected to different sensory nerves (Column Y) are given below.

Column X **Sensory nerve fibre**	**Column Y** **Sensory receptor**
A. Ia	i. Muscle spindle, flower spray ending
B. lb	ii. Pain and cold receptor
C. II	iii. Muscle spindle, annulo-spiral ending
D. III	iv. Golgi tendon organ

Which 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- ii, B- iii, C- iv D-i

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

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

Q37. The structure and process of formation of different antigens in blood ABO system are given in the following statements:

A. Galactose is added to the terminal of H-antigen by a transferase expressed in individuals with type A blood.

B. The B antigen is formed by a transferase expressed in individuals with type B blood which adds a terminal N-acetylgalactosamine to H-antigen.

C. The H-antigen is formed by fucose transferase that adds a terminal fucose to its precursor.

D. The H-antigen is the precursor of both the A- and B- antigens and it is the blood group antigen ln persons of type O blood.

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

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

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

Q38. Extracellular matrix comprises of various proteins and polysaccharides that assemble into an organized meshwork. This associates with the cells that produce them. Given below are a few statements regarding different components of the matrix ..

A. Collagen is the major protein of the extracellular matrix and is a long, and triple-stranded helical structure.

B. Hyaluronan which is produced in large quantities during wound healing is a type of glycosaminoglycan (GAG) that contains sulfated sugar and is covalently linked to the core protein.

C. Syndecans are plasma membrane proteoglycans that interact with the actin cytoskeleton and signaling molecules of the cell cortex.

D. Decorin is a small proteoglycan secreted by fibroblasts and contains 1-10 GAG chains.

Which one of the following options represents INCORRECT statements?

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

(c) A and B (d) B only

Q39. Consider a highly diverse community of Closely related species of lizards which has evolved in a short period of time and that occupies different ecological niches in peninsular India. What type of speciation process can explain the above pattern?

(a) Non-ecological speciation

(b) Adaptive radiation

(c) Allopatric speciation

(d) Parapatric speciation

Q40. Bacteria employ various mechanisms to invade or enter host cells, which are either phagocytic or non-phagocytic on nature. Given below are some of the mechanisms which are generally used for carrying out this process.

A. Some bacteria express a protein called invasin that is recognized by host-cell (31 integrins.

B. Actin polymerization along with assembly of clathrin coat results in the internalization of bacteria by Zipper mechanism.

C. Some bacteria, including Salmonella enterica, use trigger mechanism to inject a set of effector molecules in the cytosol through type Ill secretion system.

D. Some bacteria attach to host cell surface receptors inducing local elevation of Ca^{2+} in cell cytosol, leading to the fusion of lysosomes with bacteria containing plasma membrane vesicles.

Which one of the following represents the combination of correct mechanisms for invading non-phagocytic cells?

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

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

Q41. Phosphorus is an important essential element for living organisms. Given below are a few fluxes of the global phosphorus cycle.

A. Internal cycling in terrestrial ecosystems

B. Internal cycling in marine ecosystems

C. Terrestrial runoff into oceans

D. Natural chemical weathering in terrestrial ecosystems

Select the correct option that arranges the fluxes in an increasing order of magnitude.

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

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

Q42. Several extracellular mechanisms lead to intracellular changes to regulate stem cell behavior during development. Based on this, Which one of the following statements is NOT true?

(a) Structural and adhesion factors in the extracellular matrix support cellular architecture of the stem cell niche.

(b) Different patterns of chromatin accessibility influence gene expression related to stem cell behavior.

(c) Partitioning of cytoplasmic determinants distributes factors determining cell fate evenly into daughter cells during asymmetric division.

(d) Secreted proteins from surrounding cell is by autocrine, paracrine or juxtacrine mechanisms often maintain stem cells in an uncommitted state .

Q43. In a study comparing different plant communities (A to D) across a landscape, the following data were obtained

Community	A	B	C	D
No. of species in the community	12	25	11	19
No. of species common to both communities				
Community	A	B	C	D
A		9	8	10
B			6	14
C				7
D				

Which one of the following options represents the pair of communities with highest similarity value when Sorensons coefficient is used?

