

# CSIR MMT Question Paper 4



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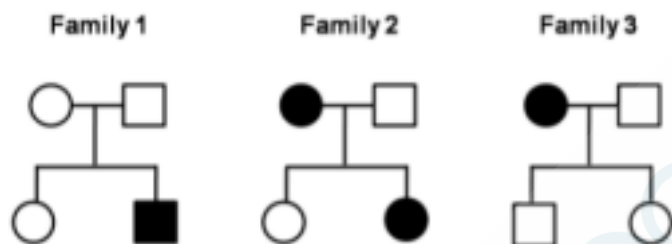
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Q.1) The inheritance of a given disorder is recorded in three small families shown below: Based on the above-limited information, which one of the following inheritance pattern best explains the observations? Which one do you like?



- A. X-linked recessive
- B. X-linked dominant
- C. Autosomal recessive
- D. Autosomal dominant

Q.2) A recessive inherited disease is expressed only in individuals of blood group O and not expressed in blood groups A, B or AB. Alleles controlling the disease and blood group are independently inherited. A normal woman with blood group A and her normal husband with blood group B already had one child with the disease. The woman is pregnant for second time. What is the probability that the second child will also have the disease?

- A.  $1/2$
- B.  $1/4$
- C.  $1/16$
- D.  $1/64$

Q.3) Somatic cell hybridization is used to assign a gene to a particular chromosome. When two cell lines from two different species are fused, they form a heterokaryon which tends to lose chromosome as they divide, preferentially from one species. A panel of cell lines was created from mouse-monkey somatic cell fusions. Each line was examined for the presence of monkey chromosomes and for the production of given enzyme. The following results were obtained.

On the basis of these results, which chromosome has the gene that codes for the given enzyme?

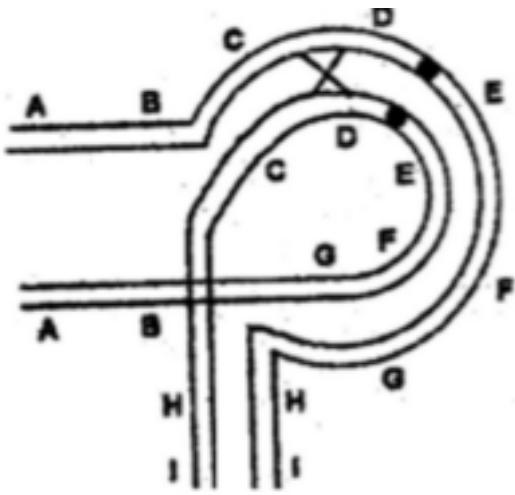
Cell line	Presence of Enzyme	Presence of Monkey chromosomes									
		1	2	3	4	5	6	7	8	9	10
A	+	+	+	+	+	+	-	+	-	+	+
B	+	-	+	+	-	+	+	+	-	+	-
C	-	-	+	-	-	-	-	-	+	+	+
D	+	+	+	+	-	-	+	+	+	+	-
E	-	-	-	-	+	+	-	-	-	+	+
F	+	+	+	-	+	+	+	+	-	+	-

- A. Chromosome 10
- B. Chromosome 7
- C. Chromosome 1
- D. Chromosome 5

Q.4) Following is the picture of an inversion heterozygote undergoing a single crossing-over event. the following statements are given towards explaining the consequence at the end of meiosis.

- A. The resultant two chromosomes will have deletions and duplications.
- B. A dicentric and an acentric chromosomes will be formed.
- C. The inversion does not allow crossing over to occur, so even if a crossing over is initiated, it will fail to occur.
- D. The crossing over is considered suppressed by inversion as the acentric chromosome will not segregate normally.
- E. All the gametes formed with cross-over chromatids at the end of meiosis will be non-viable as they carry large deletion or duplication.
- F. The gametes having non-crossover (parental) chromatid will survive.

Which combination of statements is correct?



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

Q.5) Angelman syndrome (AS) and Prader-Willi Syndrome (PWS) have very distinct symptoms. Factors responsible for the occurrence of these syndromes are given below:

- A. Microdeletion of 15q 11-13 in paternal chromosome.
- B. Uniparental disomy of maternal chromosome 15.
- C. Lack of functional maternal copy of ubiquitin ligase E3A.
- D. Lack of SNURF-SNRPN transcript, which is produced only from paternal chromosome.
- E. Deficiencies of small nucleolar RNAs, which are encoded from the introns of SNURF-SNRPN transcript from paternal chromosome.

Which of the following combination of answers is correct for Angelman and Prader-Willi Syndromes?

- A. PWS-A, C, D; AS- B, E
- B. PWS-B only; AS-A, C, D, E
- C. PWS-A, B, D, E; AS- C only
- D. PWS-A, B; AS- C, D, E

Q.6) The following table shows mapping data from three interrupted mating experiments using three different HFr strains and an F strain:  
The following answers are derived:

**The order of genes is :**

A: e g b d c f

B : f g b d c e

**The distance between**

C : f and g is 32 min and between f and b is 30 min

D : c and e is 28 min and between b and c is 20 min

The correct combination of answers is :

		Appearance of genes in F- cells				
Hfr 1	Genes	c <sup>+</sup>	f <sup>+</sup>	c <sup>+</sup>	d <sup>+</sup>	b <sup>+</sup>
	Time	6	24	34	49	54
Hfr 2	Genes	b <sup>+</sup>	d <sup>+</sup>	c <sup>+</sup>	f <sup>+</sup>	g <sup>+</sup>
	Time	1	6	21	31	63
Hfr 3	Genes	d <sup>+</sup>	c <sup>+</sup>	f <sup>+</sup>	e <sup>+</sup>	g <sup>+</sup>
	Time	4	19	29	47	61

( Time is represented in minutes)

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

Q.7) Many cytotoxic T lymphocytes initiate killing of target cells via delivery of molecules that could induce target cell damage directly. Which one of the following is the most appropriate

- A. Interferon  $\gamma$
- B. Peroxynitrite
- C. Lysozyme
- D. Granzyme

Q.8) Entry of enveloped viruses into its host cells is mediated by:

- A. Only endocytosis
- B. Both endocytosis and phagocytosis
- C. Both endocytosis and membrane fusion
- D. Only pinocytosis

Q.9) The tetanus vaccine given to humans in the case of a deep cut is a

- A. DNA vaccine
- B. recombinant vector vaccine
- C. subunit vaccine
- D. toxoid vaccine

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Q.10) DNA vaccines offer several advantages over other existing vaccine approaches. Which one of the following statements related to DNA vaccine is not correct?

- A. The immune response is directed to the antigen encoded by the DNA and able to induce both humoral and cell mediated immunity.
- B. DNA vaccine can induce prolonged expression of antigen enhancing the induction of immunological memory.
- C. DNA vaccine could remain stable and potent for long time without refrigeration, eliminating the challenges of storage and transportation.
- D. DNA vaccine construct can be engineered to carry several antigens to infect host and replicate in neuronal cells.

Q.11) Which one of the following is not a bacterial disease?

- A. Tuberculosis
- B. Typhoid
- C. Tetanus
- D. Small pox

Q.12) Which one of the following cells generally does not secrete IFN- $\gamma$ ?

- A. CD8+ T cells
- B. TH1 cells
- C. NK cells
- D. TH2 cells

Q.13) Which one of the following statements regarding B cell receptor (BCR) and T cell receptor (TCR) is NOT true?

- A. TCR is membrane bound and does not appear as soluble form as does the BCR
- B. Unlike BCR, most of the TCR are not specific for antigen alone but for antigen combined with MHC
- C. In order to activate signal transduction, BCR associates itself with Ig- $\alpha$ /Ig- $\beta$  whereas TCR associates with CD3
- D. The antigen binding interactions of BCR is much weaker than TCR



Q.14) Bacteria adopt different strategies to evade host defense mechanisms. From the list of various different mechanisms and bacterial strategies against host defense given below, select the option representing all correct pairing

Host defense mechanism	Bacterial strategies against host defense
a. Phagocytosis	W. Change of bacterial surface charge, making it more positive
b. Release antibodies, like IgG	X. Capsular polysaccharides, such as that of <i>Klebsiella pneumoniae</i>
c. Antibody-mediated agglutination	Y. Release of soluble proteins like protein A of <i>Staphylococcus aureus</i>
d. Anti-microbial peptides	Z. Secretion of elastase to inactivate C3a and C5a

- A. a-W; b-X; c-Y; d-Z  
 B. a-X; b-Y; c-Z; d-W  
 C. a-Z; b-Y; c-X; d-W  
 D. a-Y; b-W; c-Z; d-X

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Q.15) Given below are some pathogens and diseases of humans, animals and plants. Which one of the following is the correct match between the pathogen and disease caused?

