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CSIR MMT Question Paper 5

Q.1) **When fused with an S-phase cell, cells in which of the following phases of the cell cycle will initiate DNA replication prematurely—**

- A. G1
- B. S
- C. G2
- D. M

Q.2) **An ant moving straight, upon encountering an obstacle, may turn either right or left and continue moving. To test the hypothesis that the direction chosen by the ant is random, the most appropriate statistical test is**

- A. Student's t-test
- B. Chi square test of independence
- C. Chi square test of goodness of fit
- D. Correlation test

Q.3) **For developing transgenic mice, embryonic stem cells are engineered to express the transgene. These cells are selected by**

- A. Novobiocin
- B. Neomycin
- C. Tetracycline
- D. Penicillin

Q.4) **Which of the following does not represent a strategy of phytoremediation?**

- A. Phytodegradation
- B. Phytomining
- C. Continuous removal through hyper accumulators
- D. Chelate-mediated extraction of pollutants

Q.5) **A tyre has two punctures. The first puncture alone would have made the tyre flat in 9 minutes and the second alone would have done it in 6 minutes. If air leaks out at a constant rate, how long does it take both the punctures together to make it flat?**

- A. 54/15 minutes
- B. 15/54 minutes
- C. 15 minutes
- D. 5 minutes

Q.6) **A vessel is full of a mixture of spirit and water in which there is 25 percent of spirit. 4 liters are drawn off and the vessel is filled up with water. If the spirit is now 15 %, find the total quantity in the vessel (in liters)**

- A. 1 liter
- B. 5 liters
- C. 10 liters
- D. 15 liters

Q.7) **In a party 60% of the invited guests are male and 40% are female. If 80% of the invited guests attended the party and if all the invited female guests attended, what would be the ratio of males to females among the attendees in the party?**

- A. 2:3
- B. 1:1
- C. 3:2
- D. 2:1

Q.8) **How many kgs of tea costing Rs.45 per kg must be mixed with 14 kg of tea costing Rs.60 per kg so that seller may gain 25% by selling the mixture at Rs.65 per kg?**

- A. 12 kg
- B. 16 kg
- C. 18 kg
- D. 20 kg

Q.9) **The Galapagos finches were an important clue to Darwin's thinking about the origin of species. These finches are believed to have descended from a single ancestral species that colonized the Galapagos archipelago, America, over a short period of time. The Galapagos finches differ in their beak shape and size. Different species feed on seeds that vary in size and hardness.**

Which of the following is the most likely explanation for these patterns?

- A. The finches represent an example of directional trend in beak size from small to big.
- B. Beak shapes changed in response to different seed types and these changes were inherited by subsequent generations.
- C. The finches represent an example of adaptive radiation in which beak variation was generated by mutation followed by selection by different seed types.
- D. The ancestral finch already had all the beak variations and different lineages formed that were specialized to eat different seed types.

Q.10) **Which of the following causes populations to shift most quickly from an exponential to logistic population growth?**

- A. increased birth rate
- B. favorable climatic conditions
- C. removal of predators
- D. competition for resources

Q.11) **Which of the following is the most important assumption for the capture-recapture method to estimate the size of wildlife populations?**

- A. More individuals emigrate from, as opposed to immigrate into, a population.
 - a. Over 50% of the marked individuals need to be trapped during the recapture phase.
 - b. There is a 50:50 ratio of males to females in the population before and after trapping and recapture.
 - c. Marked individuals have the same probability of being recaptured as unmarked individuals during the recapture phase.

Q.12) **As N approaches K for a certain population, which of the following is predicted by the logistic equation?** ^{A.} The growth rate will approach zero.

- B. The population will show an Allee effect.
- C. The population will increase exponentially.
- D. The carrying capacity of the environment will increase.

Q.13) **Which one of the following is the most appropriate statement regarding folded proteins?**

- A. Charged amino acid chains are always buried
- B. Charged amino acid side chains are seldom buried
- C. Non-polar amino acid side chains are seldom buried
- D. Tyrosine residues are always buried

Q.14) **Glycerol is added to protein solutions to stabilize the preparations by**

- A. Increasing the viscosity of solution
- B. Stabilizing the pH
- C. Preferential hydration of protein
- D. interacting and neutralising the surface charges on the protein

Q.15) **Among the following events in the history of life**

1. prokaryotic cell
2. eukaryotic cell
3. natural selection
4. organic molecules
5. self-replicating molecules

Which is the correct chronological order ?

- A. 4, 5, 3, 1, 2
- B. 4, 5, 1, 2, 3
- C. 5, 4, 1, 3, 2
- D. 4, 5, 1, 3, 2

Q.16) **Which species concept utilizes morphological and molecular characters to distinguish between species?**

- A. Morphological
- B. Ecological
- C. Biological
- D. Phylogenetic

Q.17) **According to which evolutionary theory, there are long periods without significant evolutionary changes interrupted by short episodes of rapid evolution?**

- A. Punctuated equilibrium
- B. Genetic Drift
- C. Mutation
- D. Neutrality

Q.18) **A paraphyletic group**

- A. Contains unrelated organisms
- B. Includes the most recent common ancestor but not all of its descendants
- C. Includes all the representatives of a clade but not the most recent common ancestor
- D. Contains all the representatives of a clade and the most recent common ancestor

Q.19) **Which of the following processes interferes in sequence-based phylogeny ?**

- A. Horizontal gene transfer
- B. Adaptive transfer
- C. DNA repair
- D. Reverse transcription

Q.20) **Which of the following is not a characteristic of phylum Chordata ?**

- A. Pharyngeal slits
- B. Amniotic egg
- C. Postanal tail
- D. Notochord

Q.21) How many fragments will be generated for unknown protein sequence when treated with trypsin and chymotrypsin?

Tyr- Gly- Ala- Val- Phe-Trp- Ile-lys- Val- Met- Phe- Gly- Arg

- A. 4
- B. 6
- C. 2
- D. 3

Q.22) 'Imperfect fungi' is a group represented by fungal species which have

- A. Simple mycelia.
- B. No known mechanisms of sexual reproduction.
- C. Unknown phylogenetic relationship.
- D. Lost its survival mechanism against harsh environments.

Q.23) Two species M and N, occupy the same habitat. Given below is a 'state-space' graph in which the abundance of species M is plotted on the X-axis and abundance of species N is plotted on the Y-axis. For each species, the zero-growth isocline is plotted.

_____ zero - growth isocline for species M

----- zero - growth isocline for species N

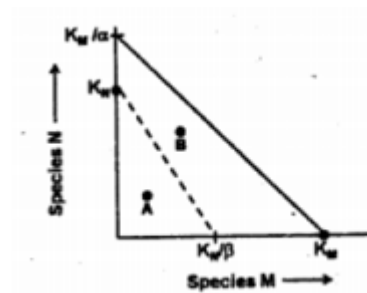
KM - carrying capacity of the habitat for species M in absence of species N.

KN - carrying capacity of the habitat for species N in absence of species M.

alpha - per capita effect of species N on M

beta - per capita effect of species M on N

Based on the above plot some deductions are made. Which one of the following statements INCORRECT ?



- A. At point A population of both the species M and N increase.
- B. At point B , population of species M increases while that of species N decreases.
- C. At point B , population of species N increases while that of species M decreases.
- D. Ultimately species N will be eliminated

Q. 24) The molar extinction coefficients of Trp and Tyr at 280 nm are 5690 and 1280 M⁻¹cm⁻¹, respectively. The poly-peptide chain of yeast alcohol dehydrogenase (37 kDa) contains 5 Trp and 14 Tyr residues. The absorbance at 280 nm of a 0.32 mg mL⁻¹ solution of yeast alcohol dehydrogenase measured in a cuvette of 1 cm pathlengths will be ----- . (Assume that the molar extinction coefficient values for Trp and Tyr apply to these amino acids in the yeast alcohol dehydrogenase).

- A. 0.4
- B. 0.5
- C. 0.6
- D. 0.7

Q.25) In an effort to produce gene knockout mice, a gene targeted homologous recombination was tried with the r exogenous DNA containing gene neo (confer G-418 resistance) and gene (confers sensitivity to the cytotoxic r nucleotide analog ganciclovir). If the gene neo was inserted within the target gene in the exogenous DNA and considering that both homologous and non-homologous recombination (random integration) is taking place, which one of the following statements is NOT correct about the possible outcome of the experiment?

- A. Cells with non-homologous insertion will be sensitive to ganciclovir.
- B. Non-recombinant cells will be sensitive towards G-418 and resistant to ganciclovir.
- C. Homologous recombination will ensure that cells will be resistant to both ganciclovir and G-418.
- D. Homologous recombinants will grow in G- 418 containing media but will be sensitive towards ganciclovir.

Q.26) **You discover a novel eukaryotic organism that glows in the dark. You believe this trait is due to a single gene, and you wish to clone the gene. Which of the following strategies is most likely to be successful?**

- A. Isolate the genomic DNA from the organism, digest with a restriction endonuclease, insert into a plasmid vector and transform into bacteria. Screen colonies for the ability to glow in the dark.
- B. Isolate the genomic DNA from the organism, digest with a restriction endonuclease, insert into a plasmid vector and transform into eukaryotic cells such as yeast. Screen colonies for the ability to glow in the dark.
- C. Isolate mRNA from the organism, reverse transcribe and generate cDNA, insert into a plasmid vector and transform into bacteria. Screen colonies for the ability to glow in the dark.
- D. Isolate mRNA from the organism, reverse transcribe and generate cDNA, insert into a plasmid vector and transform into eukaryotic cells such as yeast. Screen colonies for the ability to glow in the dark.

Q.27) **A cell undergoing meiosis produces four daughter cells, two of which are aneuploids and two are haploid. This can occur due to:**

- A. Non-disjunction during first meiotic division only
- B. Non-disjunction during second meiotic division only
- C. Non-disjunction during either first or second meiotic division
- D. Non-disjunction during both first and second meiotic divisions

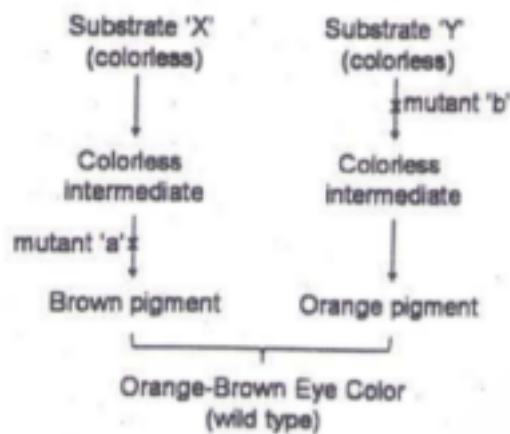
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Q.28) A hypothetical biochemical pathway for the formation of eye color in insect is given below:

Two autosomal recessive mutants 'a' and 'b' are identified which block the pathway as shown above. Considering that the mutants are not linked, what will be the phenotype of the F₂ progeny if crosses were made between parents of the genotype aaBB x AAbb, and the F₁ progeny are intercrossed?



- A. 9 orange-brown : 3 orange : 3 brown : 1 colorless
- B. 9 orange-brown : 7 colorless
- C. 1 orange : 2 colorless
- D. 15 orange-brown : 1 colorless

Q.29) Genes translocated to the heterochromatic regions of the chromosome are silenced. In *S. pombe*, a translocation event was detected wherein a gene of interest was translocated to the centromere region and is silenced. Mutagenesis leading to loss of function of the following target genes was done to allow expression of the gene of interest from its new locus.

A. Mutation in histone deacetylase (Clr3)

B. Mutation in histone acetyltransferase (HAT-8)

C. Mutation in histone H3 lysine 9 methyltransferase (Clr4)

D. Loss of Dicer, an RNA processing enzyme

Which of the above events could allow the expression of this gene from the centromeric region?