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

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

Q44. Match the names of scientists (column X) with the ecosystem concepts (column Y) they are known for:

column X		column Y	
A.	Charles Elton	i.	trophic dynamics
B.	A G Tansley	ii.	the term ecosystem
C.	A J Lotka	iii.	pyramid structure of feeding relationships in ecosystems
D.	Raymond Lindeman	iv.	a thermodynamic view of the ecosystem

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

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

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

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

Q45. A researcher had inoculated the bottom leaves of a wild-type tobacco plant with tobacco ringspot virus (TRSV) and made the following statements regarding the disease after 23 days post-1noculation.

A. Strong ringspot symptoms develop on the lower leaves.

B. The ringspot symptoms are higher on the upper leaves.

C. The top leaves have no viral symptoms

D. The top leaves are immune to secondary infection by the same virus.

Choose the option with all correct statements:

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

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

Q46. Defending a territory is energetically expensive and animals should invest in this only if it is profitable. A sunbird species ls dependent on a plant species that contains nectar-rich flowers, making it an important resource for the sunbird .. Males may defend territories containing these plants against other males, while allowing females to access the flowers. In this way they keep competitors out and get access to the females.

The columns below (P to S) represent characteristics of the resources and their variants (i and ii).

From the given options, choose the combination of plant characteristics that makes defending a territory most profitable for males.

Column P	Column Q	Column R	Column S
Abundance of flowers in the habitat	Distribution of flowers in the habitat	Nectar depletion rate of flowers	Nectar renewal rate of flowers
i. High	i. Uniform	i. High	i. High
ii. low	ii. Patchy	ii. Low	ii. Low

(a) P - i, Q-i, R-ii, S-i (b) P-i, Q-ii, R-ii, S-i

(c) P-ii, Q-i, R-i, S-ii (d) P-ii, Q-ii, R-i, S-ii

Q47. Based on theoretical concepts of mating systems in plants, pollen : ovule ratios are likely to be most skewed in which one of the following cases?

(a) Entomophilous dioecious species

(b) Entomophilous bisexual species

(c) Anemophilous bisexual species

(d) Anemophilous dioecious species

Q48. Given below are statements related to different types of natural selection models.

A. Directional selection changes the average value of a trait.

B. Stabilizing selection increases variation in a trait.

C. Disruptive selection reduces variation in a trait.

D. Balancing selection maintains variation in a trait.

Select the correct option that represents the combinations of statements that are NOT true about natural selection.

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

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

Q49. Given below are few statements regarding the light absorption by chlorophyll pigment in a green leaf.

A. The absorption of a photon by a pigment molecule converts it from its lower state to an excited state.

B. Internal conversions or relaxations of pigments convert higher excited states to the lowest excited state, with a concomitant loss of energy as heat.

C. The light reemitted from the lowest excited state of chlorophyll molecule is fluorescence.

D. Red light absorption by chlorophyll molecule results into higher excitation state relative to the blue light absorption.

Which one of the following combinations is correct?

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

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

Q50. Following statements were made about mRNA splicing:

A. Involvement of a cis-acting branchpoint site present near 3' end of each exon is essential for splicing.

B. In the first step of splicing reaction, 2'-OH of the conserved U at the branch-site acts as a nucleophile to attack the phosphoryl group of the conserved G in the 5' splice site.

C. The newly liberated intron adapts shape of a lariat due to joining of the 5' end of the intron to the branchpoint.

D. During the splicing process , there is no net gain in the number of chemical bonds.

E. Prp22 (a DEAD-box helicase) is required for stripping the spliced mRNA from the spliceosome.

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

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

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

Q51. Given below are statements about development in different model organisms.

A. Xenopus egg has yolk and hence undergoes meroblastic cleavage.

B. Embryonically transcribed beta-catenin in the blastomeres of sea urchin embryos regulates the autonomous specification of micromeres.

C. The sodium pump activity in the trophoblast helps in the formation of blastocoel of a mammalian blastocyst.

D. Prevention of tubal pregnancy is one of the major functions of zona pellucida in humans.

Which combination of the statements is true?

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

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

Q52. The characteristic features and causes of different heart sounds during a cardiac cycle of humans are given ln the following statements.

A. The second heart sound is loud and sharp when the diastolic pressure is decreased in the aorta or pulmonary artery.

B. Sudden closure of atrioventricular (AV) valves at the start of ventricular systole caused vibration that produces first heart sound.

C. The second heart sound is caused by the vibration associated with the closure of aortic and pulmonary valves after the end of ventricular systole.

D. The first heart sound is soft when heart rate is low as the ventricles are well filled with blood and the leaflets of AV valves float together before systole.