A	<i>Bordetella pertussis</i>	(i)	Lyme disease of humans
B	<i>Tilletia indica</i>	(ii)	Grain rot in rice
C	<i>Borrelia burgdorferi</i>	(iii)	Karnal bunt of wheat
D	<i>Anaplasma marginale</i>	(iv)	Whooping cough in humans
E	<i>Burkholderia glumae</i>	(v)	Hemolytic anemia in cattle

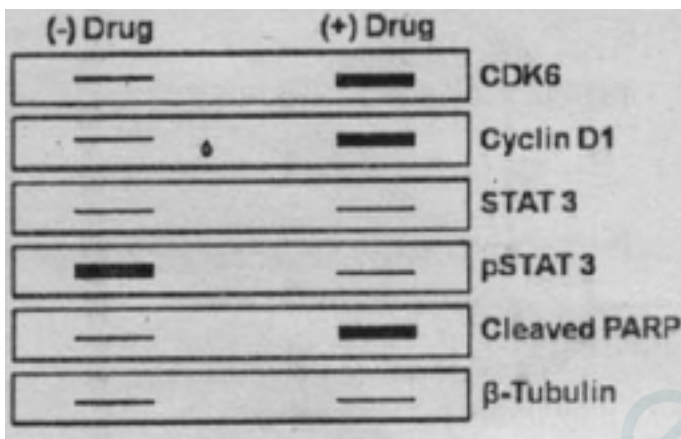
- A. A – (iv), B – (iii), C – (i), D – (v), E – (ii)  
 B. A – (iv), B – (v), C – (i), D – (ii), E – (iii)  
 C. A – (iii), B – (iv), C – (v), D – (i), E – (ii)  
 D. A – (ii), B – (v), C – (i), D – (iii), E – (iv)

Q.16) A western blot analysis after treating cancer cells with a prospective anti-cancer drug is given below:

The following assumptions were made:

- A. The drug may have arrested the growth of cells at the G1 phase.
- B. The drugs targeted the JAK-STAT signaling pathway.
- C. The drug led to apoptosis of the cell.
- D. Drug – induced apoptosis was through the extrinsic or mitochondria –independent pathway.

Which one of the following combination is correct?



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

Q.17) Which one of the following statements regarding clonal selection hypothesis is not correct?

- A. Mature B lymphocytes bear Ig receptors on their cell surface and all receptors on a single B cell have variable specificity for antigen.
- B. On antigen stimulation, B cell matures , migrates to lymphoid organs and replicates. Its clonal descendants bear the same receptor as parental B cell and secrete antibodies with identical specificity.
- C. After immune response, more B cells bearing receptors will remain in the host and act as memory cells for mounting enhanced secondary response.
- D. B cells with receptors for self antigens are deleted during embryonic development.

Q.18) Toll like receptors(TLR) present in mammalian macrophages are recognized by types of molecules that are not present in vertebrates but are present in certain groups of microbial pathogens. When these pathogens infect macrophages, TLR signalling is stimulated. Following are the list of macromolecules in column A and types of TLR in column B.

Which of the following is the best possible match of the pathogenic ligand with their corresponding TLR?

A		B	
(i)	Lipopolysaccharide(LPS)	a.	TLR3
(ii)	Flagellin	b.	TLR4
(iii)	Double stranded RNA	c.	TLR5
(iv)	Unmethylated CpG dinucleotides	d.	TLR9

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

Q.19) Immunoglobulins have therapeutic applications in cancer treatment, infection clearance and targeted drug delivery. For this reason, immunoglobulins are briefly cleaved by the enzyme pepsin. Following are some of the statements regarding the brief digestion of immunoglobulin by pepsin.

- (i) F(ab)<sub>2</sub> fragment is generated which retains the antigen binding activity.  
 (ii) F(ab) fragment having antigen binding activity and the crystallisable Fc fragment are generated.  
 (iii) The fragment generated on incubation with a proper antigen forms a visible precipitate.  
 (iv) The fragment generated is incapable of forming a visible precipitate on incubation with a proper antigen  
 Which of the above statements are correct?

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

Q.20) Histone acetylase and chromatin remodeling complexes are recruited to specific regions of chromatin by

- A. gene activator proteins  
 B. specific promoter sequence  
 C. phosphorylation of histone acetylase  
 D. dephosphorylation of chromatin remodeling complexes



Q.21) Origin of replication usually contains

- A. GC rich sequences
- B. Both AT and GC rich sequences
- C. No particular stretch of sequences
- D. AT rich sequences

Q.22) Bacteriophage T4 infects E.coli and injects its DNA inside the cell. The transcription of a viral gene occurs in three stages: immediate-early, early and late. All the promoters on the viral genome are available, but the control takes place at the level of

- A. Promoter strength
- B. Modification of host polymerase
- C. Synthesis of new polymerases
- D. Turn over rate of RNA synthesis

Q.23) During each cycle of chain elongation in translation, how many conformational changes does the ribosome undergo that are coupled to GTP hydrolysis?

- A. 0
- B. 1
- C. 2
- D. 3

Q.24) The lambda (I) and P22 phages are two related lambdoid bacteriophages. A recombinant lambda phage (I Mut) was derived from the wild type lambda (I WT) by replacing its CI repressor gene and the CI binding site with those from the P22 phage. Both the wild type and mutant were used independently to infect E.coli strain over-producing lambda WT CI repressor. Following outcomes were surmised

1. Infection with wild type will lyse the E.coli used
2. Infection with wild type will establish lysogeny the E.coli used
3. Infection with mutant will lyse the E.coli used
4. Infection with mutant will establish lysogeny the E.coli used

Which combination of the above statements is correct?

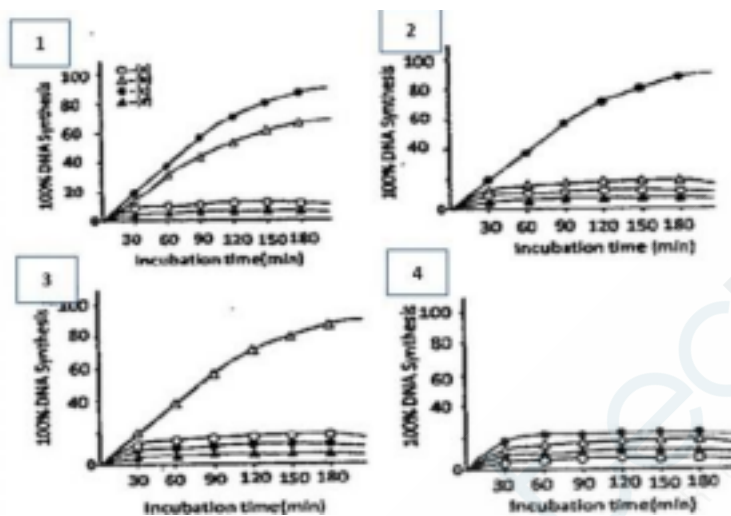
- A. 1 and 2
- B. 2 and 3
- C. 3 and 4
- D. 4 and 1

Q.25) In a cell free extract containing DNA polymerase I,  $Mg^{2+}$ , dATP, dGTP, dCTP and dTTP ( $3H$ ), the following DNA molecules were added:

- Single stranded closed circular DNA molecule containing 824 nucleotides.
- Single stranded closed circular DNA molecule having 1578 nucleotides base paired with a linear single standard DNA molecule of 824 nucleotides having a free 3'-OH group.
- Double stranded linear DNA molecular containing 1578 nucleotides having free 3'-OH group at both ends.
- Double stranded closed circular DNA molecule having 824 nucleotides.

The rate of DNA synthesis was measured by incorporation of  $3H$  thymidine in the DNA molecule and expressed as the percentage of DNA synthesis relative to total DNA input.

Which one of the following graphs represents the correct result?



- 1
- 2
- 3
- 4

Q.26) HeLa cell extract was used to study transcription of a gene 'X' having six introns. RNA Pol II complex containing all associated proteins was isolated from an actively transcribing system and subjected to proteome analysis. Results showed the presence of both splicing and capping enzymes in the complex. When transcription elongation was inhibited by flavopiridol, polymerase complex contained only capping enzymes. When phosphorylation of the CTD domain of Pol II was inhibited by a kinase inhibitor, the complex contained neither splicing nor capping enzymes. From these results, following conclusions were made:

- Transcription of gene X is coupled to mRNA capping.
- Transcription elongation is coupled to splicing.
- Phosphorylation of CTD is required for the recruitment of capping and splicing enzymes.
- Both capping and splicing of mRNAs occur simultaneously.

Identify the correct set of conclusions:

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

Q.27) In order to ensure that only fully processed mature mRNAs are allowed to be exported to the cytosol, pre-mRNAs associated with snRNPs are retained in the nucleus. To demonstrate this, an experiment was performed where a gene coding a pre-mRNA with a single intron was mutated either at the 5 or 3 splice sites or both the splice sites. Given below are a few possible outcomes:

- A. Pre-mRNA having mutation at both the splice sites will be retained in the nucleus because of the presence of bound snRNPs.
- B. Pre-mRNA having mutation at both the splice sites will be exported to cytosol because of the absence of bound snRNPs.
- C. Pre-mRNA mutated at either 3 or 5 splice sites will be retained in the nucleus because of the presence of bound snRNPs.
- D. Pre-mRNA mutated at either 3 or 5 splice sites will be exported to cytosol because of the absence of bound snRNPs.