A. A, B & C

B. A, C & D

C. B & C

D. A & C

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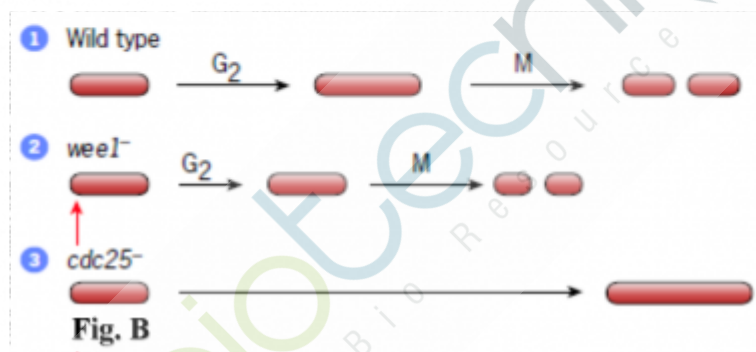
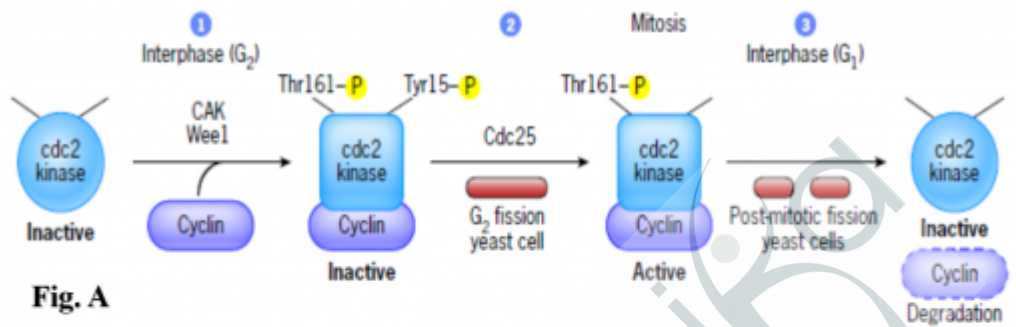
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Q.30) **CAK, Wee1, and Cdc25 play an important role in regulating Cdc2 activity (Fig. A). During the G₂ phase, Wee1 adds inhibitory phosphate at Tyr15, and CAK adds activating phosphate at Thr161. When the cell reaches a critical size, Cdc25 phosphatase removes the inhibitory phosphate and activates Cdc2 which drives the cell into mitosis. Fig. B shows the effect of mutations in the genes that encode Wee1 and Cdc25 on the cell cycle and phenotype of the yeast cells. What phenotype would you expect in a yeast cell carrying a temperature-sensitive CAK mutation, after raising the temperature of the culture medium in G₂?**



- Cells divide and generate daughter cells smaller in size as observed in Wee1 mutation
- No cell division and no changes in cell size after S phase
- No cell division and cells elongate further as observed in Cdc25 mutation
- Cells divide and generate daughter cells of normal size as observed in wild type

Q.31) **The drug cytochalasin B blocks the function of actin. Which of the following aspects of the cell cycle would be most disrupted by cytochalasin B?**

- spindle formation
- spindle attachment to kinetochores
- cell elongation during anaphase
- cleavage furrow formation

Q.32) Jasmonate is known to inhibit root growth while auxin facilitates root growth. Upon infection with pathogenic bacteria that produce coronatine, we may expect the following in plants:

- A. Upregulation of CO1-1 gene and inhibition of root growth
 - B. Upregulation of Aux1-1 gene and inhibition of root growth
 - C. Inhibition of Aux1-1 gene and promotion of root growth
 - D. Inhibition of CO1-1 gene and promotion of root growth
- Which one of the following is correct?

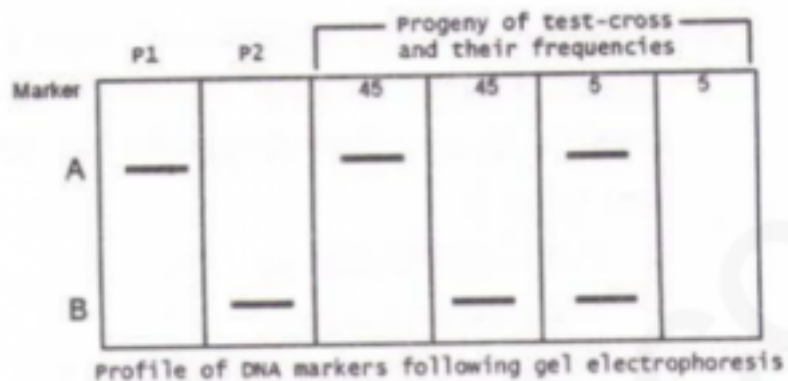
- A. A, B and C
- B. only A
- C. only B
- D. only C

Q.33) Two homozygous individuals (P1 and P2) were genotyped using dominant DNA markers A and B, as shown below. The F1 progeny obtained was test crossed. The frequency of progeny with which different genotypes appear, is given below.

The following conclusions were made:

- P. In the F1, markers A and B are linked and in coupling phase (cis)
- Q. In the F1, markers A and B are linked and in repulsion phase (trans)
- R. The distance between A and B is 10cM
- S. The distance between A and B is 15cM

Which of the above conclusions are correct?



- A. P and R
- B. P and S
- C. Q and R
- D. Q and S

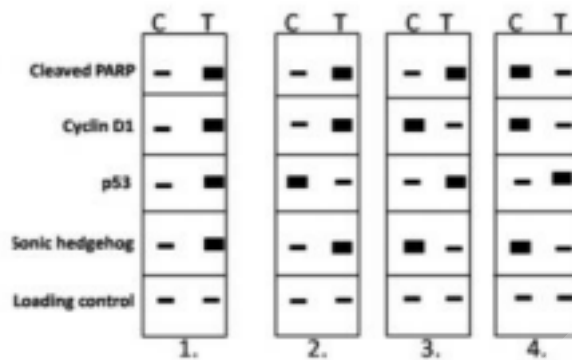
Q.34) Transgenic tobacco plants over-expressing isopentenyl transferase (IPT) under the control of promoter region of Senescence Associated Receptor kinase (P) were exposed to drought for 15 days followed by re-watering SARK for 7 days. The following hypotheses were proposed regarding changes in the transgenic plants at the end of 7 days of re-watering:

- A. The plants would be wilted and fail to survive.
- B. The plants would be healthy and survive.
- C. The plants would show higher production of cytokinin compared to wild type plants.
- D. The plants would show higher production of abscisic acid compared to wild type plants.

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

- A. A and C
- B. A and D
- C. B and C
- D. B and D

Q.35) A student treated cancer cells with an anti-cancer drug and performed western blot analysis. Which one of the following blots is the best representation of untreated control (C) and treated (T) samples?



- A. Option 1
- B. Option 2
- C. Option 3
- D. Option 4

Q.36) In a bacterial culture, there were 1×10^4 cells. After 4 h, the culture had 6.5×10^7 cells. Calculate the generation time of the population. [NOTE: $\log 65 = 1.81$]

- A. 19 mins
- B. 34 mins
- C. 75 mins
- D. 121 mins

Q.37) The glycolysis and citric acid cycles are important pathways to generate energy in the cell. Given below are statements regarding the production of ATP.

- P. Electrons released during the oxidative steps of glycolysis and citric acid produce 10 ATP molecules of NADH and 2 ATP molecules of FADH₂ per molecule of glucose.
- Q. Electrons released during the oxidative steps of glycolysis and citric acid cycle produce 20 molecules of NADH and 4 molecules of FADH₂ per molecule of glucose.
- R. The Coenzymes produced are oxidized by electron transfer chain.
- S. The conversion of ADP and Pi to ATP takes place in the intermembrane space of mitochondria.
- Which one of the following combination of above statements is correct?

- A. P and Q
- B. Q and R
- C. R and S
- D. P and R

Q.38) Symbiotic nitrogen fixation in legume nodules involves complex interactions between *Rhizobium* and legume roots. This complex interaction is governed by

- P. Integration of sym plasmid of *Rhizobium* in the root nuclear genome
- Q. Sensing of plant flavonoids by rhizobia
- R. Activation of nod genes in rhizobia
- S. Activation of NODULIN genes in legume roots

Which one of the following combinations is correct?

- A. P, Q and R
- B. P, R and S
- C. Q, R and S
- D. P, Q and S

Q.39) The following are certain facts regarding biological nitrogen fixation in plants:

P. Oxygen irreversibly inactivates nitrogenase enzyme involved in nitrogen fixation

Q. The nod genes that code for nodulation proteins are activated by Nod D.

R. The two components of nitrogenase enzyme complex ,the Fe protein and MoFe protein can show catalytic activity independently

S. During the reaction catalyzed by nitrogenase enzyme the Fe protein reduces the MoFe protein while the Mo Fe protein reduces N₂.

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

A. P, Q and R

B. Q, R and S

C. P, R and S

D. P, Q and S

Q.40) The frequencies of alleles A and a in a population at Hardy Weinberg equilibrium are 0.7 and 0.3 respectively. In a random sample of 650 individuals taken from the population, how many are expected to be heterozygous?

A. 112

B. 81

C. 273

D. 145

Q.41) Four different species concepts are given below:

P. Species separate based on their use of different ecological niches and their presence in different habitats and environments.

Q. Differences in physical characteristics or molecular characteristics are used

to distinguish species R. Species are distinct if they are reproductively isolated

S. Phylogenetic trees and analyses of ancestry serve to differentiate species.

Which of the following gives the correct names of the above concepts?

- A. P- Biological, Q- Phylogenetic, R- Evolutionary, S- Ecological
- B. P- Ecological, Q- Phylogenetic, R- Biological, S- Evolutionary
- C. P- Evolutionary, Q- Ecological, R- Biological, S- Phylogenetic
- D. P- Phylogenetic, Q- Evolutionary, R- Ecological, S- Biological

Q.42) **After absorbing light, chlorophyll molecules in green plants exist in singlet and triplet states. Following are certain statements on singlet and triplet states of chlorophyll molecules:**

- A. Singlet state is short lived compared to triplet state.**
- B. Singlet state is long lived compared to triplet state.**
- C. Singlet state contains electrons with anti-parallel spins while triplet state has electrons with parallel spins.**
- D. Singlet state contains electrons with parallel spins while triplet state has electrons with anti-parallel spins. Which one of the following combinations is correct?**

- A. A and B
- B. B and C
- C. A and C
- D. B and D

Q.43) **Choose the correct statement from the following:**

- A. Disulfide bonds in a 20-residue peptide can be formed only if the cysteines are adjacent to each other.
- B. The amino acid isoleucine has only one chiral centre.
- C. Both bases and sugar contribute to chirality of nucleic acids.
- D. The pI of aspartic acid is less than that of glutamic acid. The pI of aspartic acid is less than that of glutamic acid. The pI of aspartic acid is less than that of glutamic acid. The pI of aspartic acid is less than that of glutamic acid.

Q 44) A cross was made between Hfr met⁺ arg⁺ leu⁺ str^s x F⁻ met⁻ arg⁻ leu⁻ str^r, in which leu⁺ exconjugants are selected. If the linear organization of the genes are leu⁺ arg⁺ met⁺, which one of the following genotypes is expected to occur in the lowest frequency?

- A. leu⁺ arg⁻ met
- B. leu⁺ arg⁺ met
- C. leu⁺ arg⁺ met⁺
- D. leu⁺ arg⁻ met⁺

Q.45) Sting of a bee causes pain, redness and swelling. Melittin is a major peptide in bee venom. Melittin is a membrane binding peptide that is involved in activating phospholipases in the membrane. The possible target phospholipase that is activated by melittin is

- A. Phospholipase C to generate inositol phosphates.
- B. Phospholipase A2 to generate arachidonic acid.
- C. Phospholipase D to generate 1', 3'- inositol.
- D. Phospholipase A1 to generate palmitic acid

Q.46) Of the following, which one of the individuals will not necessarily carry the allele responsible for the mentioned trait?

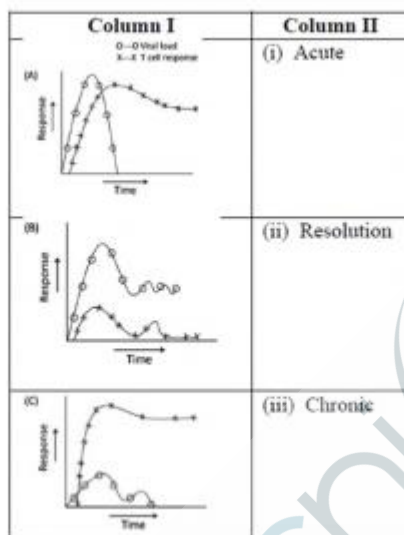
- A. A woman in a family where an autosomal dominant trait is segregating and her mother and son are affected
- B. A daughter of a man who is affected by an X-linked dominant trait
- C. A father of a child who is affected with an autosomal recessive trait
- D. A father of a boy affected with X linked recessive trait

Q.47) Consider a short double-stranded linear DNA molecule of 10 complete turns with 10.5 bp/turn. The ends of the DNA molecule are sealed together to make a relaxed circle. This relaxed circle will have a linking number of

- A. 105
- B. 20.5
- C. 10.0
- D. 10.5

Q.48) The relation between cellular immune response generated against hepatitis C virus is the critical determinant of the outcome of infection. Given below are the representative figures of cellular immune response in column I and various outcome of infection in column II.