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

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

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

Q53. A new strain of bacteria was created by introducing an artificial operon, to allow bacterial cells to grow in the presence of iron. The Fe++ operon consisted of genes that made the cells capable of tolerating increased iron. For efficient functioning of this operon, the following desirable features were considered.

Which one of the following can be used to develop this operon?

(a) A repressor protein, which is active when bound to Fe++

(b) An activator protein, which is active when not bound to Fe++

(c) A repressor protein, which is inactive when bound to Fe++

(d) A repressor protein, which is active constitutively

Q54. Synchronous cultures of MCF7 breast cancer cells were grown and treated with the following:

(i) buffer (plate was named MCF7),

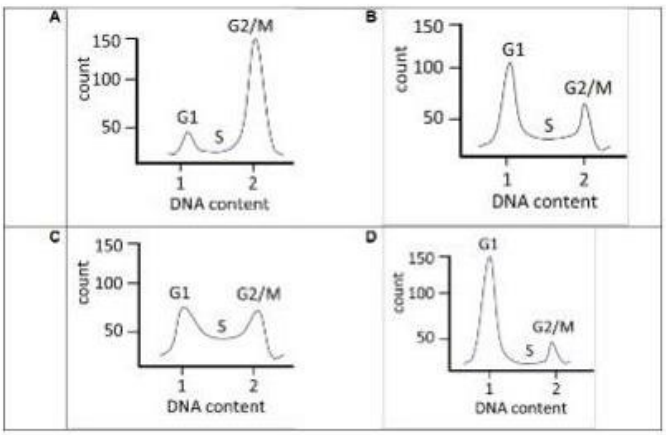
(ii) an inhibitor of Cyclin D (plate was named MCF7.1), and

(iii) siRNA designed against Cyclin B1 (plate was named MCF7.

Following this, the cells were stained and sorted using flow cytometry.

The relative amount of DNA in each of the three phases of the cell cycle (G1, S, G2/M in arbitrary units) were plotted against the number of cells, as shown below.

Which one of the following options correctly represents all the cell cycle states of MCF7, MCF7.1 and MCF7.2?



(a) MCF7-C; MCF7.1-D; MCF7.2-A

(b) MCF7-C; MCF7.1 -A; MCF7. 2-D

(c) MCF7-B ; MCF7.1-D ; MCF7.2-A

(d) MCF7-B; MCF7.1-A; MCF7.2-D

Q55. Which one of the following nucleic acids with same concentrations in water, will form a stable stem-loop structure upon annealing by heating and flash cooling on ice?

(a) 5'- GGCUUAUUUUCUUCGG -3'

(b) 5'- CCGAACUUUUAUUCGG -3'

(c) 5' - AUGCCAUUUUCGGCUU -3'

(d) 5' - AGAGCGUUUUAUUCGG -3'

Q56. The following statements pertain to limb development in chick. Each statement describes an experiment and the expected outcome.

A. Targeted loss of retinoic acid synthesis in the forelimb causes a reduction of Tbx4 expression and the failure to form forelimbs.

B. When Fgf10 secreting beads are placed at a somite level that induced limb bud expressing Tbx5 in the anterior and Tbx4 in the posterior part, a chimeric limb can be formed.

C. Constitutive activation of FGF receptors results in the loss of forelimb field, demonstrating that expression of Fgf8 functions to inhibit forelimb development.

Which one of the following option (s) is/are correct?

(a) A only (b) B only

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

Q57. Apoptosis refers to programmed cell death that is triggered by specialized intracellular proteases called caspases. The intrinsic pathway of apoptosis

A. depends on the activation of Fas domain by the Fas ligand, which activates the DISC.

B. is regulated by the Bcl2 family of proteins.

C. consists of a key regulatory protein Apaf1 which is a water-soluble component of the electron transport chain.

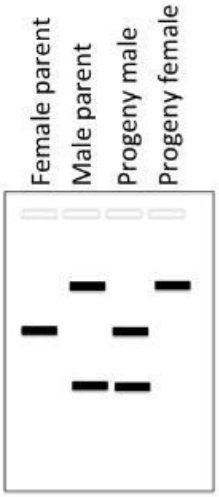
D. recruits procaspase 9 into the apoptosome, and once activated, caspase 9 cleaves and activates downstream executioner caspases.

Which of the following combinations represents all correct statements?

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

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

Q58. The following represents a Southern hybridization of restricted genomic DNA, probed with a DNA fragment corresponding to gene 'Z'. 'Z' is a single copy gene.