Choose the correct combination of the possible outcomes:

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

Q.28) Amino acid selenocysteine (Sec) is incorporated into polypeptide chain during translation by:

- A. charging of Sec into tRNA<sup>ser</sup> followed by incorporation through serine codon
- B. charging of serine into tRNA<sup>ser</sup> followed by modification of serine into selenocysteine and the incorporation through serine codon
- C. charging of Sec into tRNA<sup>ser</sup> and then incorporation through selenocysteine codon
- D. charging of serine into tRNA<sup>ser</sup> followed by modification of serine into selenocysteine and then incorporation through a specially placed stop codon

Q.29) Puromycin is an antibiotic used to inhibit protein synthesis. Given below are few statements about the antibiotic.

- A. It enters the E-site of the ribosome where it prevents the release of deacetylated tRNA after the action of peptidyl transferase.
- B. It blocks the translocation process by binding to the translocation factor EF-G.
- C. Puromycin resembles the initiator tRNA, tRNA<sup>Met</sup> and binds exclusively to the P-site.
- D. It resembles the aminoacyl tRNA and binds to the A-site of the ribosome.
- E. Puromycin inhibits only prokaryotic protein synthesis.

F. Puromycin inhibits both prokaryotic and eukaryotic protein synthesis.

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

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

Q.30) Two experiments were performed. In the first one, Okazaki fragments were prepared from a replicating cell of E.coli grown in the presence of  $^{32}\text{P}$ . In the other, the two strands of the E.coli chromosome were separated into an H strand and L strand, immobilized onto a nitrocellulose membrane and hybridized with the Okazaki fragments prepared in the first experiment.

Which one of the following options correctly describes the observation?

- A. Okazaki fragments will hybridize to only H strand
- B. Okazaki fragments will hybridize to only L strand
- C. Okazaki fragments will hybridize with both H and L strands
- D. Because the H and L strands have been prepared from different cultures of E. coli, the Okazaki fragments will hybridize to neither

Q.31) Which one of the following agents cause relaxation of mesangial cells?

- A. Histamine
- B. Thromboxane A<sub>2</sub>
- C. Norepinephrine
- D. Dopamine

Q.32) The membrane potential in a giant squid axon recorded intracellularly at the resting condition (-70 mV) was reversed at the peak of action potential (+35 mV) after stimulation of the nerve fibre with a threshold electrical stimulus. This overshoot of the membrane potential has been explained in the following proposed statements:

- A. The rapid increase in  $\text{Na}^+$ -conductance during early phase of action potential uses membrane potential to move toward the equilibrium potential of  $\text{Na}^+$  (+45 mV).
- B. The  $\text{Na}^+$ -conductance quickly decreases toward resting level after peak in the early phase and  $\text{Na}^+$ -ions are not able to attain its equilibrium potential within this short time.
- C. The conductance of  $\text{K}^+$  at the early phase of action potential is increased and that leads to the reversal of membrane potential.
- D. The increase of  $\text{K}^+$ -conductance due to stimulation of nerve occurs before the changes of  $\text{Na}^+$ -conductance is initiated and thus causes overshoot at the peak of action potential.

Which one of the following is correct?

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

Q.33) After hemorrhage, a subject develops hypovolemia and hypotension. Following are some of the statements regarding homeostatic measure taken by the body after hemorrhage.

- A. Increased release of vasopressin
- B. Increased water retention and reduced plasma osmolality
- C. Increased rate of afferent discharge from low pressure receptors of vascular system
- D. Decreased rate of afferent discharge from high pressure receptors of vascular system

Which one of the following is NOT correct in this condition?

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

Q.34) Maintaining the salt concentration and volume plasma are two key parameters for physiological processes achieved by the kidney. Which of the following structural and functional combines the most efficient renal regulatory system mammals?

Combination No	Structural	Functional
1	Large glomerulus, long proximal and distal tubules, long Henle's loop	Trans epithelial in proximal countercurrent multiplier, ADH responsiveness of distal tubule
2	Small glomerulus, short proximal and distal tubules, short Henle's loop	Trans epithelial potential in distal tubule, very high ADH concentration in circulation
3	Very large glomerulus, short proximal tubule, very long distal tubule, long Henle's loop	Very efficient glomerular filtration, prevention of solute loss
4	Small glomerulus, long proximal and distal tubules, Henle's loop	Preventing water and solute filtration, excreting solute, lowering ADH responsiveness



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

Q.35) Three forms of dextrans namely neutral, polyanionic and polycationic having different molecular radii were injected separately in three groups of rats.

The concentrations of dextrans in glomerular filtrate were measured to determine the filterability of the dextrans. The possible outcomes could be as follows:

- (A) The dextrans having smaller diameter have greater filterability than larger dextrans.
- (B) Neutral dextrans were filtered more than polycationic and polyanionic dextrans.
- (C) Polycationic dextrans were filtered more than neutral and polyanionic dextrans.
- (D) Polyanionic dextrans were filtered more than neutral and polycationic dextrans.

Which one of the following combinations is correct?

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

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

- A. 36
- B. 168
- C. 364
- D. 196

Q.37) Which of the following statements is not correct regarding the effect of genetic drift ?

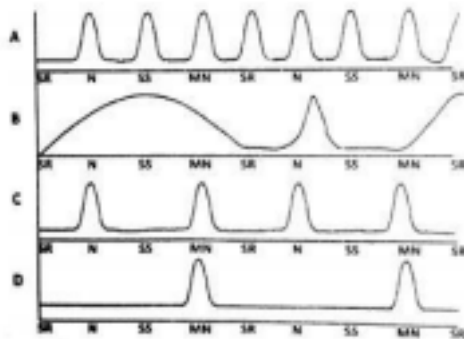
- A. It alters allele frequency substantially only in small population
- B. It can cause allele frequencies to change at random
- C. It can lead to a loss of genetic variation within population
- D. It can cause harmful alleles to become eliminated

Q.38) Which of the following is NOT an assumption of the Hardy-Weinberg model?

- A. Population mates at random with respect to the locus in question
- B. Selection is not acting on the locus in question
- C. One allele is dominant and the other is recessive at this locus
- D. The population is effectively infinite in size

Q.39) Following are the plots representing biological rhythms at different time points depicted as: SR = Sunrise; N = Noon; SS = Sunset; MN = Midnight.

Which of the plot(s) represent the ultradian biological rhythm(s)?



- A. Plot B
- B. Plots A and C
- C. Plots C and D
- D. Plot D

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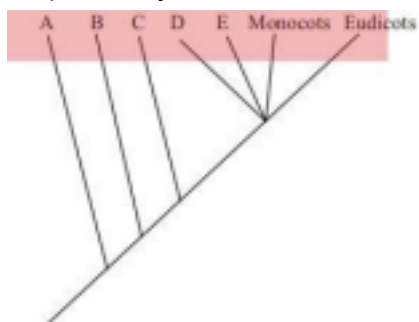
Q.40) Red hair is a recessive trait in humans. In a randomly mating population in Hardy-Weinberg equilibrium, approximately 9% of individuals are red-haired. What is the frequency of heterozygotes?

- A. 81%
- B. 49%
- C. 42%
- D. 18%

Q.41) Consider an autosomal locus with two alleles A1 and A2 at frequencies of 0.6 and 0.4 respectively. Each generation, A1 mutates to A2 at a rate of  $\mu = 1 \times 10^{-5}$  while A2 mutates to A1 at a rate of  $\nu = 2 \times 10^{-5}$ . Assume that the population is infinitely large and no other evolutionary force is acting. The equilibrium frequency of allele A1 is

- A. 1.0
- B. 0.5
- C. 0.67
- D. 0.33

Q.42) Following is a cladogram of the major taxonomic groups of the angiosperms. Groups A-E represent respectively:



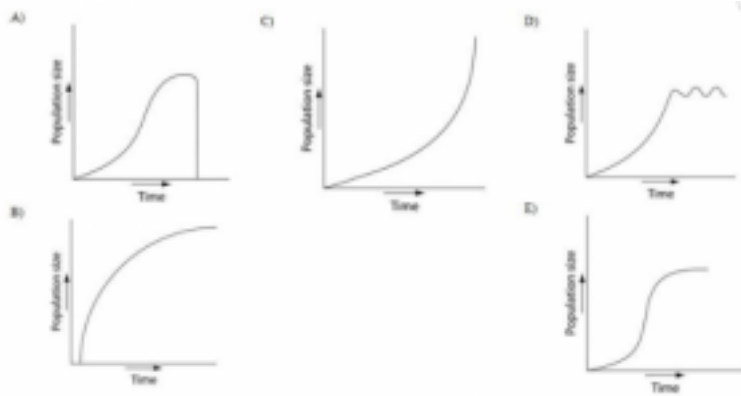
- A. Astrobaleales, Nymphaeales, Amborellales, Chloranthaceae, Magnoliids
- B. Amborellales, Astrobaleales, Nymphaeales, Magnoliids, Chloranthaceae
- C. Amborellales, Nymphaeales, Astrobaleales, Magnoliids
- D. Amborellales, Nymphaeales, Chloranthaceae, Magnoliids, Astrobaleales

Q.43) The following table shows selected characters used in analyzing the phylogenetic relationships of four plant taxa : Taxa T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> are respectively :

Taxon	Characters			
	Xylem or Phloem	Wood	Seed	Flowers
T <sub>1</sub>	+	-	-	-
T <sub>2</sub>	+	+	+	+
T <sub>3</sub>	+	+	+	-
T <sub>4</sub>	-	-	-	-

- A. Ferns, Oaks, Pines, Hornworts
- B. Oaks, Pines, Hornworts, Ferns
- C. Hornworts, Pines, Oaks, Ferns
- D. Ferns, Pines, Oaks, Hornworts

Q.44) 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. A
- B. B or C
- C. D
- D. A or E

Q.45) A population is correctly defined as having which of the following characteristics?