Choose the best possible combination



- A. A – (ii), B – (iii), C – (i)
- B. A – (i), B – (iii), C – (ii)
- C. A – (iii), B – (ii), C – (i)
- D. A – (i), B – (ii), C – (iii)

Q.49) If a cell has an adequate supply of adenine nucleotides but requires more guanine nucleotides for protein synthesis:

- A. Glutamine-PRPP amidotransferase will not be fully inhibited.
- B. AMP will be a feedback inhibitor of the condensation of IMP with aspartate.
- C. ATP will stimulate the production of GMP from IMP.
- D. ATP will inhibit nucleoside diphosphate reductase.

- A. A, B and C
- B. A and C
- C. B and D
- D. D only

Q.50) **Major histocompatibility complex (MHC) molecules are encoded by a cluster of genes called MHC locus. There are several reasons why an MHC molecule on the surface of a cell is important. Which one of the following reasons is INCORRECT?**

- A. To display self class I to demonstrate that the cell is normal and healthy
- B. To display foreign-peptide in class I to show that the cell is infected and to engage with T helper cells
- C. To display a self-peptide in class I and II to test developing T cells for autoreactivity
- D. To display a self-peptide in class I and II to maintain tolerance to self-proteins

Q.51) **During gluconeogenesis, the three irreversible steps of glycolysis have to be bypassed. First step is the conversion of pyruvate to phosphoenol pyruvate. Following are some statement regarding the reaction step?**

- A. This reaction involves two step process catalyzed by pyruvate carboxylase and phosphoenolpyruvate caboxykinase
- B. Conversion of oxaloacetate from pyruvate occurs in mitochondria and shuttled into cytosol.
- C. Phosphoenol pyruvate utilizes both ATP and GTP as energy source.
- D. Acetyl CoA is an inhibitor of enzyme pyruvate carboxylase.

Which of these are false?

- A. A and B
- B. B and C
- C. C and D
- D. B and D

Q.52) **The probable effects of lesion of left optic tract on the vision of a human subject are given below. Identify the correct statement**

- A. Blindness in the left eye but the visual field of right remains intact
- B. Blindness in the right half of the visual fields of both the eyes
- C. Blindness in the left half of the visual field of left eye and blindness in the right half of the visual field of right eye
- D. Blindness in the left half of the visual field of both the eyes

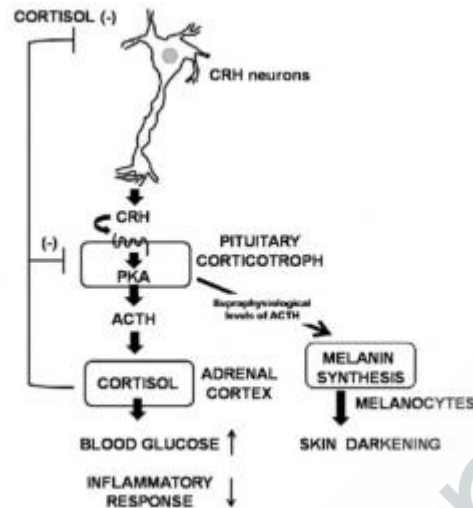
Q.53) **The following statements are made on nucleic acid structure:**

- A. In the B-form of DNA, the sugar pucker is C2' endo
- B. In RNA, the sugar pucker is C3' exo
- C. The wobble base pair is formed between G and A in RNA
- D. A change in the sugar pucker from C2' endo in the B-form of DNA to C3' endo alters the width and depth of the major groove.

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

- A. A and C
- B. B and D
- C. A and D
- D. B and C

Q.54) The above figure depicts the regulation of hypothalamo-pituitary-adrenal (HPA) axis. Changes in cortisol level in Addison's disease can lead to



- A. suppressed immune system and increased blood glucose level
- B. gain of body weight and lightening of skin
- C. loss of body weight, reduced blood glucose level and hyperpigmentation
- D. increased blood glucose and activated immune system

Q.55) **Instructive and permissive interactions are two major modes of inductive interaction during development. The following compares some properties of cell lines and cord blood stem cells. Cell lines, which are stored in liquid nitrogen, can be retrieved for experiments, where they behave as per their original self. Cord blood can also be retrieved from liquid nitrogen for procuring stem cells. Unlike cell lines, the stem cells can be additionally induced to undergo differentiation into desired lineages, which are very different from their original self. The behavior of cell lines and stem cells is analogous to which of the interactions?**

- A. Both cell lines and stem cells show instructive interaction
- B. Cell lines show instructive interactions whereas stem cells show permissive interaction
- C. Cell lines show permissive interaction whereas stem cells show instructive interaction
- D. Both types of cells show permissive instruction

Q. 56) In the glomerular capillary (GC), fluid moves into Bowman's capsule through its almost entire length. But in the muscle capillary (MC), fluid moves into interstitial space at its arteriolar end. The difference between these two capillaries is explained in the following proposed statements:

- A. Afferent and efferent arterioles are present on the two ends of GC, but in MC, arteriole and venule are present on two ends.**
- B. The hydrostatic pressure in GC is higher than that in MC.**
- C. The efferent arteriole in GC has a relatively low resistance, but venules in MC has a high resistance.**
- D. The difference of hydrostatic pressure between two ends of GC is relatively more but it is negligible in MC. E. The difference of oncotic pressure between two ends of MC is negligible but it is relatively more in GC.**
- F. The net filtration pressure falls to zero at the efferent end of GC but it is 9 mm Hg inward at the venular end of MC.**

Which of the above statements are INCORRECT?

- A. A and B**
- B. C and D**
- C. E and F**
- D. B and F**

Q.57) Sickle-cell anemia is an interesting genetic disease. Normal homozygous individuals (SS) have normal blood cells that are easily infected with the malarial parasite. Thus, many of these individuals become very ill from the parasite and many die. Individuals homozygous for the sickle-cell trait (ss) have red blood cells that readily collapse when deoxygenated. Although malaria cannot grow in these red blood cells, individuals often die because of the genetic defect. However, individuals with the heterozygous condition (Ss) have some sickling of red blood cells, but generally not enough to cause mortality. In addition, malaria cannot survive well within these "partially defective" red blood cells. Thus, heterozygotes tend to survive better than either of the homozygous conditions.

If 9% of an African population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous (Ss) for the sickle-cell gene?

- A. 50%**
- B. 42%**
- C. 38%**

D. 64%

Q.58) After graduation, you and 19 of your closest friends (lets say 10 males and 10 females) charter a plane to go on a round-the-world tour. Unfortunately, you all crash land (safely) on a deserted island. No one finds you and you start a new population totally isolated from the rest of the world. Two of your friends carry (i.e. are heterozygous for) the recessive cystic fibrosis allele (c).

Assuming that the frequency of this allele does not change as the population grows, what will be the incidence of cystic fibrosis on your island?

A. 0.21 %

B. 0.20%

C. 0.25%

D. 0.30%

Q.59) Number of trials required for rats to learn a task when they were exposed to various conditions were as follows: Which of the following inferences is most appropriate?

Experimental conditions	Observations
P. Light: light dark cycle - 12h: 12h	N-trials
Q. Bright light - 24h	Significantly more trials than 'N'
R. Bright Light - 24h + continuous physical disturbance	Significantly more trials than 'N'
S. Dark light - 24h + continuous physical disturbance	Significantly more trials than 'N'

A. Continous light enhanced learning

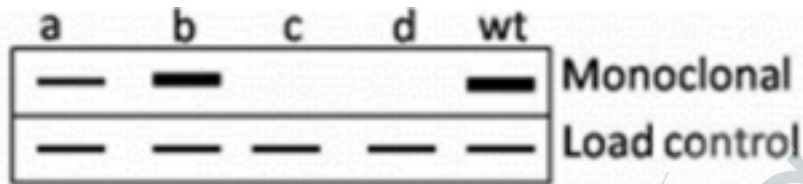
B. Continous darkness inhibited llearning

C. Physical activity inhibited learning

D. Learning was reduced by sleep loss

Q.60) Four single amino acid mutants (a to d) of a protein in the epitope-region of a monoclonal antibody X were made and expressed in *E. coli*. The lysates from the four *E. coli* cultures expressing these four proteins were run on an SDS-PAGE gel and subsequently transferred to nitrocellulose membrane and Western blotted using a monoclonal antibody X raised against the wild type protein. The results are presented in the figure below: The four single mutations, upon sequencing, were found to be Valine (V) to Alanine (A); Glycine (G) to Proline (P); Alanine (A) to Aspartic acid (D) and Isoleucine (I) to Leucine (L).

Which one of the following statements is correct?



- A. b is due to V → A and c is due to G → P
- B. b is due to G → P and d is due to V → A
- C. d is due to I → L and a is due to A → D
- D. c is due to V → A and a is due to I → L

Q.61) Some errors occur during DNA replication that are not corrected by proof reading activity of DNA polymerase. These are corrected by specialized repair pathways. Defect in the activities of some of the following enzymes impair this process.

- (a) DNA polymerase III and DNA ligase
- (b) AP endonuclease and DNA glycosidase
- (c) Mut S and Mut L
- (d) RecA and RecF

Defect in which of the above enzymes impair the process?

- A. (a), (b) and (c)
- B. (d) and (b)
- C. (a) and (d)
- D. (a) and ©

Q. 62) You have labelled DNA in a bacterium by growing cells in medium containing either ^{14}N nitrogen or the heavier isotope ^{15}N . Furthermore, you have isolated pure DNA from these organisms, and subjected it to CsCl density gradient centrifugation leading to their separation of light (^{14}N) and heavy (^{15}N) forms of DNA to different locations in the centrifuge tube. In the next experiment, bacteria were grown first in medium containing ^{15}N , so that all the DNA made by cells will be in heavy form. Then these cells were transferred to medium containing only ^{14}N and allowed the cells to divide for one generation. DNAs were extracted and centrifuged as above in the CsCl gradient. A hybrid DNA band was observed at a position located between and equidistant from the ^{15}N and ^{14}N DNA bands.

Based on the above observation, which one of the following conclusions is correct?

Based on the above observation, which one of the following conclusions is correct?

- A. Replication of DNA is conservative
- B. Replication of DNA is semi- conservative
- C. Replication of DNA is dispersive
- D. Replication by rolling circle mode

Q.63) The mismatch repair activity of E.coli repair is mis-incorporated bases which is not removed by the proofreading activity of DNA polymerase. However, while doing so, it has to decide which strand of the DNA is newly synthesized and which one is parental. Mismatch repair system does it by which one of the following ways?

- A. It recognizes nearby GATC sequence.
- B. It recognizes any nearby palindromic sequence.
- C. It recognises a specific repetitive sequence.
- D. It recognises the hemimethylated GATC sequence nearby.

Q.64) In prokaryotes, the initiator t-RNA is first charged with a methionine, followed by the addition of a formyl group to the methionine by the enzyme Met-tRNA transformylase. Given below are several statements in this context (a) All prokaryotic proteins have formyl methionine at their amino-terminal end.

(b) Deformylase removes the formyl group from the amino terminal methionine.

(c) All prokaryotic proteins have methionine at their amino terminal end.

(d) Aminopeptidases often remove amino terminal methionine.

(e) Aminopeptidases remove amino terminal formyl methionine.

Which for the above statement (s) are most likely to be true ?

A. A only

B. B and C

C. E only

D. B and D

Q.65) Aminoacyl-tRNA synthetases are very specific for aminoacylation of tRNAs with the correct cognate amino acids. However, there is a possibility of a mismatch between the tRNA and its cognate amino acid. This error is corrected by the inherent proof-reading activity of the aminoacyl-tRNA synthetase. In case of two very similar amino acids, namely valine and isoleucine, isoleucyl-tRNA synthetase employs the following possible approaches for an error-free aminoacylation :

(1) It removes an incorrect amino acid by hydrolyzing the aminoacyl-AMP linkage following the first reaction step

(2) It is activated for proof-reading activity, leading to breakage of the bond between the wrong amino acid and tRNA

(3) It has an intrinsic ability to recognize the structural difference between amino acids leading to abortive elimination of the non-cognate amino acid

(4) It gets sequestered in the second step with the wrong amino acid, and that freezes the aminoacylation process.

Which of the following combinations is correct ?