The hybridization patterns of parents and their progeny have been presented. Which one of the following options is a correct interpretation of the observation?

(a) Gene 'Z' is present on an autosome.

(b) Gene 'Z' is an example of X- linked gene.

(c) In this organism the female is the heterogametic sex.

(d) Polymorphism of this gene has been studied by RAPD.

Q59. Following statements were made about rolling circle mechanism of replication.

A. It occurs unidirectionally, with only one replicating fork.

B. The E. coli ϕX174 phage uses this mechanism to replicate double stranded circular genome.

C. E. coli utilizes this mechanism to replicate its double-stranded DNA genome.

D. In X, the progeny DNA may range several genomes long before it is packaged.

E. The lagging strand is not formed in rolling circle mechanism of replication.

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

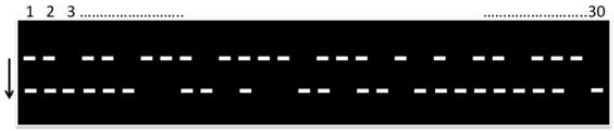
(a) A and C (b) A and D

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

Q60. This is a hypothetical example. In a plant, a single gene governs flower color. The wild type color is red, while the mutant is white. It was demonstrated that insertion of a transposable element caused the white phenotype .

In a PCR test, a set of primers outside the site of insertion is used to amplify the genomic DNA and the PCR products are resolved by Agarose gel electrophoresis.

A geneticist made a cross between two plants. 30 progeny from the cross was analyzed by PCR Each lane in the gel below represents analysis of one progeny.



Based on the above, which one of the following statements .is correct?

(a) The DNA marker is dominant.

(b) Plant 3 has white flowers.

(c) In the above cross one of the parents was heterozygous while the other was homozygous.

(d) If the progeny from a cross between plant 1 and plant 30 is analyzed in a similar way two different kinds of banding pattern will be observed.

Q61. Stomata detached from the epidermis of common dayflower (Commelina communis) were treated with saturating photon fluxes of red light. After a duration of 2 hours, the same stomata, under the background of red light were also illuminated with blue light. Which one of the following statements regarding opening of stomatal apertures is true?

(a) The red light illumination will saturate stomata opening and blue light illumination will have no effect on it.

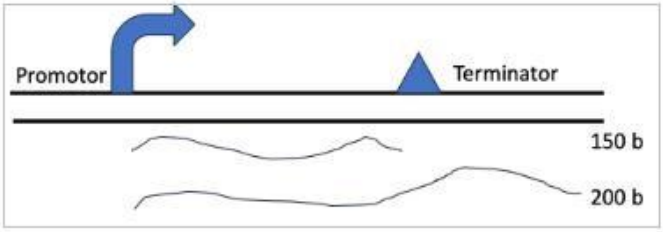
(b) The red light illumination will not result in opening of stomata and they will open only upon perceiving blue light.

(c) The blue light illumination will increase the level of stomata opening above the saturation level of stomata! opening by red tight illumination.

(d) The blue light illumination will result in closing of the stomata opened due to red light illumination.

Q62. Given below is the structure of a gene whose transcription is terminated in a Rho-independent manner. When the terminator ls operational, the short transcript of 150 bases is formed and when it is not operational, a longer transcript of 200 bases is formed. A researcher generated several mutations in the terminator region and examined the transcripts obtained.

The manipulations done are:



A. Three nucleotides of the string of 8Ts were replaced by GCC.

B. The 8T sequence was transferred to the template strand .

C. The sequences that generate the paired stem were altered to disrupt pairing.

D. The sequences that generate the paired stem were altered to disrupt pairing, followed by introduction of compensatory mutations to restore pairing.

Choose the option that correctly predicts the potential transcript size ln each of these cases.

(a) Short transcript in A and D; long in B and C

(b) Long transcript in A, Band D; short ln C

(c) Short transcript in B and D; long in A and C

(d) Long transcript in A, B and C; short ln D

Q63. An oligopeptide is subjected to amino acid analysis and found to have the following composition. Tyr, Phe, Asp, Val, Arg, Met

The following statements represents/outline/list the results obtained after analysis:

A. The above oligopeptide is subjected to N-terminal Edman degradation, revealing Tyrosine residue.

B. Trypsin treatment did not affect the peptide.

C. Cyanogen bromide treatment yielded a dipeptide, tetrapeptide, and free Arginine.

D. Chymotrypsin treatment yielded dipeptide and tetrapeptide. The composition of tetrapeptide was Valine, Arginine, and Methionine.