- I. inhabiting the same general area
- II. belonging to the same species
- III. possessing a constant and uniform density and dispersion

- A. I only
- B. III only
- C. I and II only
- D. II and III only

Q.46) Which of the following assumptions have to be made regarding the capture- recapture estimate of population size?

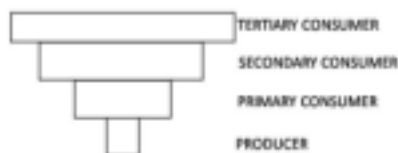
- I. Marked and unmarked individuals have the same probability of being trapped.
- II. The marked individuals have thoroughly mixed with the population after being marked.
- III. No individuals have entered or left the population by immigration or emigration, and no individuals have been added by birth or eliminated by death during the course of the estimate.

- A. I only
- B. II only
- C. II and III only
- D. I, II, and III

Q.47) A species whose life history strategies allow for high intrinsic rates of increase (r strategist) will also exhibit the following EXCEPT

- A. high tolerance for both environmental instability and low quality resources
- B. short period of exponential population growth (r)
- C. reproductive strategy that involves random mating, semelparity and little or no parental investment
- D. survivorship that show density-dependent mortality, typically exhibiting Type 1 or 2 survivorship curve

Q.48) Given below is an ecological pyramid: The pyramid represents:



- A. Pyramid of number of a parasitic food chain and pyramid of biomass of a pond ecosystem
- B. Pyramid of number of a pond ecosystem and pyramid of biomass of a forest ecosystem
- C. Pyramid of energy of a grassland and pyramid of biomass of an open ocean ecosystem
- D. Pyramid of biomass of a grassland and pyramid of number of a tropical forest ecosystem

Q.49) A mineral contains a cubic and spherical cavity. The length of the side of the cube is the same as the diameter of the sphere. If the cubic cavity is half-filled with a liquid and the spherical cavity is completely filled with liquid, what is the approximate ratio of the volume of liquid in the cubic cavity to that in the spherical cavity?

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

Q.50) Four friends were sharing a Pizza. They decided that the oldest friend will get an extra piece of pizza. Bahu is two months older than Kattappa, who in turn is three months younger than Bhalla. Devsena is one month older than Kattappa. Who should get the extra piece of Pizza?

- A. Bahu
- B. Devsena
- C. Bhalla
- D. Kattappa



Q.51) Two persons A and B start walking in opposite directions from a point. A travels as twice as fast as B. the speed at which B travels is 1 km/h. If A travels 2 km and turns back and starts walking towards B, at what distance from the starting point will A cross B?

- A. 2 km
- B. 4 km
- C. 6 km
- D. 8 km

Q.52) Prof. Murthy likes to let her students choose who their partners will be; however, no pair of students may work together for more than seven class periods in a row. Alice and Bob have worked together for seven class periods in a row. Calvin and Denny have worked together for three class periods in a row. Calvin does not want to work with Alice. Who should be assigned to work with Bob?

- A. Calvin
- B. Alice
- C. Denny
- D. None

Q.53) If  $P + = 1$  and  $Q + = 1$ , then what is PQR?

- A. -1
- B. 2
- C. -2
- D. Cannot be determined

Q.54) A 4m 4m floor needs to be covered by tiles of size 2m 1m. Two diagonally opposite corners should be left uncovered. How many tiles are required to complete the job without breaking the tiles or overlapping them?

- A. 8
- B. 7
- C. 6
- D. Impossible to cover

Q.55) Consider a square of side a. Fit the largest possible circle inside it and the largest possible square inside the circle. What is the side length of the innermost square?

- A.  $a / \sqrt{2}$
- B.  $a / 2$
- C.  $a / 2\sqrt{2}$
- D.  $a / \sqrt{2}$

Q.56) If NET14 & NET15 are five-digit numbers such that their sum = 157229, then  $N + E + T$  would be

- A. 15
- B. 21
- C. 25
- D. 72

Q.57) If the product of three consecutive positive integers is equal to their sum, then what would be the sum of their squares?

- A. 9
- B. 14
- C. 16
- D. 24

Q.58) A woman starts shopping with Rs.  $X$  and Y paise spends Rs. 3.50 and is left with Rs.  $2Y$  and  $2X$  paise. The amount she started with is

- A. Rs. 48.24
- B. Rs. 28.64
- C. Rs. 32.14
- D. Rs. 23.42

Q.59) A man sells three articles A, B, C and gains 10% on A, 20% on B and loses 10% on C. He breaks even combined selling prices of A and C are considered, whereas he gains 5% when combined selling prices of B and C are considered. What is his net loss or gain on the sale of all the articles?

- A. 10% gain
- B. 20% gain
- C. 10.66% gain
- D. 6.66% gain

Q.60) The houses of three sisters lie in the same row, but the middle sister does not live in the middle house. In the morning, the shadow of the eldest sister's house falls on the youngest sister's house. What can be concluded for sure?

- A. The youngest sister lives in the middle.
- B. The eldest sister lives in the middle.
- C. Either the youngest or the eldest sister lives in the middle.
- D. The youngest sister's house lies on the east of the middle sister's house.

Q.61) A milkman adds 10 liters of water to 90 liters of milk. After selling  $\frac{1}{5}$ th of the total quantity, he adds water equal to the quantity he has sold. The proportion of water to milk he sells now would be

- A. 72:28
- B. 28:72
- C. 20:80
- D. 30:70

Q.62) Two coconuts have spherical space inside their kernels, with the first having an inner diameter twice that of the other. The larger one is half-filled with liquid, while the smaller is completely filled. Which of the following statements is correct?

- A. The larger coconut contains 4 times the liquid in the smaller one.
- B. The larger coconut contains twice the liquid in the smaller one.
- C. The coconuts contain equal volumes of liquid.
- D. The smaller coconut contains twice the liquid in the larger one.

Q.63) A chocolate salesman is traveling with 3 boxes with 30 chocolates in each box. During his journey, he encounters 30 toll booths. Each tollbooth inspector takes one chocolate per box that contains chocolate(s), as tax. What is the largest number of chocolates he can be left with after passing through all toll booths?

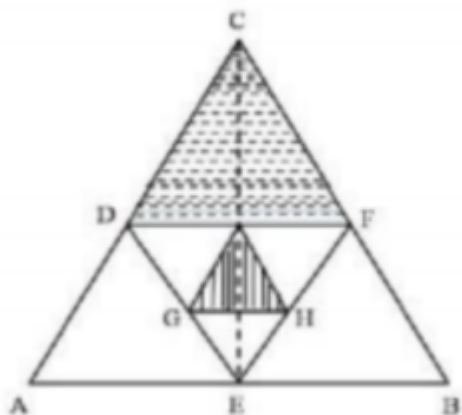
- A. 0
- B. 30
- C. 25
- D. 20

Q.64) The mid-point of the arc of a semicircle is connected by two straight lines to the ends of the diameter as shown. What is the ratio of the shaded area to the area of the triangle?




- A.  $\frac{1}{2} - 1$
- B.  $\frac{1-1}{2}$
- C.  $\frac{1}{2} - 1 \times \frac{1}{2}$
- D.  $2\frac{1}{2} - \frac{1}{4}$

Q.65) Equilateral triangles are drawn one inside the other as shown. What is the ratio of the two shaded areas?