A. (1) and (2)

B. (1) and (4)

C. (2) and (4)

D. (3) and (4)

Q.66) An organism has the following architectural pattern :

- (i) multicellular with germ layers
 - (ii) a coelom derived from the mesoderm
 - (iii) primary bilateral symmetry with secondary radial symmetry
 - (iv) presence of endoskeletal plates
- Such an organism is most likely to
1. have mesophyl as its connective tissue.
 2. undergo torsion, whereby the mouth and anus are properly oriented.
 3. be devoid of a brain but have calcareous spicules.
 4. have comb plates to help in locomotion.

Which of the following is true?

- A. 1 and 3
- B. 3 only
- C. 4 only
- D. 2 and 3

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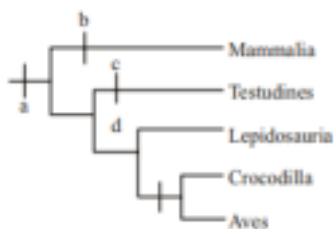
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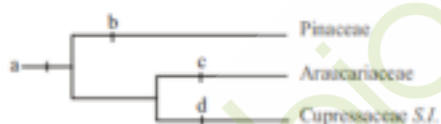
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Q.67) Identify the apomorphic characters marked in the cladogram:



- A. a-amniotic egg; b-4-chambered heart; c- anapsidan skull; d-diapsidan skull; e synapsid skull.
- B. a-amniotic egg; b-synapsidan skull; c-4-chambered heart; d; anapsidan skull; e-diapsidan skull.
- C. a-4-chambered heart; b-synapsidan skull; c-amniotic egg; d-diapsidan skull; e anapsidan skull.
- D. a-amniotic egg; b-synapsidan skull; c-anapsidan skull, d-diapsidan skull; e-4-chambered heart.

Q.68) Identify the synapomorphies in the following cladogram :



- A. (a) seeds with long terminal wing; (b) ovules 1–20 per scale; (c) resin canals; (d) 1 ovule per scale
- B. (a) resin canals; (b) seeds with long terminal wing; (c) 1 ovule per scale; (d) ovules 1–20 per scale
- C. (a) resin canals; (b) seeds with long terminal wing; (c) 1 ovule per scale; (d) ovules 1–20 per scale
- D. (a) seeds with long terminal wing : (b) ovules 1-20 per scale ; (c) 1 ovule per scale; (d) resin canals

Q.69) During a field study, three insects with the following characteristics were observed :

1. elongate, membranous wings with netlike venation, long and slender abdomen, large compound eyes
2. small bodies, sucking mouth parts, narrow wings fringed with setae

3. sclerotized forewings, membranous hindwings, chewing mouth parts

They can be identified to their respective orders as

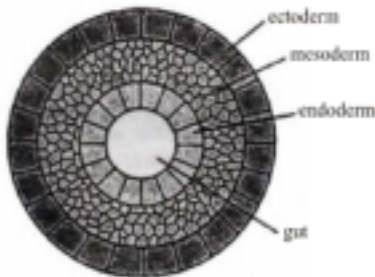
- A. 1–Orthoptera; 2–Hemiptera; 3– Coleoptera
- B. 1–Odonata; 2–Coleoptera; 3–Hemiptera
- C. 1–Orthoptera; 2–Odonata; 3–Coleoptera
- D. 1–Odonata; 2–Thysanoptera; 3–Coleoptera

Q.70) Identify a, b and c in the figure:



- A. a = mitochondria; b = multicellularity; c = chloroplast
- B. a = mitochondria; b = chloroplast; c = multicellularity
- C. a = chloroplast; b = multicellularity, c = mitochondria
- D. a = chloroplast; b = nucleus; c = multicellularity

Q.71) The schematic section given below of an animal indicates that the animal is:



- A. Triploblastic, coelomic, invertebrate
- B. Triploblastic, acoelomic, invertebrate
- C. Diploblastic, coelomic, invertebrate
- D. Triploblastic, coelomic, vertebrate

Q.72) From among the five animals listed below, match the two attributes — amniotic egg and endothermy, with the correct animal (s):

- (a) Fish
- (b) Frog
- (c) Crocodile
- (d) Pigeon
- (e) Zebra

- A. Amniotic egg: b, c, d; Endotherm : d, e
- B. Amniotic egg: c, d, e; Endothermy: d, e
- C. Amniotic egg: a, b, c, d; Endothermy: c, d, e
- D. Amniotic egg: b, c, d; Endothermy; c, d, e

Q.73) **Agrobacterium Ti plasmid vectors are used to generate transgenic plants. The following are examples of vir gene-encoded proteins that are important for the transfer of T-DNA into plants:**

A. Vir E, a single-stranded DNA binding protein

B. Vir D2 that generates T-strands

C. Vir A that senses plant phenolic compounds

D. Vir F which directs T-complex proteins for destruction in proteasomes

Which one of the following combinations of proteins functions inside the plant cells?

A. Only A and C

B. A, B and C

C. Only B and C

D. A, B and D

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Q.74) Match the following Vir proteins with their correct function during Agrobacterium mediated transfer of T-DNA to plant cells.

	Vir protein		Function
A	Vir G	(i)	Nucleus targeting of T-DNA
B	Vir D2	(ii)	Component of membrane structure (transfer apparatus) for T-DNA transfer
C	Vir B1	(iii)	Proteasome mediated destruction of proteins coating T-DNA complex
D	Vir F	(iv)	Induction of <i>Vir</i> genes

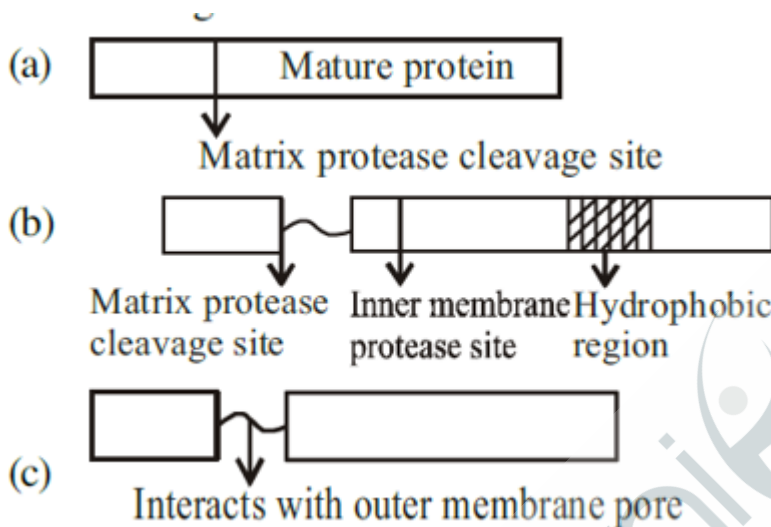
- A. A-(i), B(ii), C-(iii), D-(iv)
 B. A-(iv), B(i), C-(ii), D-(iii)
 C. A-(i), B(iii), C-(iv), D-(ii)
 D. A-(iii), B(ii), C-(i), D-(iv)

Q.75) Following are certain statement regarding somatic hybridization, a technique used for plant improvement :

- (1) Protoplasts of only sexually compatible plant species can be fused
 - (2) Hybrids are produced with variable and asymmetric amounts of genetic material of parental species
 - (3) Protoplast fusion permits transfer of gene block or chromosomes
 - (4) Genes to be transferred need to be identified and isolated
- Which one of the following combinations of the above statements is correct ?

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

Q.76) Following is the domain organization of three proteins that are targeted to the mitochondria. Based on the domain organization in the above figure and assuming the left box to be having the mitochondrial sorting signal, predict the most likely sub-compartment of the mitochondria in which the protein will be found.



- A. (A)A in matrix;B in inner membrane;C in inter-membrane space
- B. (B)A in innermembrane; B in inter-membrane space; C in outer membrane
- C. (C)A and B are in matrix; C in outer membrane space
- D. (D)A in matrix; B and C are in inter- membrane space

Q.77) A student wrote following statements regarding comparison of Restriction Fragment Length Polymorphism(RFLP), Random Amplified Polymorphic DNA (RAPD), Amplified Fragment Length Polymorphism (AFLP) and Simple Sequence Repeats (SSRs) techniques used for generating molecular markers in plants: (a) All these techniques can be used for fingerprinting.

- (b) Detection of allelic variation can be achieved only by RFLP and SSRs.
- (c) Use of radioisotopes is required in RFLP and RAPD only.
- (d) Polymerase chain reaction is required for all the techniques.

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

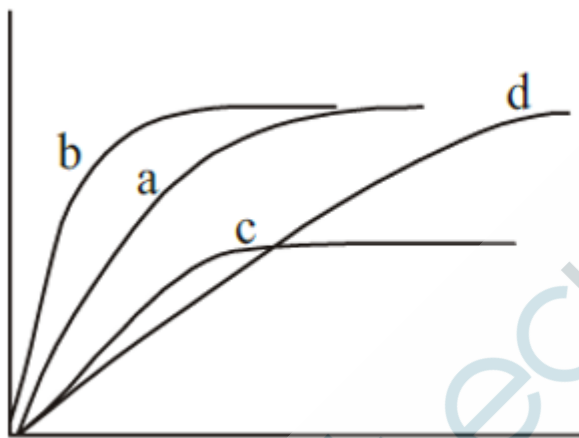
- A. (a)and(b)
- B. (b)and(c)
- C. (c)and(d)
- D. (d)and(a)

Q.78) Fluorescence recovery after photobleaching (FRAP) is a method to estimate the diffusion of molecules in a membrane. Fluorescently labelled molecules such as

- i. a receptor tagged with green fluorescent protein (GFP)
- ii. a receptor labelled with GFP which interacts with cytoskeleton
- iii. a labelled lipid
- iv. a labelled protein that binds to the membrane surface are photobleached and the recovery profiles (a-d) were obtained to estimate their diffusion coefficients.

The following data were obtained:

Which one of the combinations is correct?



- A. (A) a = i; b = ii
- B. (B) b = iii; a = iv
- C. (C) c = iii; d = iv
- D. (D) d = ii; b = i

Q.79) When a nerve fiber is stimulated with increasing strength of the stimulus, the action potential fails to generate even though the threshold level may be passed. The following statements may explain this accommodation of nerve fiber:

- A. The critical number of open sodium channels required to trigger the action potential may never be attained due to slow depolarization.
- B. Potassium channels open in response to slow depolarization, which makes the nerve fiber refractory to depolarization.
- C. The low threshold sodium channels remain open, which increases the threshold of firing of the action potential.

D. The efflux of sodium and influx of potassium due to the operation of Na^+ , K^+

ATPase oppose depolarization. Which one of the following is correct?

- A. A only
- B. A and B
- C. C only
- D. C and D

Q.80) If in a blood transfusion, type A donor blood is given to recipient having type B blood, the red blood cells (RBC) of donor blood would agglutinate but the recipients RBCs would be least affected. These observations can be explained in the following statements.

- A. Agglutinins in recipient's plasma caused agglutination by binding with type A agglutinogens.**
- B. The agglutinins of donor blood was diluted in recipient's plasma resulting in low agglutination.**
- C. Low titre of anti-A agglutinins is the cause of low agglutinations of recipients RBC's.**
- D. High agglutination of donor RBC's is the outcome high titre of anti-B agglutinins**

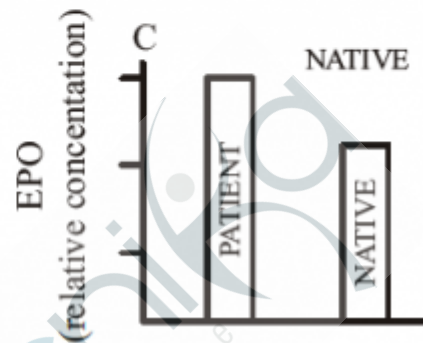
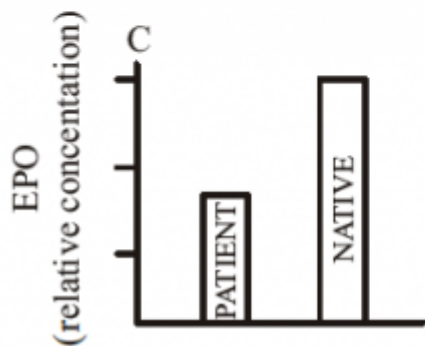
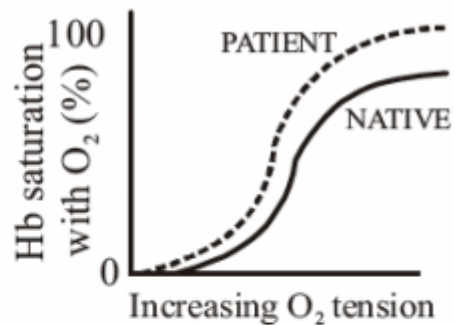
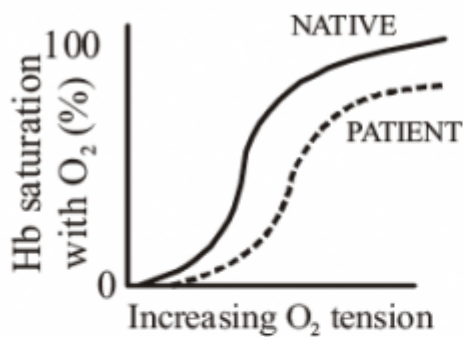
Which of the above statement(s) is/are INCORRECT?