Based on above observations, what is the CORRECT sequence of heptapeptide?

(a) Tyr-Asp-Phe-Met-Val-Met-Arg

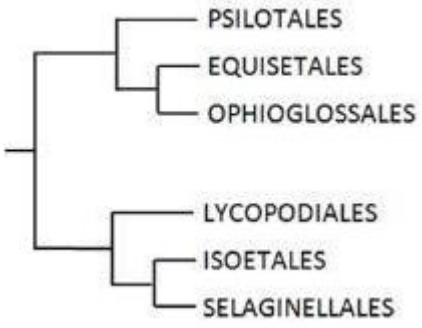
(b) Tyr-Phe-Asp-Met-Met-Val-Arg

(c) Tyr-Met-Asp-Val-Met-Arg-Phe

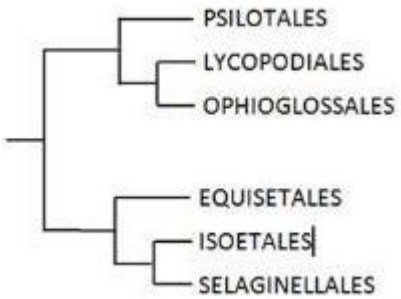
(d) Tyr-Asp-Met-Met-Phe-Val-Arg

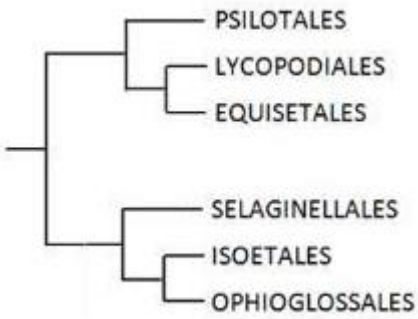
Q64. Which one of the follwoign phylogenetic trees correctly depicts the relationship between the given orders of pteridophytes, according to the Pteridophyte Phylogency Group 1?

(a)

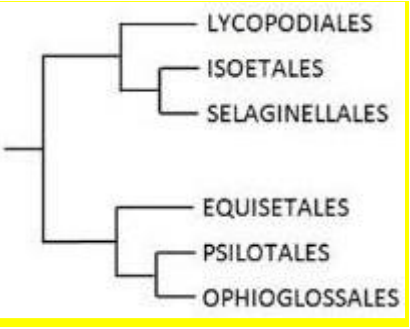


(b)





(c)



(d)

Q65. Apoplast phloem loading is determined by the cellular location and transport function of the membranebound proteins. Following are certain statements regarding these proteins.

A. SWEETs are the sugar transporter proteins and are capable of transporting only sucrose and not glucose.

B. Double mutants of Arabidopsis SWEET11 and SWEET12 results in carbohydrate accumulation in the source leaves and slower export of the photoassimilates.

C. H^+-symport mechanism loads sucrose or polyols into Sieve Element (SE)/Companion Cell (CC) complexes.

D. Several clades of sucrose/H+ symporters (SUTs or SUCs) are localized to plasma membranes of minor vein SE/CCs and participate in apoplastic loading.

Which one of the following combinations ls correct?

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

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

Q66. P. aeruginosa makes a blue-green pigment called pyocyanin. To understand the pyocyanin biosynthetic pathway, mutants which cannot make pyocyanin were isolated. Six such mutants are crossed with each other and the data is given below:

Mutant	1	2	3	4	5	6
1	–	+	+	+	+	–
2	+	–	+	+	+	+
3	+	+	–	+	+	+
4	+	+	+	–	+	+
5	+	+	+	+	–	+
6	–	+	+	+	+	–

- is pyocyanin negative; + pyocyanin positive Based on this data, can you predict how many genes are responsible for the pyocyanin production?

(a) One (b) Two

(c) Five (d) Six

Q67. In an experiment using nude mice, the population is divided into two groups, and B group A mice are injected with T cells from normal mice and Group B mice are left untreated. Both the groups are then immunized with LPS. Which one of the following statements regarding antibody production in groups A and B is most likely to be true?