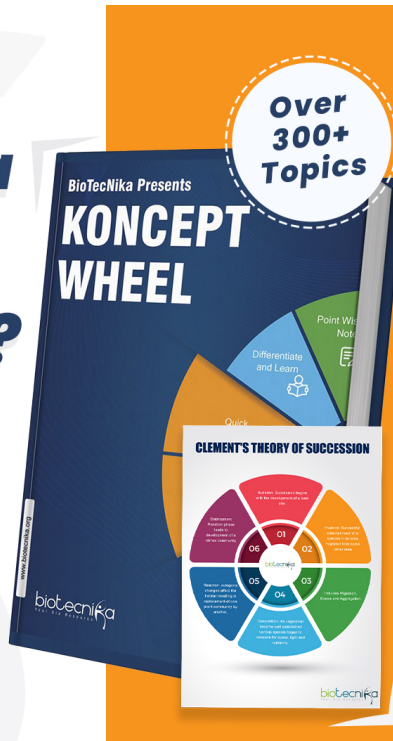


- A. 2:1
- B.  $\sqrt{3}$ :4
- C. 4:1
- D. 8:1

  
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Q.66) Abdul travels thrice the distance Catherine travels, which is also twice the distance that Binoy travels. Catherine's speed is  $\frac{1}{3}$  of Abdul's speed which is also  $\frac{1}{2}$  of Binoy's speed. If they start at the same time then who reaches first?

- A. Both Abdul and Catherine
- B. Binoy
- C. Catherine
- D. All three together

Q.67) A train running at 36km/h crosses a mark on the platform in 8 sec and takes 20 sec to cross the platform. What is the length of the platform?

- A. 120 m
- B. 30 m
- C. 40 m
- D. 160 m

Q.68) When a polynomial  $f(x)$  is divided by  $x - 5$  or  $x - 3$  or  $x - 2$  it leaves a remainder of 1. Which of the following would be the polynomial?

- A.  $x^3 - 10x^2 + 31x + 31$
- B.  $x^3 - 10x^2 + 31x - 29$
- C.  $x^3 - 10x^2 + 31x + 38$
- D.  $x^3 - 10x^2 + 31x + 21$

Q.69) You are asked to identify the stage of the estrous cycle in the vaginal smear of a mouse containing a large number of leukocytes and very few nucleated epithelial cells. Which one of the following will be the correct stage of the estrous cycle?

- A. Early estrus, late proestrus
- B. Late estrus, early metestrus
- C. Late metestrus, early diestrus
- D. Late diestrus, early proestrus

Q.70) Which one of the following neurotransmitters is secreted by the preganglionic neurons of sympathetic nervous system

- A. Epinephrine
- B. Acetylcholine
- C. Dopamine
- D. Norepinephrine

Q.71) Which one of the following is NOT involved with the pacemaker potential of the heart?

- A. "h"- channel
- B. Transient calcium channel
- C. Long-lasting calcium channel
- D. "f"- channel

Q.72) Which of the following food crops has recently been genetically engineered to obtain edible vaccine to develop immunity against Hepatitis B?

- A. Banana
- B. Maize
- C. Potato
- D. Tomato



Q.73) Routinely used glucose biosensor estimates blood glucose level by sensing the concentration of

- A. glucose
- B. oxygen
- C. gluconolactone
- D.  $H_2O_2$

Q.74) Industrial products in which bacteria are employed for production are shown in the following table:

I List of Products	II-Microorganism
P. 2,3-Butane diol	1. Leuconostoc
Q. Dextran	2. Brevibacterium
R. Glutamic acid	3. Bacillus polymyxa
S. Cobalamin	4. Propionibacterium

The correct combination is

- A. P-3, Q-1; R-2, S-4
- B. P-1, Q-2; R-3, S-4
- C. P-3, Q-2; R-4, S-1
- D. P-2, Q-3; R-4, S-1

Q.75) Which of the following describes facilitated diffusion?

- A. The passive movement of a particle through the phospholipid bilayer of the cell membrane.
- B. The movement of a particle down the concentration gradient helped by active pumping.
- C. The passive movement of a particle across the cell membrane via a channel protein.
- D. The movement of a particle up a concentration gradient helped by active pumping.

Q.76) Which of the following is most likely true of a protein that cotransports glucose and sodium ions into the intestinal cells of an animal?

- A. The sodium ions are moving down their electrochemical gradient while glucose is moving up.
- B. Glucose entering the cell along its concentration gradient provides energy for uptake of sodium ions against the electrochemical gradient.
- C. Sodium ions can move down their electrochemical gradient through the cotransporter whether or not glucose is present outside the cell.
- D. A substance that blocks sodium ions from binding to the cotransport protein will also block the transport of glucose.

Q.77) Which of the following statements are correct?

- a) Lysosomes are formed from Golgi-derived coatamer-coated vesicles.
- b) Lysosomal enzyme transport vesicles are able to fuse with late endosomes.
- c) The lowering of the pH in lysosomes, autophagosomes and phagosomes by an ATP-driven H<sup>+</sup> pump in their membranes lowers their luminal pH and activates their digestive enzymes.
- d) The proteins of the lysosomal membrane are heavily glycosylated on their cytosolic surface giving them a dense oligosaccharide layer that protects the membrane from digestion.

A. A and B

B. B and C

C. C and D

D. A and D

Q.78) The following are statements about molecular markers in the context of plant breeding

P. Molecular markers can be used for elimination of undesirable traits

Q. Molecular markers cannot be used for estimation of the genetic contribution of each individual parent in a segregation population

R. Molecular markers are used for mapping of QTLs, which is also possible by conventional techniques

S. Molecular markers can be used for selection of individuals from a population that are homozygous for the recurrent parent genotype at loci flanking the target locus

Which of the statements are true

A. p&Q

B. P&R

C. P&S

D. Q&R

Q.79) Following are a few observations about protein translocation into mitochondria. Choose the statements which are incorrect.

1. Proteins imported into the matrix of mitochondria are usually taken up from the cytosol
2. Most of the mitochondrial precursor proteins have a signal sequence at their C terminus.
3. The TOM complex is required for the import of all nucleus-encoded mitochondrial proteins.
4. The TIM22 complex mediates the insertion of a subclass of inner membrane proteins, including the carrier protein that transports ADP, ATP, and phosphate.
5. The OXA complex mediates the insertion of inner membrane proteins that are synthesized within the cytosol.
6. The mitochondrial precursor proteins bind to import receptor proteins of the TOM complex, which recognize the mitochondrial signal sequences.
7. Protein translocation through the TIM requires an electrochemical H<sup>+</sup> gradient across the inner membrane.
8. Hsp70 chaperone proteins are present in the matrix space and the cytosol

- A. 1, 2 and 8 only
- B. 2, 3, 5 and 7
- C. 2 and 5 only
- D. 1, 4, 6 and 8

Q.80) Membrane proteins are synthesized on endoplasmic reticulum and transported to various organelle membranes. One hypothesis for membrane protein sorting is hydrophobicity matching i.e., the proteins with a shorter transmembrane portion would partition into thinner membranes. You are given the following three observations

- A. It was found that transmembrane portions of proteins in Golgi membranes are shorter than those in plasma membranes
  - B. Presence of cholesterol increases the thickness of the bilayer
  - C. The phospholipid composition of Golgi and plasma membranes are same
- Which one of the following statements is correct?

- A. Proteins in plasma membrane have longer transmembrane portion than proteins in Golgi membranes
- B. Proteins in Golgi membranes have longer transmembrane portion than proteins in plasma membranes
- C. Proteins of both Golgi and plasma membranes have same length of transmembrane portion
- D. Cholesterol is more in Golgi membrane than in plasma membrane

Q.81) A plasmid with a linking number (Lk) of 200, topological winding (Tw) number of 200 and a writhing number (Wr) of 0 was transformed into E.coli. The plasmid was re-isolated from the culture of the transformant. The re-isolated plasmid was found to possess the same molecular weight as the original plasmid, but it possessed a writhing number of -5. Following statements are made about this observation.