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

Q.81) During the Spanish conquest of the Inca Empire at the high altitude in Peru, many soldiers fell sick. It was found

that the sickness was due to the low partial pressure of O_2 in the atmosphere at that altitude. To determine the reason, blood was collected from those patients. The circulating erythropoietin (EPO) level were estimated and the O_2 - dissociation curve of haemoglobin were drawn and compared with the same in native people as depicted below. Ref Pic

Which one of the following combinations is logically correct?



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

Q.82) A researcher collected information from four forest areas using a sensor to assess their green cover, observed average spectral values for each of the forests are given in the table below. Choose the forest green cover in order of highest to lowest

Forest	Spectral value	
	NIR	VIS
A	0.50	0.08
B	0.40	0.30
C	0.50	0.20
D	0.60	0.20

- A. A>C>B>D
- B. A>D>C>B
- C. B>C>D>A
- D. D>A>B>C

Q.83) The ECG recorded by different leads is analysed on the basis of variation of electrical potential at various loci on the surface of the body and the time scale relation of different waves. After analysis the ECG, following particulars of hearts are proposed to be obtained:

- A. Stoke volume and cardiac output
- B. Volume and pressure changes during cardiac cycle
- C. Anatomical orientation of heart
- D. Various disturbance in the rhythm and conduction of cardiac excitation
- E. The extent location and progress of ischemic damage to mycoradium

Which one of the following combination represents the INCORRECT particulars of hearts

- A. A and B
- B. B and C
- C. C and D
- D. D and E

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COLLECTINS INFLAMMATION PROTAGLA

MAST CELLS INFLAMMATORY BARRIERS PHAGOSOME

COMPLEMENT PROTEINS CLONAL A

HISTAMINE DIAPEDESIS VA

CHEMOTAXIS WHEAL-AND-LEUKOTRINE A

REACTIVE NITROGEN SPECIES ME

WITH SWEET ALLOGENIC KETOGENIC

VITAMIN DEFICIENCIES

Q.84)

In *C. elegans*, an anchor cell and a few hypodermal cells take part in the formation of vulva. The experiments performed to understand the role of these cells in vulva formation and the results obtained are as follows:

- If the anchor cell is killed by laser beam, hypodermal cells do not participate in vulva formation and no vulva develops.
- If six hypodermal cells closely located with anchor cell (called vulval precursor cells) are killed, no vulva develops.
- If the three central vulval precursors are destroyed, the three outer cells, which normally form hypodermis, take the fate of vulval cells instead.

Following are certain statements regarding vulva formation:

- A. Anchor cell acts as an inducer
 - B. Six hypodermal cells with the potentiality to form vulva, form an equivalence group
 - C. Three, out of six, hypodermal cells participate in vulva formation
 - D. The central cell functions as the 1° cell and the two cells on both side act as the 2° cells
 - E. The 1° cell secretes a short range juxtacrine signal
- Which combinations of the above statements have been derived from the above experimental results?

- A. A,B,C
- B. A,B and D
- C. D and E
- D. B,D and E

Q.85) The following small peptide substrates are used for determining elastase activity and the following data have been recorded (as per the table)

The arrow indicates the cleavage site . From the above observations, it appears that :

- A. PAPAF is digested most rapidly
- B. PAPAG is digested most rapidly
- C. A hydrophobic residue at the C-terminus seems to be favored
- D. A smaller residue at the C terminus seems to be favored
- E. Elastase always requires a smaller residue at the N terminus of the cleavage site

Which of the following is true ?

Substrate	$K_M(\text{mM})$	$k_{\text{cat}}(\text{s}^{-1})$
P A P A ↓ G	4.02	26
P A P A ↓ A	1.51	37
P A P A ↓ F	0.64	18

- A. A, C and E
- B. B, D and E
- C. E only
- D. D and E

Q.86) Which of the following are functions of Sertoli cells?

- (1) protection of developing spermatogenic cells,
- (2) nourishment of spermatocytes, spermatids, and sperm,
- (3) phagocytosis of excess spermatocyttoplasm as development proceeds,
- (4) mediation of the effects of testosterone and FSH,
- (5) control of movements of spermatogenic cells and release of sperm into the lumen of seminiferous tubules

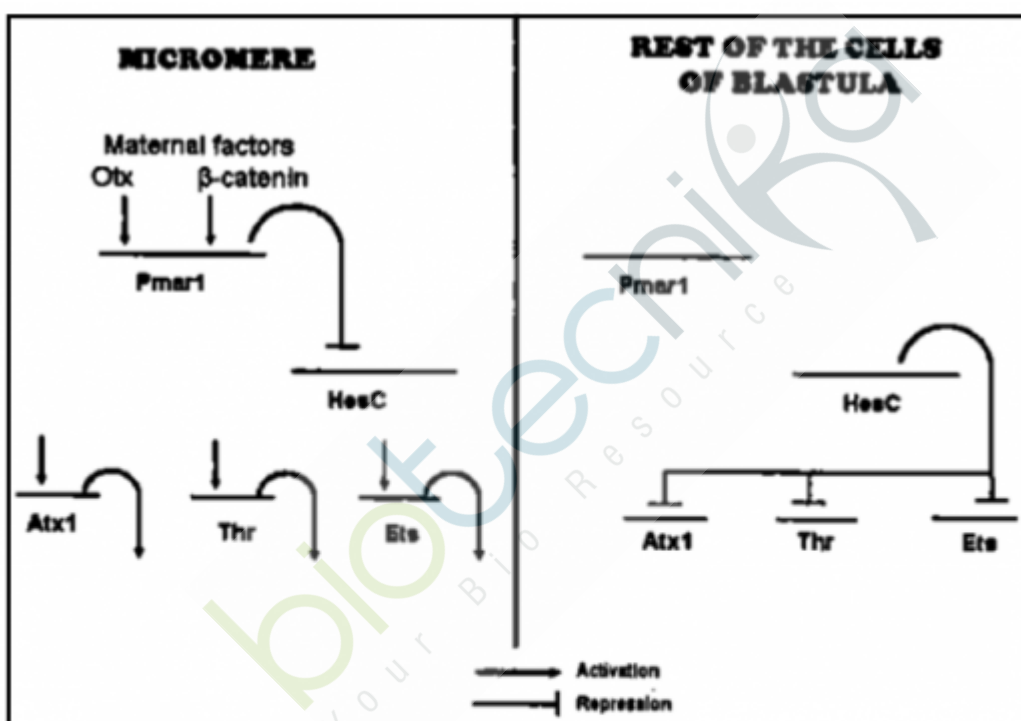
- A. 1,2,4,5
- B. 1,2,3,5
- C. 2,3,4,5,
- D. 1,2,3,4,5

Q.87) Consider the structureless oligopeptide , R-G-P-S-T-K-M-P-E-Y-G-S-T-D-Q-S-N-W-H-F-R.
The number of bonds that will be cleaved by trypsin and chymotrypsin treatments separately are :

- A. 1, 2
- B. 2,2
- C. 2,3
- D. 1,3

Q.88) In sea urchins, a group of cells at the vegetal pole become specified as the large micromere cells. These cells are determined to become skeletogenic mesenchyme cells that will leave the blastula epithelium to ingress into the blastocoel. This specification is controlled by the expression of Pmar1 which is a repressor of HesC. HesC represses the genes encoding transcription factors activating skeleton forming genes. The gene regulatory network is given below.

Below, column I lists the experiments carried with mRNA/antisense RNA of different genes injected into single celled sea urchin embryo while column II lists the developmental outcomes: Match the following: Which of the following combinations is correct?



Column I (Injection of)	Column II (developmental outcomes)
A. mRNA of Pmar1	1. All cells will start ingressing into the blastocoel
B. mRNA of HesC	2. Skeleton mesenchyme will not be formed
C. Antisense of Pmar1	
D. Antisense of HesC	

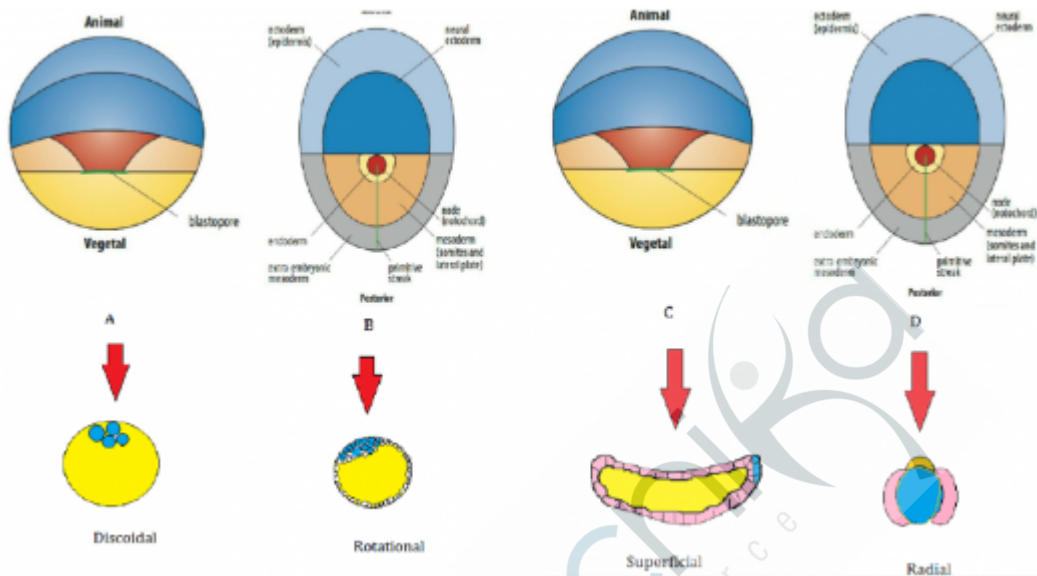
A. A-2, B-1, C-1, D-2

B. A-1, B-1, C-2, D-2

C. A-1, B-2, C-2, D-1

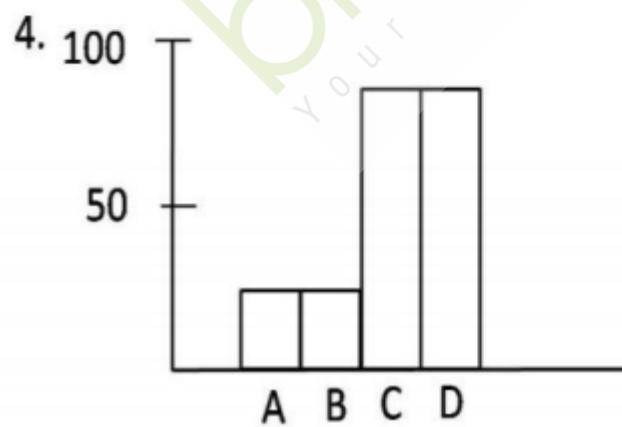
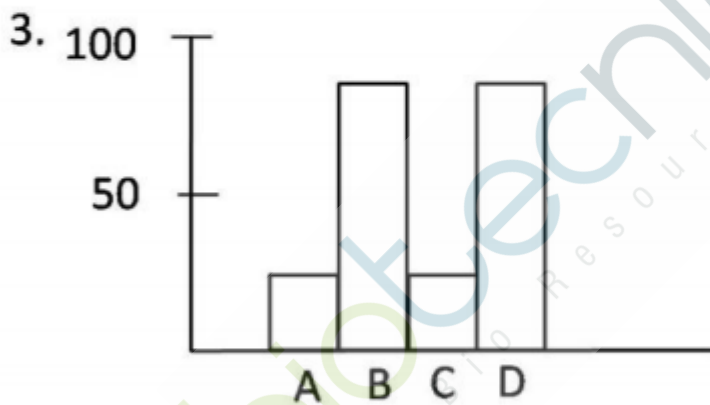
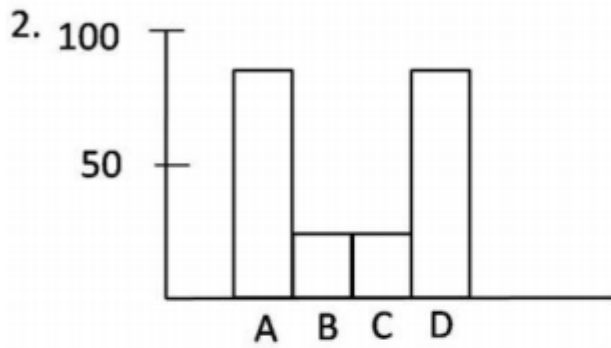
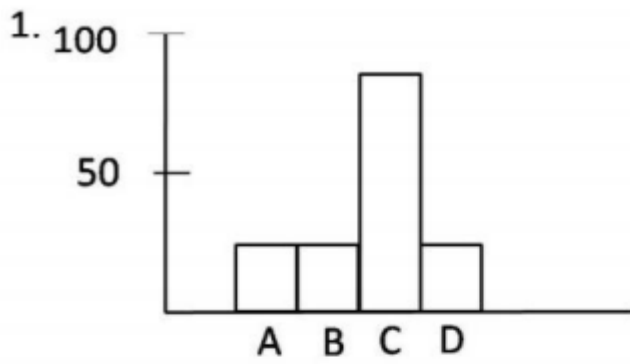
D. A-2, B-2, C-2, D-2

Q.89) Given below are fate map of two organisms and the pattern by which embryos undergo cleavage. Which of the following is/are the right combination(s)?