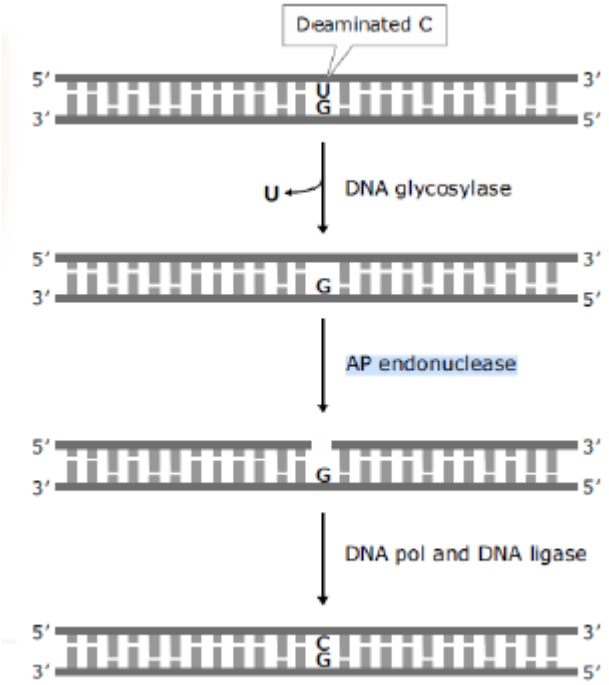
(a) Both groups of mice will have very similar levels of antibody against LPS as it is a thymus- independent antigen.

(b) No immune response will be generated in both groups of mice as they lack thymus.

(c) Only Group A mice will have antibodies as T-independent antigens are dependent on T-cell activation.

(d) Only Group B mice will have antibodies, because in group A mice, the presence of T cells will interfere with the production of antibodies against T-independent antigen.

Q68. A mutant strain of E.coli having defects in one of the DNA repair pathways was identified. To identify the pathways where mutation occurred, a researcher looks at the following parameters and identified the defect to be in base excision repair pathway.



A. Topoisomerase II enzyme activity.

B. AP endonuclease activity Deaminated

C. Expression of mutL and mutS

D. DNA glycosylase activity

E. DNA ligase activity

Based on the changes in which of the above parameters, this conclusion can be drawn?

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

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

Q69. In DNA foot-printing,

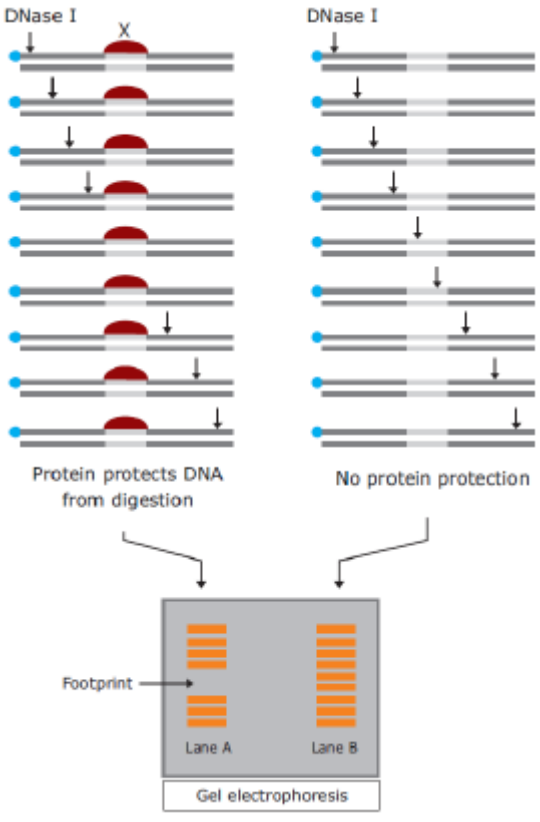
A. The DNA is labelled by random priming so that the entire DNA is labelled and one does not miss out any region that binds with the given protein.

B. The DNA is end-labelled so that the bands get organized from higher to lower size after electrophoresis and autoradiography.

C. A sequencing polyacrylamide gel is used to resolve all the fragments distinctly..

D. A higher concentration of agarose gel is used to resolve the finer bands.

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



(a) A only (b) B and D

(c) B and C (d) D only

Q70. Following statements were made about initiation of translation in eukaryotes.