- A. Lk of the re-isolated plasmid would be 195
- B. Lk of the re-isolated plasmid would remain 200
- C. Tw of the re-isolated plasmid would remain 200
- D. Tw of the re-isolated plasmid would be 195

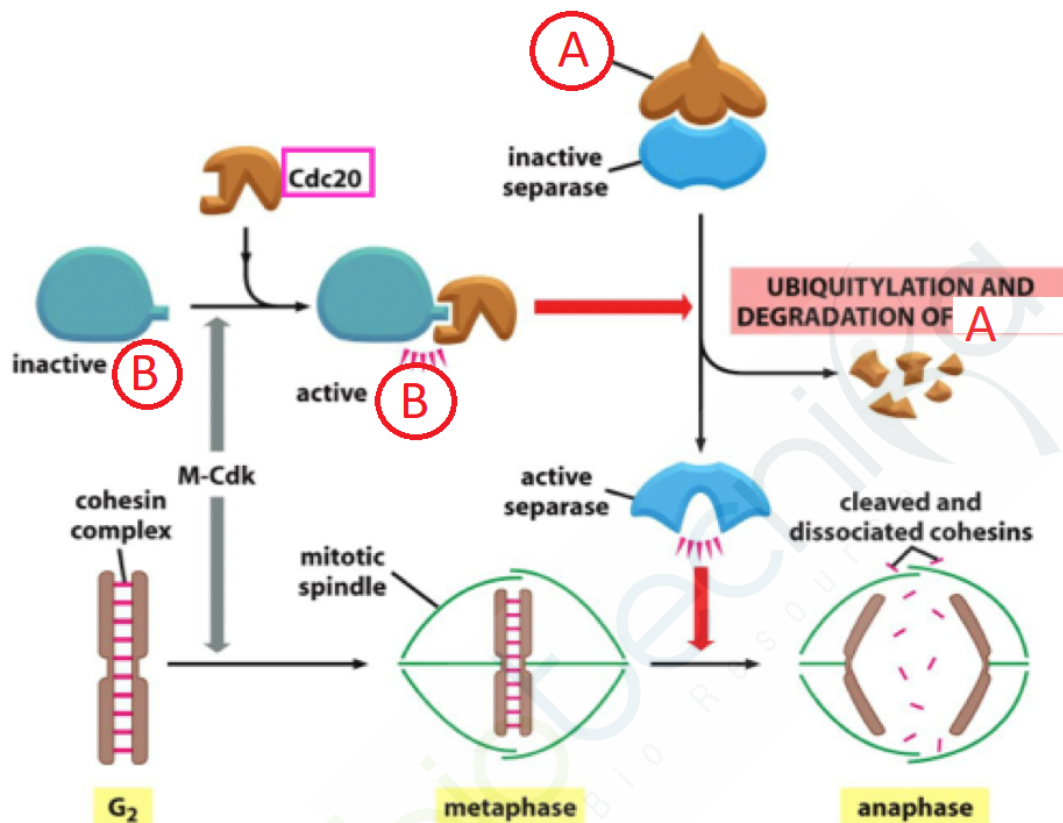
Which one of the following combinations of the above statements is the correct representation of the facts.

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

Q.82) How does a somatic cell that has just completed the S phase of its cell cycle compare in respect to its number of chromosomes and amount of DNA with a gamete of the same species?

- A. It has twice the number of chromosomes and twice the amount of DNA
- B. It has the same number of chromosomes but twice the amount of DNA
- C. It has twice the number of chromosomes and four times the amount of DNA.
- D. It has four times the number of chromosomes and twice the amount of DNA

Q83) Identify A and B



- A. securin, CAK
- B. condensin, APC
- C. securin, condensin
- D. securin, APC

Q.84) The cleavage of X-gal by beta galactosidase enzyme produce the blue coloured 5-bromo-4 chloro-3 hydroxy indone and

- A. alpha-L galactose
- B. beta-D galactose
- C. alpha-D galactose
- D. beta-L galactose

Q.85) A partial diploid of genotype  $I^+ P^+ O^+ Z^+ Y^- / I^- P^+ O^c Z^- Y^+$  will show:

- A. Inducible production of  $\beta$ -galactosidase and permease.
- B. Constant expression of  $\beta$ -galactosidase and inducible expression of permease.
- C. Constant expression of  $\beta$ -galactosidase and permease.
- D. Inducible expression of  $\beta$ -galactosidase and constant expression of permease.

Q.86) In the bacterial growth kinetics, during exponential phase, the growth rate is

- A. same as generation time
- B. reciprocal of generation time
- C. time required for population to double
- D. rate of doubling population

Q.87) A group of scientists performed an experiment where they artificially fused mouse cells with monkey cells. The resulting fused cells were labeled with fluorescently tagged antibodies against mouse and monkey surface receptor proteins, X and Y respectively. At the time of 0 minute just after fusion of events, two receptors were confirmed to their own half in in the heterokaryon. However, such surface receptors (X and Y) intermixed on the cell surface after 60 minutes. Which one of the given statements correctly reflects the outcome of the experiment?

- A. The proteins in cytoplasm are in a dynamic state
- B. The proteins on the membrane surface are in a dynamic state
- C. Surface membrane proteins exchange with the cytosolic proteins
- D. Membrane surface proteins are in a static phase

Q.88) In amphibian oocyte, the germplasm which gets segregated during cleavage to give rise to primordial germ cells (PGC's) is normally

- A. distributed evenly throughout the oocyte.
- B. localized at animal pole.
- C. localized at vegetal pole.
- D. aggregated in central part of oocyte.



Q.89) Cytoplasmic determinants coding for anterior structure of *Drosophila* embryo if injected elsewhere in the recipient embryo, would lead to

- A. normal development.
- B. formation of additional ectopic head.
- C. a phenotype with two heads and two tails
- D. degeneration.

Q.90) During early cleavage of *Caenorhabditis elegans* embryos, each asymmetrical division produces one founder cell which produces differentiated descendants and one stem cell. The very first cell division produces one anterior founder cell, namely AB and one posterior stem cell, namely P1. When these blastomeres are experimentally separated and allowed to proceed further with development, one could get the following possible outcomes:

- A. P1 cell would develop autonomously while the AB would show conditional development.
- B. P1 cells would show conditional development while AB would show autonomous development.
- C. Both would show autonomous specification and result in mosaic development.
- D. Both would show conditional specification and result in regulative development.

Q.91) The total variance in a phenotypic character can be split into two components-genetic ( $V_g$ ) and environmental variance ( $V_e$ ). The heritability of a phenotypic trait can be expressed quantitatively as heritability coefficient ( $H^2$ ) which is calculated as  $H^2 =$

- A.  $V_g - V_e$
- B.  $V_e / V_g$
- C.  $V_g / (V_g + V_e)$
- D.  $V_e / (V_g - V_e)$

Q.92) A gene encoding tRNA undergoes a mutational event in its anticodon region that enables it to nonsense codon and permit completion of translation. Such a mutation is known as

- A. Silent Mutation
- B. Neural Mutation
- C. Reversion
- D. Non sense suppressor

Q. 93) The following is the amino acid sequence of a protein encoded by gene 'X'.

...Phe Leu Val Pro Ser Tyr Cys...

A mutant for gene 'X' is isolated following treatment with a mutagen. The amino acid sequence of the same region encoded by the mutant gene is as follows:

...Phe Leu Phe Arg Arg Ile..

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

- A. 5-bromouracil
- B. 2-amino purine
- C. Ethyl methanesulfonate
- D. Acridine orange

Q 94) A practical class was going on where the students were demonstrating ATP synthesis in vitro using active mitochondria. Some students added one of the following options to their tubes. In which one of the above, ATP synthesis will be detected?

- A. Dinitrophenol (DNP), an uncoupler
- B. Mild acidification of the medium
- C. Glutiferone, that permeabilizes both the membranes
- D. An outer membrane permeable  $H^+$  quencher compound, Elila

Q.95) A cell line deficient in salvage pathway for nucleotide biosynthesis was fed with medium containing  $^{15}N$  labelled amino acids. Purines were then extracted. Treatment with which one of the following amino acids is likely to produce  $^{15}N$  labelled purines?

- A. Aspartic acid
- B. Glycine
- C. Glutamine
- D. Aspartamine

Q.96) Three electron acceptors 'X', 'Y' and 'Z' have redox potential ( $E_0'$ ) of +0.15V, +0.05 V and -0.1 V respectively. For a reaction  $B + 2H + 2e^- \rightarrow BH_2$   $E_0' = +0.05$  V

Which of these electron acceptors are appropriate?

[Useful equation :  $\Delta G_0' = -nFE_0'$

$\Delta G_0'$  = free energy change; n = number of electrons ; F = Faraday constant]

- A. X and Y
- B. Only X
- C. Y and Z
- D. Only Z

Q.97) Which one of the following statements on nucleic acids is NOT true?

- A. The conformation of ribose in DNA is  $\alpha$ -2'-deoxy-D-ribofuranose
- B. Hydrolysis of RNA takes place under alkaline conditions unlike DNA, as the 2'-hydroxyl in RNA acts as a nucleophile in an intramolecular displacement.
- C. DNA can occur in different three-dimensional forms.
- D. In DNA, deamination of cytosine to uracil can occur in a non enzymatic manner.

Q.98) In a 30-residue peptide, the dihedral angles  $\phi/\psi$  have been determined by one or more methods. When their values are examined in the Ramachandran plot, it is

- A. not possible for  $\phi/\psi$  values to be distributed in the helical as well as beta sheet region.
- B. possible that the  $\phi/\psi$  values are all in the helical region although circular dichroism spectral studies indicate beta sheet conformation.
- C. possible to conclude that the peptide is composed of entirely D-amino acids.
- D. not possible to conclude if the peptide is entirely helical or entirely in beta sheet conformation

Q.99) 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. 10.5
- B. 20.5
- C. 10
- D. 105

Q.100) 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.101) Which one of the following statements on protein conformation is NOT true?


- A. Dihedral angles of side-chains in amino acids are depicted in the Ramachandran plot.
- B. Infrared spectroscopy can be used to deduce hydrogen bonding in peptides.
- C. Three dimensional structures of protein composed of ~100 amino acids can be obtained by nuclear magnetic resonance spectroscopy.
- D. Globular proteins have  $\alpha$ -helical and  $\beta$ -sheet components.