- A. B only
- B. B and A
- C. A and C
- D. B and D

Q.90) A protein X is kept in an inactive state in cytosol as complexed with protein Y. Under certain stress stimuli, Y gets phosphorylated resulting in its proteasomal degradation. X becomes free, translocates to nucleus and results in the transcription of a gene which causes cell death by apoptosis. Stress stimuli were given to following four different cases. Case A: Protein Y has a mutation such that phosphorylation leading to proteasomal degradation does not occur. Case B: Cells are transfected with a gene which encodes for a protein L that inhibits the translocation of protein Y to the nucleus. Case C: Cells are transfected only with empty vector used to transfect the gene for protein L. Case D: Cells are treated with Z-VAD-FMK, a broad spectrum caspase inhibitor. Which one of the following graphs best describes the apoptotic state of the cells in the above cases? Y-axis represents % apoptotic cells.



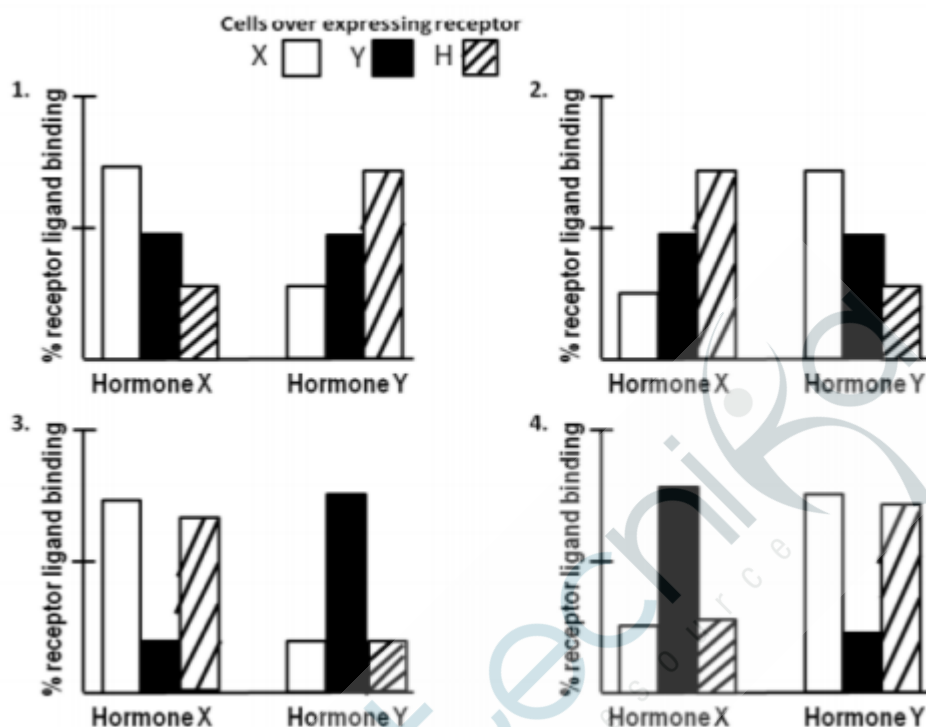
A. Option 1

B. Option 2

C. Option 3

D. Option 4

Q.91) Two steroid hormone receptors X and Y both contain a ligand binding domain and a DNA binding domain. Using recombinant DNA technology, a modified hybrid receptor H is prepared such that it contains the ligand binding domain of X and DNA binding domain of Y. Three sets of cells over-expressing receptors X, Y and H were then treated separately either with hormone X or with hormone Y. Assuming that there is no cross-reactivity, which one of the following graphs best represent the receptor-ligand binding in each case?

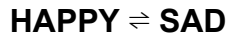


- A. Option 1
- B. Option 2
- C. Option 3
- D. Option 4

Q.92) for translation process besides eIF2, Met-t-RNA eukaryotic 80S ribosome also require

- A. GTP
- B. ATP
- C. UTP
- D. CTP

Q.93) A research group discovers a new version of happyase, which they call happyase*, that catalyzes the chemical reaction



The researchers begin to characterize the enzyme.

(a) In the first experiment, with [Et] at 4 nM, they find that the V_{\max} is $1.6 \mu\text{M s}^{-1}$.

Based on this experiment, what is the k_{cat} for happyase?

(b) In another experiment, with [Et] at 1 nM and [HAPPY] at $30 \mu\text{M}$, the researchers find that V_0 300 nM s^{-1} . What is the measured K_m of happyase for its substrate HAPPY?

A. 10 s^{-1} and $400 \mu\text{M}$ respectively

B. 400 s^{-1} and 10 M respectively

C. 10 s^{-1} and 400 M respectively

D. 400 s^{-1} and $10 \mu\text{M}$ respectively

Q.94) A mouse was primed with trinitrophenyl-lipopolysaccharide (TNP-LPS) whereas another mouse was primed with TNP-keyhole limpet hemocyanin (TNP-KLH). After three weeks, these mice were sacrificed and splenic cells were fractionated to B cells and T cells. B cells from TNP-LPS primed mice were co-cultured with T cells from TNP-LPS or TNP-KLH primed mice. Similarly, B cells from TNP-KLH primed mice were co-cultured with T cells from TNP-LPS or TNP-KLH primed mice. So, among the four co-cultures which one will give maximum antibody production:

A. $\text{B}^{\text{TNP-LPS}} \times \text{T}^{\text{TNP-LPS}}$

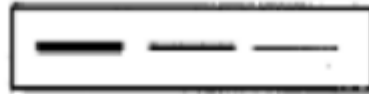
B. $\text{B}^{\text{TNP-LPS}} \times \text{T}^{\text{TNP-KLH}}$

C. $\text{B}^{\text{TNP-KLH}} \times \text{T}^{\text{TNP-LPS}}$

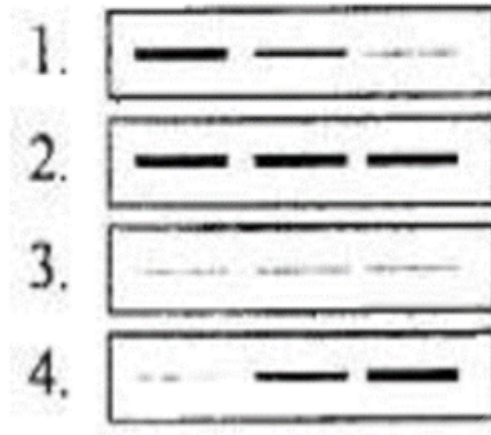
D. $\text{B}^{\text{TNP-KLH}} \times \text{T}^{\text{TNP-KLH}}$

Q.95) One of the cellular events that TOR, a kinase, positively regulates is the rate of rRNA synthesis. TOR regulates the association of a transcription factor to a Pol I subunit. When TOR is inhibited by the drug rapamycin, the transcription factor dissociates from Pol I. A yeast strain is engineered, which expresses a fusion of the transcription factor and the Pol I subunit. The level of rRNA synthesis is monitored in these cells using pulse labelling following rapamycin addition for the times indicated below. The transcription profile of rRNA observed for the wild type cells is given below: Identify the pattern expected in the engineered strain.

t (min): 0 20 40



Expected pattern in engineered strains



- A. 1
- B. 2
- C. 3
- D. 4

Q.96) A man can do a job in 6 days. His brother takes 12 days and his sister completes the job in 24 days. How long will they take to complete the job if they all work together?

- A. 7/24 days
- B. 7 days
- C. 24/7 days
- D. 3 days

Q.97) Two different mutants of *Drosophila* gives a black body color. when these mutants are crossed all progeny have wildtype color. It means mutations are

- A. Co-dominant
- B. allelic
- C. non-allelic

D. epistatic

Q.98) **Inversion leads to crossover suppression because**

- A. when crossing over happens within an inversion loop, leads to deleted and duplicated cross over chromosome, and inviability of the zygotes carrying them
- B. no crossing over in the inversion loop
- C. crossingover leads to the formation of all acentric chromosome
- D. seggregation of chromosome is not normal

Q.99) **The afferent nerve fibers of a stretch reflex were electrically stimulated and the contraction of the muscle innervated by efferent fibers was recorded. The time points of the nerve stimulation and response**

of the muscle. Which one of the following time durations will be probable value for the observed synaptic delay?

- A. (A) 0. 05 msec
- B. (B) 0.5 msec
- C. (C) 0.5 sec
- D. (D) 5.0 msec

Q.100) **Polygenic traits in crops can be identified by**

- A. QTL mapping
- B. Cluster analysis
- C. Tandem array analysis
- D. gene mapping

Q.101) **A *Neurospora* strain have start and stop growth behaviour. the mutated gene was found to be on the mitochondria. If male *Neurospora* having stp mutation, is crossed with wild type female *Neurospora*. Phenotype of progenies will be**

- A. all start and stop mutation
- B. all wild type
- C. majority of start and stop mutant
- D. majority of wild type

Q.102) **The time taken for atrial systole and diastole in a normal heart is t_{as} and t_{ad} seconds, respectively. If ventricular**

diastolic time (seconds)

(A) $(t_{as} + t_{ad}) - t_{vs}$

(B) $(t_{as} - t_{ad}) + t_{vs}$

(C) $(t_{ad} - t_{as}) - t_{vs}$

(D) $(t_{as} + t_{ad}) \times t_{vs}$

- A. A
- B. B
- C. C
- D. D

Q.103) **The cell bodies of sympathetic preganglionic neurons are located in :**

- A. (A) Intermedio lateral cell column of spinal cord
- B. (B) Posterior cell column of spinal cord
- C. (C) Celiac ganglion
- D. (D) Paravertebral ganglion.