A. The elF2 facilitates correct recognition and binding of ribosomal subunits .

B. The elF2B activates elF2 by replacing its GDP with GTP.

C. The elF3 binds to the 60S ribosomal subunit and inhibits its reassociation with the 40S subunit.

D. elF5 promotes association between the 60S ribosomal subunit and the 48S complex.

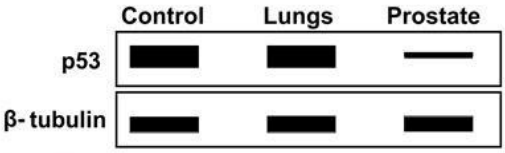
E. The elF6 binds to the 60S ribosomal subunit and blocks reassociation with the 40S subunit.

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

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

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

Q71. The Cre-LoxP system was used to knock-out the p53 gene from the mice lungs. An immunoblot analysis was carried out as shown below.



The following assumptions were made.

A. The LoxP system did not work since the recombinase was not functiona

B. The Lox P sites were introduced under a promoter specific for lungs.

C. The tissue-specified promoter selected was of the prostate gland. p-tubulin

D. The mice died because of being knocked out of p53.

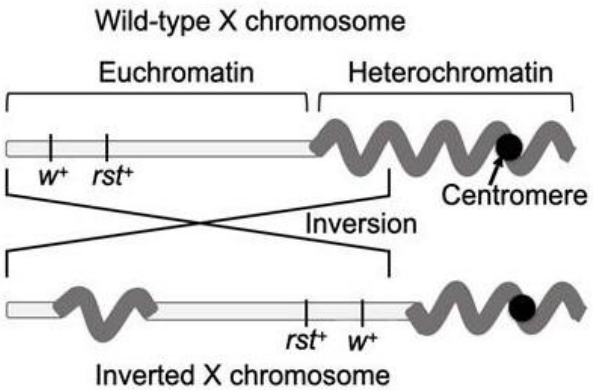
E. The knocked-out mice developed mutagen-induced tumours in their prostate gland more rapidly than in their lungs.

Which one of the following is correct combination of above assumption?

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

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

Q72. Shown below is the inversion product of the X chromosome of wild type Drosophila. The w+ gene coding for the red eye colour is near the telomere and another gene roughest (rst+) is close to w+ but towards the centromere. The eyes of roughest mutants have rough appearance The inversion brings w+ near the vicinity of highly compact centromeric heterochromatin and places rst+ little farther away from the centromeric heterochromatin.



Which of the following phenotypes will NEVER be observed in the Drosophila strain with inversion?

(a) Red and smooth eyes

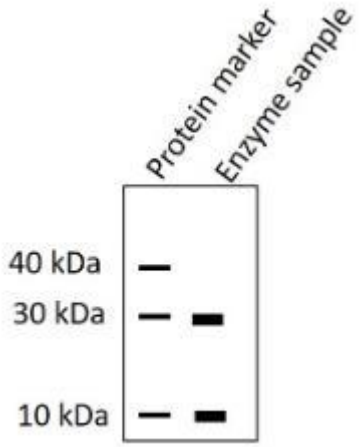
(b) White and smooth eyes

(c) White and rough eyes

(d) Red and rough eyes

Q73. You have purified an enzyme that has a molecular weight of 60 kDa. You run this protein on an SDS-PAGE gel and get the following results.

Which of the following statements is valid for the quaternary structure of this enzyme?



(a) Two subunits of 30 kDa

(b) One subunit of 30 kDa and three subunits of 10 kDa

(c) Six subunits of 10 kDa

(d) Three subunits of 30 kDa and one subunit of 10 kDa

Q74. Following statements are suggested regarding the principle and uses of positron emission tomography (PET):

A. The PET scanner is a positron ray detector.

B. The PET scanner cannot determine the location of collision between positron and electron in the brain.

C. The typical PET activation studies can measure the absolute metabolic activity of brain.

D. In PET, a radioactive isotope is introduced into blood as 'tracer' that rapidly decays by emitting a positron from their atomic nuclei.

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

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

(c) C and D (d) D only

Q75. Photorespiration or C2 cycle takes place in three distinct organelles in the plant cells. Following are certain statements related to the C2 cycle.

A. Reduced ferredoxin and ATP are required for photorespiration and assimilation of resulting NH_3.

B. Photosynthetic electron transport provides energy rich ATP and NAPDH for photorespiration.

C. Glutamate is translocated from chloroplast to peroxisome, while a-ketoglutarate is translocated from peroxisome to chloroplast.

D. The action of enzyme serine hydroxymethyl transferase takes place in peroxisome.

Which one of the following combinations has all correct statements?

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

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