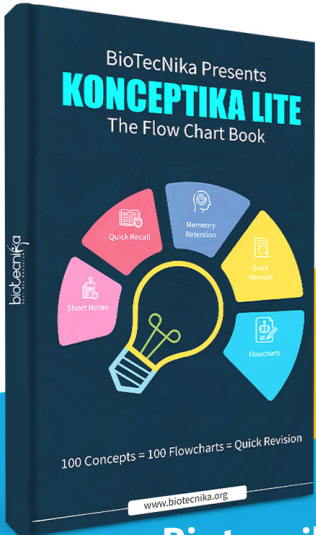
Q 102) Following are statements on  $\beta$ -turns:

- A. All the 20 coded amino acids have equal propensity to form  $\beta$ -turns.
- B. Pro cannot occur in  $\beta$ -turns.
- C. Pro-Gly sequence strongly favours  $\beta$  - turns.
- D. In Asn-Gly  $\beta$ -turns, Asn can have positive  $\phi$   $\psi$  values.

Choose the combination with all correct statements:

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





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Q.103) The following statements are made:

- A.  $\alpha$  and  $\beta$  anomers of glucose are interconvertible and the ratio of their abundance is 1:2, respectively.
- B. Single chain lipids ( $\geq C_{14}$ ) form micelles and double chain lipids form bilayers in water.
- C. Proline is energetically favoured at the C termini of an  $\alpha$ -helix than at the N-termini.
- D. Major groove of DNA readily accommodates several common structural motifs in protein than the minor groove.
- E. Replacement of a canonical Watson-Crick pairing by Wobble base pairs does not change the surface properties in t-RNA.

Which one of the following combinations is INCORRECT?

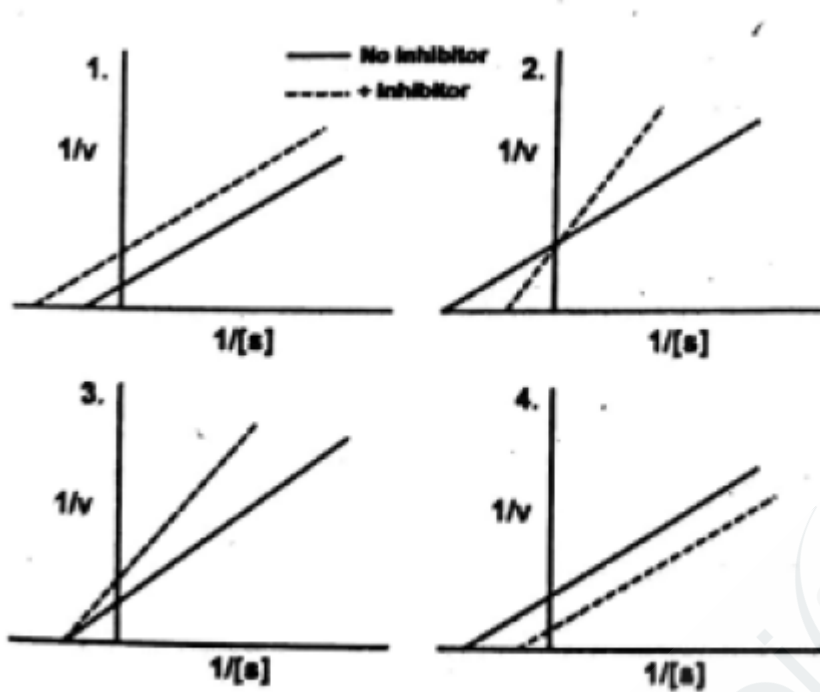
- A. A and D
- B. B and E
- C. C and E
- D. B and C

Q.104) Match the chemical agents that interfere in oxidative phosphorylation process with their respective mode of action

Column I			Column II
(A)	Antimycin A	(i)	Inhibits $F_0$ component of ATP synthase
(B)	Oligomycin	(ii)	Disrupts inner mitochondrial membrane potential
(C)	Valinomycin	(iii)	Prevent electron transport from Fe/S cluster to ubiquinone
(D)	Rotenone	(iv)	Blocks electron transfer from cytochrome b to cytochrome $c_1$
		(v)	Inhibits adenine nucleotide translocase

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

Q.105) For a reversible non-competitive inhibition of an enzyme, choose the plot that you would use to determine  $K_m$ :



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

Q.106) DNA melting temperature ( $T_m$ ) was found to be 47 degree C and enthalpy measured at  $T_m$  was 0.032kJ. The entropy change would be:

- A.  $1 \times 10^{-3}$  kJ
- B.  $1 \times 10^{-4}$  kJ
- C.  $3 \times 10^{-2}$  kJ
- D.  $6 \times 10^{-2}$  kJ

Q.107) The turnover number and specific activity of an enzyme (molecular weight 40,000 D) in a reaction ( $V_{max} = 4 \mu\text{mol}$  of substrate reacted/ min, enzyme amount = 2  $\mu\text{g}$ ) are

- A. 80,000/min,  $2 \times 10^3 \mu\text{mol}$  substrate/min
- B. 80,000/min,  $2 \times 10^3 \mu\text{mol}$  substrate/second
- C. 40,000/min,  $1 \times 10^3 \mu\text{mol}$  substrate/min
- D. 40,000/min,  $2 \times 10^3 \mu\text{mol}$  substrate/min

Q.108) the part of embryo from which ectoderm, endoderm and mesoderm are formed in chick is known as

- A. primitive streak
- B. hypoblast
- C. epiblast
- D. cytotrophoblast

Q.109) which protein secreted from amphibian organizer induces neural tissue formation by inhibiting Bone morphogenetic Protein?

- A. beta catenin
- B. noggin
- C. dishevelled
- D. dickkopf

Q.110) homologue of beta-catenin in Drosophila is

- A. Fushi tarazu
- B. Engrailed
- C. Armadillo
- D. Cubitus interruptus

Q.111) in case of *Xenopus levis* which cells make up the Kewkoop center and Spemann's organizer?

- A. endodermal and mesodermal respectively
- B. mesodermal and endodermal respectively
- C. ectodermal and endodermal respectively
- D. endodermal and ectodermal respectively

Q.112) capacitation of sperma in humans

- A. occurs during copulation
- B. occurs after acrosomal reaction
- C. takes place in the ampulla of the oviduct
- D. takes place in the epidermis of the testis



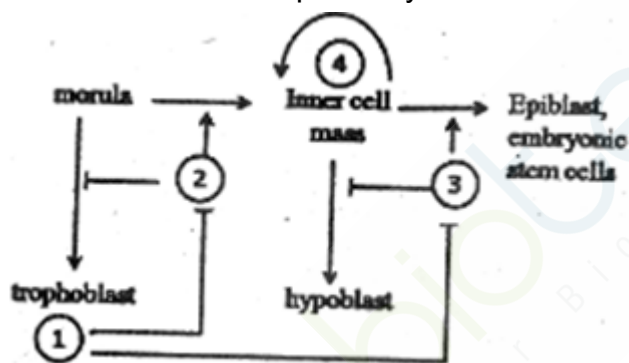
Q.113) with respect to development of any organism 'autonomous specification' would result in which type of development?

- A. regulative
- B. mosaic
- C. syncytial
- D. definitive

Q.114) which of the following maternal effect gene product regulate the production of anterior structures in Drosophila embryo?

- A. bicoid and nanos
- B. bicoid and hunchback
- C. bicoid and caudal
- D. nanos and caudal

Q.115) the decision to become either the inner cell mass or the trophoblast blastomere is one of the first decisions taken by any mammalian embryo. Below is the diagrammatic representation of the different cells formed during development from the morula with the help of different molecules. Identify the molecules from 1-4 sequentially



- A. cdx 2, Oct 4, Nanog, Stat 3
- B. cdx 2, Nanog, Stat 3, Oct 4
- C. cdx 2, Nanog, Oct 4, Stat 3
- D. Nanog, Stat 3, Oct 4, cdx 2

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Q.116) the pattern of embryonic cleavage specific to a species is determined by two major parameters

1. the amount and distribution of yolk protein in the cytoplasm
2. the factors in the cytoplasm that influences the angle of the mitotic spindle and the timings of its formation

which of the following statements are true?

- A. species having telolecithal eggs follow a holoblastic cleave
- B. species having isolecithal eggs follow a holoblastic cleave
- C. species having centrolecithal eggs follow a holoblastic cleave
- D. species having isolecithal eggs follow a meroblastic cleave

Q.117) segmentation genes in Drosophila are divide into three groups (gap, pair rule, segment polarity), based on their mutant phenotype. Below are some of the major genes expressed in a sequential manner affecting segmentatio pattern

- (A) *hairy* → *paired* → *tailless* → *patched*
- (B) *hunchback* → *even-skipped* → *fushi*  
*tarazu* → *wingless*
- (C) *odd-skipped* → *giant* → *paired* → *wingless*
- (D) *tailless* → *hairy* → *fushi tarazu* → *gooseberry*

which of the above sequence of gene expressed from early to late embryo is/are correct?