Q.104) **Lipid rafts are involved in signal transduction in cells. Rafts have a composition different from the rest of the membrane. Rafts were isolated and found to have cholesterol to sphingolipid ratio of 2:1. The estimated size of the raft is 35 nm². If the surface areas of cholesterol is 40 Å² and sphingolipid is 60 Å², how many cholesterol and sphingolipids are present in one raft?**

- A. 1. 50 cholesterol; 25 sphingolipid
- B. 2. 200 cholesterol: 100 sphingolipid
- C. 3. 40 cholesterol : 20 sphingolipid
- D. 4. 20 cholesterol: 10 sphingolipid

Q.105) **Which one of the following statements correctly applies to proteins which are translated on the rough endoplasmic reticulum?**

- A. (A) Cytoplasmic proteins which are targeted to the nucleus in response to hormone stimuli
- B. (B) Proteins targeted to lysosomes, plasma membrane and cell exterior
- C. (C) Proteins which are targeted to the nucleus through endoplasmic reticulum lumen as the lumen is in direct connection with the inter membrane space of the nucleus
- D. (D) All proteins which get targeted to peroxisomes

Q.106) **Which one of the following is NOT involved with the absorption of iron in the intestine?**

- A. Divalent metal transporter
- B. Ferroportin 1
- C. Hephaestin
- D. Transferrin

Q.107) **In which one of the body fluids is K⁺ concentration higher than that of Na⁺?**

- A. Plasma
- B. Perilymph
- C. Endolymph
- D. Cerebrospinal fluid

Q.108) **The quantum yield of oxygen evolution during photosynthesis drastically drops in far red light. This effect is known as?**

- A. Far red drop
- B. red drop
- C. blue drop
- D. visible spectrum drop

Q.109) **Which of the following compounds is generally translocated in the phloem?**

- A. Sucrose
- B. Glucose
- C. D -Mannose
- D. D- Fructose

Q.110) **In male gametogenesis, what is the role of Sertoli cells?**

- A. Form junctional complex
- B. Attach to basal lamina
- C. Isolate gamete cells
- D. Replicate Type A pale spermatogonia

Q.111) **In order to survive in a non- aquatic environment , plants acquired several adaptations with specialized functions . Given below is a list of features/ Characteristics (column A) and their potential role (column B) Which one of the following options represents a correct match between the adaptations and their functions?**

Column A		Column B	
A.	Waxy cuticle	(i)	Mechanical support
B.	Thickened or lignified cell walls	(ii)	Protection against excess light
C.	Homoiohydric	(iii)	Restrict water loss
D.	Pigmentation	(iv)	Vascular system

A. A- i, B- ii, C- iii, D- iv

B. A- iv, B - iii, C- i, D- iii

C. A- iii, B- i, C- iv, D- ii

D. A- ii, B- iii, C- ii, D- i

Q.112) **Following are certain statements regarding the energy efficiencies of ectotherms and endotherms: A. Ectotherms have high assimilation efficiency but low production efficiency.**

B. Ectotherms have low assimilation efficiency but high production efficiency.

C. Endotherms have high assimilation efficiency but low production efficiency.

D. Endotherms have low assimilation efficiency but high production efficiency.

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

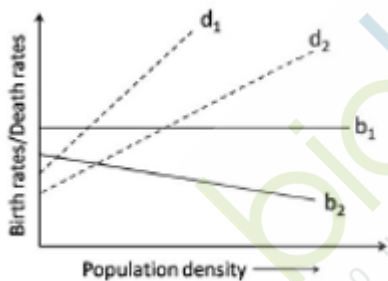
A. A and B

B. B and C

C. C and D

D. A and C

Q.113) **Which of the following statements about the birth rates (b_1 , b_2) and death rates (d_1 , d_2) of species 1 and 2 indicated in the figure is NOT true?**



A. Birth rates of species 1 are density - independent.

B. Death rates of both species are density- dependent.

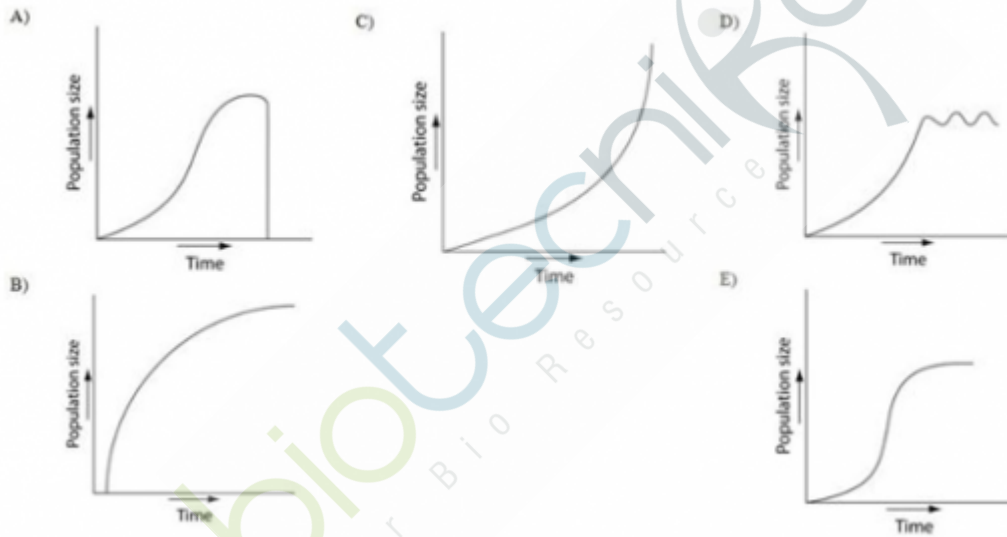
C. Birth rates of species 2 are density- dependent.

D. Density- dependent effects on death rates are similar for both the species.

Q.114) Two species of plants were sampled in 32 quadrats in a forest. The mean and variance for the occurrence of species 1 were 16.2 and 48 and species 2 were 3.6 and 3.2 respectively. Which of the following statements about the distribution of the two species in these quadrats is supported by these findings?

- A. Both species were distributed randomly.
- B. Species 1 is distributed randomly and species 2 is clustered.
- C. Species 1 is clustered and species 2 is distributed randomly.
- D. Both species are clustered.

Q.115) Which of the following graphs illustrates the growth over several seasons of a population of snowshoe hares that were introduced to an appropriate habitat also inhabited by predators in northern Canada?



- A. B or C
- B. D
- C. A or E
- D. A

Q.116) In electron microscopy, to detect specific macromolecule or spindle pole body (SPB), the frequently used procedure is to couple secondary antibody with

- A. Alexa 568
- B. Cy5
- C. Gold particle
- D. Osmium tetroxide

Q.117) **Measurement and mapping of spatial resolution the membrane potential of a cell, which is too small for a microelectrode impalement is done using**

- A. pH sensitive chemical
- B. voltage sensitive dye
- C. radioisotope
- D. vital dye

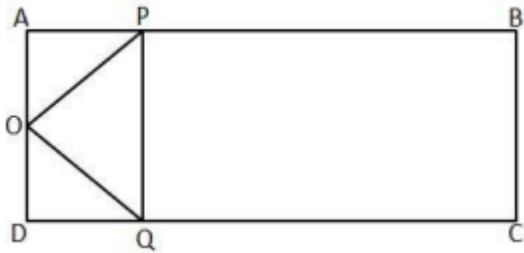
Q.118) **In an experiment designed to clone a PCR-amplified fragment in a cloning vector digested with XhoI (C/TCGAG) and SmaI (CCC/GGG), which one of the following combinations of restriction enzymes can be used in the PCR primer to generate compatible ends for cloning? ('/' indicates the site of cleavage within the recognition sequence).**

- A. XbaI (T/CTAGA) and SpeI (A/CTAGT)
- B. EcoRI (G/AATTC) and SmaI(CCC/GGG)
- C. Sal I (G/TCGAC) and EcoRV (GAT/ATC)
- D. Hind III (A/AGCTT) and PvuII (CAG/CTG)

Q.119) **Why is net primary production (NPP) a more useful measurement to an ecosystem ecologist than gross primary production (GPP)?**

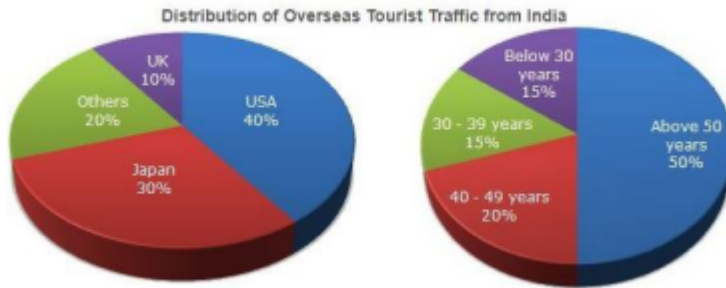
- A. NPP can be expressed in energy /unit of area/ unit of time .
- B. NPP can be expressed in terms of carbon fixed by photosynthesis for an entire ecosystem.
- C. NPP represents the stored chemical energy that is available to consumers in the ecosystem.
- D. NPP is the same as the standing crop

- Q.120) **ABCD is a rectangle and O is the mid-point of AD. P and Q are points on AB and CD, respectively such that $AP = \frac{1}{4} AB$ and $DQ = \frac{1}{4} DC$**
The ratio of the area of the rectangle ABCD to that of the triangle OPQ is



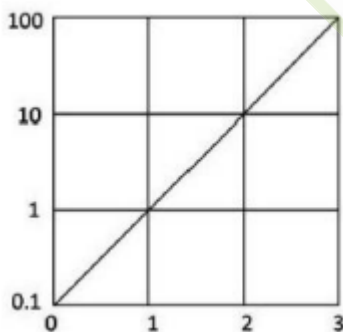
- A. 4
B. 6
C. 8
D. 16
- Q.121) **If amongst other countries, Switzerland accounted for 25% of the Indian tourist traffic, and it is known from official Swiss records that a total of 25 lakh Indian tourists had gone to Switzerland during the year, then find the number of 30-39-year-old Indian tourists who went abroad in that year?**
- A. 18.75 lakh
B. 25 lakh
C. 50 lakh
D. 75 lakh

- Q.122) The following Pie chart exhibits the distribution of overseas tourist traffic from India. The two charts show the tourist distribution by country and by the age profiles of the tourists respectively. The ratio of the number of tourists that went to the USA to the number of Indian tourists who were below 30 years of age is?



- A. 2:1
 B. 8:3
 C. 3:8
 D. cannot be determined

- Q.123) The function $f(x)$ is plotted against x as shown. Extrapolate and find the value of the function at $x = -1$



- A. -0.01
 B. -0.1
 C. 0.01
 D. 0.1

Q.124) The smallest square floor which can be completely paved with tiles of size 8×6 without breaking any tile needs n tiles, Find n ?

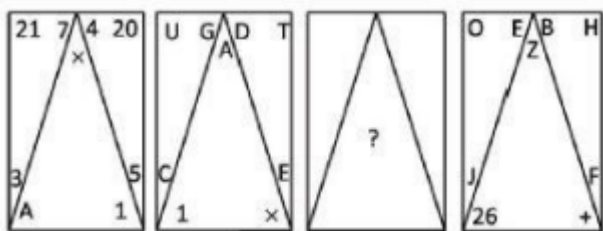
A. 56

B. 12

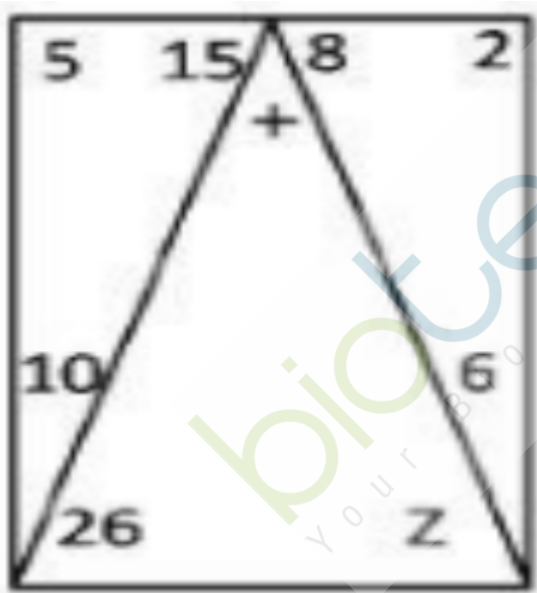
C. 24

D. 48

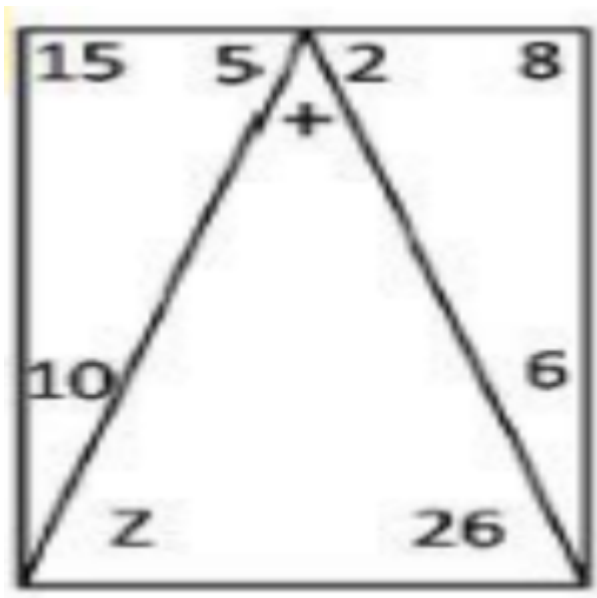
Q.125) Find the missing pattern



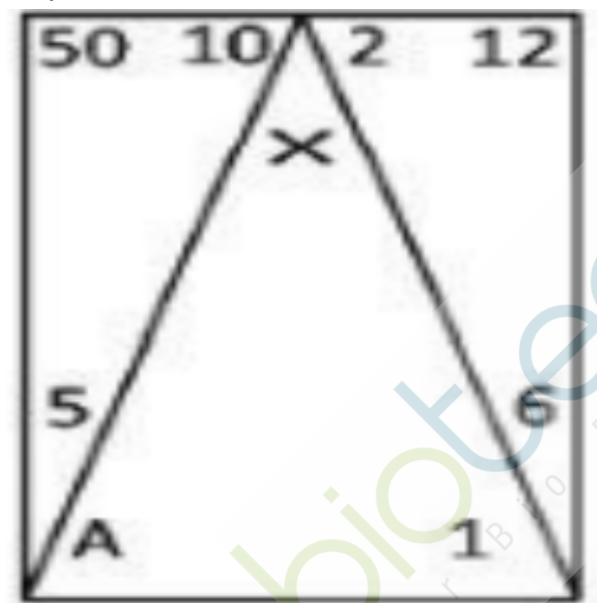
A. Option 1



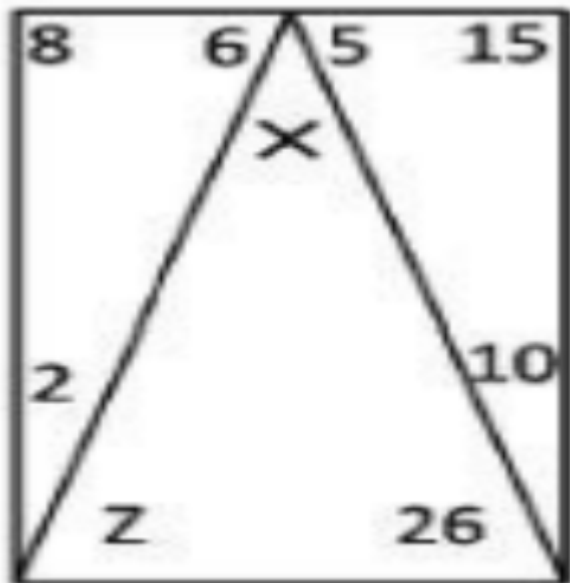
B. Option 2



C. Option 3



D. Option 4

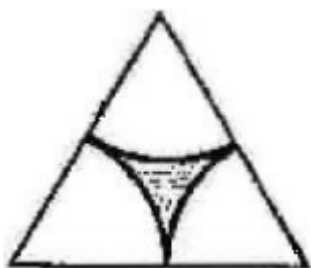


Q.126) There are two examinations, A and B in a subject that are evaluated out of 30 and 70 marks, respectively. In order to pass the course, the student has to get at least 40% in total and at least 40% in B. The following are the marks of the students S1 to S4. The only student/s to have passed is/are

Students	A	B
S ₁	12	28
S ₂	10	29
S ₃	16	27
S ₄	05	29

- A. S₁, S₃
- B. S₁, S₂, S₃
- C. S₁, S₂
- D. S₁

Q.127) What fraction of the equilateral triangle shown below with three identical sectors of a circle is shaded?



A. $1 - \frac{\pi}{2\sqrt{3}}$

B. $\frac{\pi}{2\sqrt{3}}$

C. $1 - \frac{2\pi}{\sqrt{3}}$

D. $1 - \frac{\sqrt{3}\pi}{2}$

Q.128) In a university, 200 students are selected at random. 150 like tea, 110 like coffee, and 70 like both tea and coffee. How many students like neither tea nor coffee?

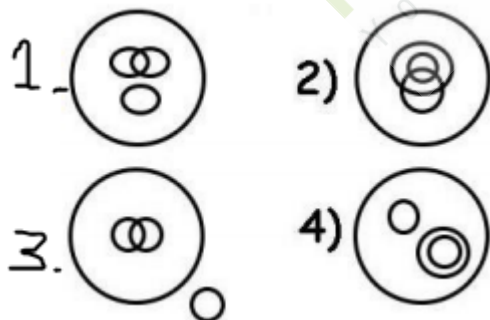
A. 10

B. 20

C. 50

D. 70

Q.129) In a dinner party, both fish and meat were served. Some took only fish and some only meat. There were some vegetarians who did not accept either. The rest accepted both fish and meat. Which of the following Venn diagrams correctly reflects this situation?



A. Option 1

B. Option 2

C. Option 3

D. Option 4

Q.130) **Fourteen of the students in the class are girls. Eight students in the class wear blue shirts. Two are neither girls nor wear blue shirts. Five students who wear blue shirts are girls. How many students are there in the class?**

- A. 19
- B. 29
- C. 17
- D. 24

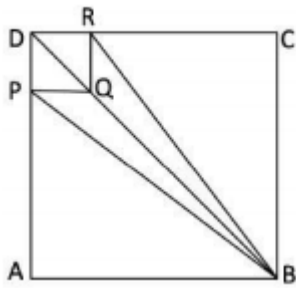
Q.131) **In a group of persons traveling in a bus, 6 persons can speak Tamil, 15 can speak Hindi, and 6 can speak Gujarati. In that group, none can speak any other language. If 2 persons in the group can speak two languages and one person can speak all the three languages, then how many persons are there in the group?**

- A. 21
- B. 22
- C. 23
- D. 24

Q.132) **A given company has 1500 employees. Of those employees, 800 are computer science majors. 25% of those computer science majors are also mathematics majors. That group of computer science/math dual majors makes up one-third of the total mathematics majors. How many employees have majors other than computer science and mathematics?**

- A. 200
- B. 300
- C. 400
- D. 500

Q.133) DRPQ is a small square of side a in the corner of a big square ABCD of side A . What is the ratio of the area of the quadrilateral PBRQ to that of the square ABCD, given



- A. $\frac{2}{9}$
- B. $\frac{1}{6}$
- C. $\frac{1}{3}$
- D. $\frac{2}{7}$

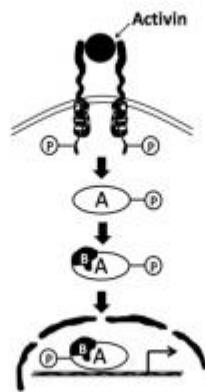
Q.134) In a group of students, 30% play only cricket, 20% play only football and 10% play only basketball. 20% of the students play both football and cricket, 15% play both basketball and cricket, 10% play both football and basketball. 15 students play no games, while 5% of the students play all three games. What is the total number of students?

- A. 300
- B. 250
- C. 350
- D. 400

Q.135) How many secondary spermatogonium are required to make 400 spermatocyte?

- A. 100
- B. 200
- C. 400
- D. 800

Q.136) In the above signalling cascade, which one of the following molecules is denoted by 'B'?



- A. STAT 5
- B. SMAD 6
- C. GSK3beta
- D. SMAD 4

Q.137) The secondary antibodies routinely used for the detection of primary antibodies in western blotting experiment are

- A. anti-allotypic
- B. anti-idiotypic
- C. anti-isotypic
- D. anti-paratypic

Q.138) Four groups of mice were studied for the factor required for mast cell generation: IL-3 deficient, GM-CSF deficient, G-CSF deficient and erythropoietin deficient. In which mice, mast cell generation is most likely to be deficient.

- A. IL-3 deficient
- B. GM-CSF deficient
- C. G-CSF deficient
- D. erythropoietin deficient

Q.139) **Acetylcholine receptor is an archetype for**

- A. Ligand gated ion channels
- B. ATPase dependent voltage gated ion channels
- C. ATPase dependent calcium gated ion channels
- D. ATPase independent voltage gated ion channels

Q.140) **For translation process besides eIF2, Met-t-RNA, eukaryotic 80S ribosome also requires**

- A. GTP
- B. ATP
- C. CTP
- D. UTP

Q.141) **If cell is not dividing (arrested cell in cell cycle) which repair mechanism will not occur?**

- A. recombination repair mechanism
- B. excision repair mechanism
- C. transcriptional coupled repair mechanism
- D. DNA synthesis annealing mechanism

Q.142) **T4 bacteriophage after infecting E.coli generally hack host machinery for transcription of its own gene. It is done by**

- A. degrading host RNA Polymerase
- B. modifying host RNA Polymerase
- C. synthesis of own RNA Polymerase
- D. degrading host genome

Q.143) Which of the following factors is known to be involved in postponing programmed cell death in cereal aleurone until endosperm mobilization is complete?

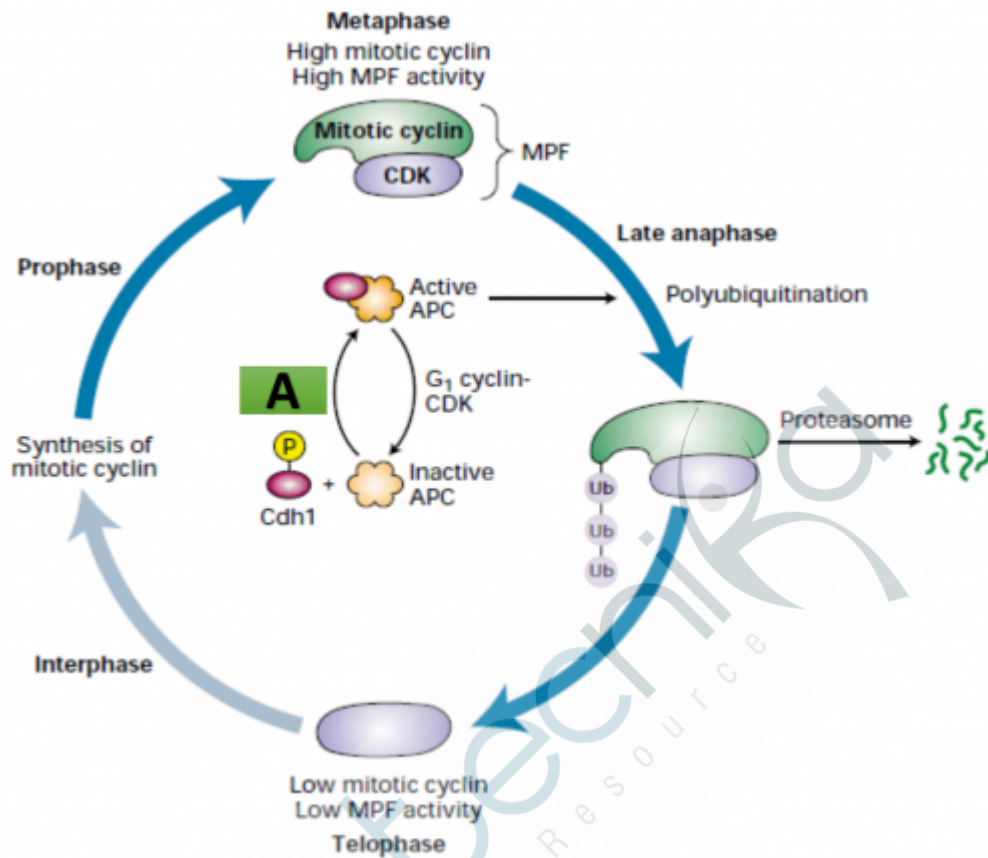
- A. Gibberellic acid
- B. Abscissic acid
- C. Acidic pH of the vacuoles
- D. cGMP mediated signal transduction pathways

Q.144) While screening an EMS mutagenized population of a plant, a researcher identified a mutant with reduced gibberellic acid sensitivity. Which one of the following proteins is most likely to be defective in this mutant?

- A. Sucrose non fermenting related kinase (SnRK2)
- B. Constitutive triple response 1(CTR1)
- C. Phytochrome interacting factor(PIF)
- D. Coronatine insensitive 1(COI1)

The advertisement features a red background with a collage of scientific images. At the top right is the Biotechnika logo with the tagline 'Your Bio Resource'. The main headline reads 'Want To Be Industry Job Ready?'. Below this, in yellow text, is 'UPSKILL YOURSELF WITH CERTIFICATION COURSES BY BIOTECHNIKA'. A white box contains the following benefits: 'Get Life Time Access', '24x7 Chat Support', 'Hard Copy Certificate', and 'Expert Guidance'. At the bottom left, a yellow box displays the website 'stores.biotechnika.org'. On the right side, there is a grid of nine course covers, each with the Biotechnika logo and a certification badge. The courses are: 1. Bioinformatic Methods & Tools Master Course, 2. Next Gen Sequencing Certification Course, 3. CRISPR Advanced Certification Program (CRISPR-CAS9), 4. PCR Technique Online Certification Program, 5. Molecular Biology Technique Online Certification Program, 6. Advance Cell Culture Technique Certification Course, 7. Virology & COVID-19 Certification Course, and 8. Artificial Intelligence In Biology Certification Course. The ninth cover, partially visible, shows a person working on a computer.

Q.145) To activate APC dephosphorylation of cdh1 is required. Dephosphorylation is done by a phosphatase which is designated in the figure as A. What is A?



- A. Cdc2
- B. Cdc14
- C. Cdc20
- D. Cdc25