- A. D only
- B. A & B
- C. B & C
- D. B & D

Q.118) the fate of a cell or tissue specified when it is capable of differentiating autonomously on being placed on a neutral environment with respect to the developing pathway. an embryo will show development pattern based on its type of specification. based on the above fact we can say that the potency of a cell is

1. equal to its normal fate in regulative development
2. greater than its normal fate in regulative development
3. equal to its normal fate in mosaic development
4. greater than its normal fate in mosaic development

which of the above statements are true?

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

Q.119) which of the inferences (A-D) given below would you draw from the following tissue transplantation experiments performed with the early and late gastrula stages of Newt?

	Host regions	Donor regions	Differentiation of donor tissue
	<b>EARLY GASTRULA</b>		
(i)	Prospective neurons	Prospective epidermis	Epidermis
(ii)	Prospective epidermis	Prospective neurons	Neurons
	<b>LATE GASTRULA</b>		
(i)	Prospective neurons	Prospective epidermis	Neurons
(ii)	Prospective epidermis	Prospective neurons	Epidermis

1. cells of early Newt gastrula exhibit conditional development
  2. cells of early Newt gastrula exhibit autonomous development
  3. cells of late Newt gastrula exhibit conditional development
  4. cells of late Newt gastrula exhibit autonomous development
- the correct inferences are

- 1 & 4
- 2 & 3
- 1 only
- 4 only

Q.120) during fertilization in mammals, sperm-egg interaction is mediated by zona-pellucida (ZP) membrane proteins and their receptors present on the sperm membrane. ZP3 has been identified as the principle ZP protein whose post translational modification is important for sperm-egg interaction. in a competitive inhibition assay, the sperm is saturated with either active ZP3 or its modified forms, before studying sperm egg interaction. which of the following experiments will not inhibit sperm egg interactions?

- saturation of sperm with ZP3 prior to its use
- Deglycosylate the ZP3 and use it for saturation of sperms
- phosphorylate the ZP3 and use it for saturation of sperms
- dephosphorylate the ZP3 and use it for saturation of sperms

Q.121) Graves disease is associated with

- A. Insufficiency of thyroid hormones
- B. Excess of corticosteroids
- C. Insufficiency of corticosteroids.
- D. Excess of growth hormones.

Q.122) If the core body temperature of a human rises above normal, which of the following processes would have initiated sequentially for Thermo-regulation?

- A. Peripheral vasodilatation, increased rate of respiration, tachycardia
- B. Peripheral vasoconstriction, increased rate of respiration, bradycardia
- C. Peripheral vasodilatation, decreased rate of respiration, tachycardia
- D. Peripheral vasodilatation, decreased rate of respiration, bradycardia

Q.123) In a normal human eye, for sharp image formation on the retina, maximum dioptric power is provided by the

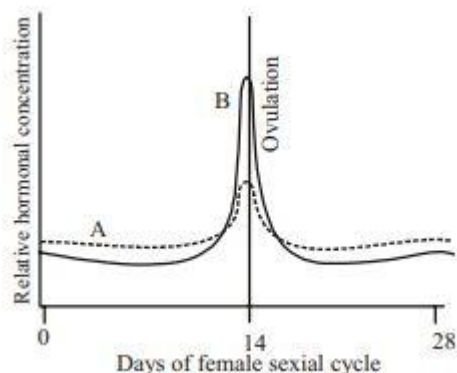
- A. Retina
- B. Cornea
- C. Anterior surface of the lens
- D. posterior surface of the lens

Q.124) Spinal cord of an animal was transected at C1 /C2 level. The respiration of the animal stopped and it needed artificial respiration. However, the heart continued to beat although at a slower rate. Some of the explanations given were:

1. Respiration regulatory centre is located in the medulla.
2. Respiration regulatory centre is located above the C1 /C2 cut.
3. Heart regulatory centre is above the C1 /C2 cut.
4. Heart has autoregulation. Which one of the following is most appropriate ?

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

Q.125) The graph represents relative plasma concentration of hormones (A and B) during reproductive cycle in a normal female. Which one of the following combinations is correct ?



- A. (A) is FSH and (B) is estrogen
- B. (A) is estrogen and (B) is LH
- C. (A) is FSH and (B) is LH
- D. (A) is LH and (B) is FSH

Q.126) GnRH is secreted during infancy (0-6 months) and puberty onwards (4 years and above) in monkeys. However, i.v. injection of GnRH during pre-pubertal period (about 2 years of age) led to elevated LH and FSH in blood compared to untreated 2 years old monkey. This suggests that:

1. hypothalamus is active during pre-pubertal period.
2. GnRH action on pituitary is age dependent.
3. pituitary matures during adulthood.
4. pituitary is active in all the stages of development in monkey.

Which one of the following is true?

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

Q.127) Given below are the intervals/duration of electrocardiogram of a human subject (Column A) and the event in heart during the process (Column B)

Which one of the following options is a correct match of entries in Column A and B?

COLUMN A		COLUMN B	
a	PR interval	i	Ventricular action potential
b	QRS duration	ii	Atrioventricular conduction
c	QT interval	iii	Ventricular depolarization
d	ST interval	iv	Plateau portion of the ventricular action potential

A. a - (i); b - (iv); c - (ii); d - (iii)

B. a - (ii); b - (iii); c - (i); d - (iv)

C. a - (iv); b - (ii); c - (iii); d - (i)

D. a - (iii); b - (i); c - (iv); d - (ii)

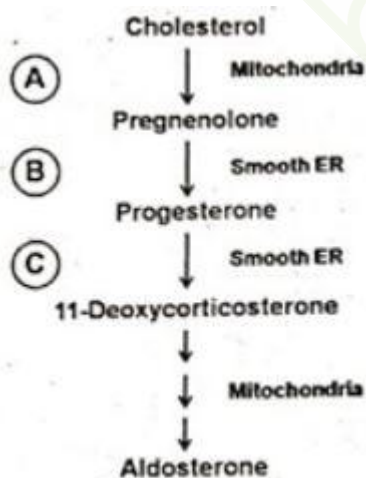
Q.128) The pathway of synthesis of aldosterone in zona glomerulosa along with the intracellular locations is shown below: The enzymes below are required for different steps of aldosterone:

(i) 21- Hydroxylase

(ii) p450 side chain cleavage enzyme

(iii)  $3\beta$ -Hydroxy steroid dehydrogenase

Which one of the following options represents correct matched for A, B and C?



A. A - (i); B - (ii); C - (iii)

B. A - (iii); B - (i); C - (ii)

C. A - (ii); B - (iii); C - (i)

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

Q.129) When a nerve fiber is stimulated with increasing strength of stimulus, the action potential fails to generate even though the threshold level may be passed. The following statement may explain this accommodation of nerve fiber :

- (1) The critical number of open sodium channels required to trigger the action potential may never be attained due to slow depolarization
  - (2) Potassium channels open in response to slow depolarization, which makes the nerve fiber refractory to depolarization
  - (3) The low threshold sodium channels remain open, which increases the threshold of firing of action potential
  - (4) The efflux of sodium and influx of potassium due to operation of  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase oppose the depolarization
- Which one of the following is correct ?

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

Q.130) Question : Following are the main types of defense employed by prey species against predators

**Types of defense:**

- Chemical with aposematic coloration (A);
- Cryptic coloration (B);
- Batesian mimicry (C);
- Intimidation display (D)

**Prey Species:**

- Grasshoppers and seahorses (i);
- Hoverflies and wasps (ii);
- Bombardier beetles, ladybird beetles (iii);
- Frilled lizard, Porcupine fish (iv)

Which one of the following combinations is correct?

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



Q.131) A restriction fragment containing a specific gene of interest can be identified by gel electrophoresis followed by transferring the DNA to a membrane as a solid support matrix using a procedure called

- A. a southern blot
- B. identification of a gene
- C. a restriction fragment length polymorphism
- D. plasmid vectors for cloning

Q.132) When a PCR reaction is performed using genomic DNA as a template, a 1.5 kb product is amplified. When the same reaction is set up using cDNA, a 0.8kb product is amplified. A likely explanation for the different sized products is that

- A. Primers always bind to different sequences in different templates
- B. There is mutation in the genomic DNA
- C. There is an intron in the gene
- D. The cDNA is degraded

Q.133) The major advantage of using artificial chromosomes such as YACs and BACs for cloning genes is that

- A. plasmids are unable to replicate in cells.
- B. only one copy of a plasmid can be present in any given cell, whereas many copies of a YAC or BAC can coexist in a single cell.
- C. YACs and BACs can carry much larger DNA fragments than ordinary plasmids can.
- D. YACs and BACs can be used to express proteins encoded by inserted genes, but plasmids cannot.

Q.134) DNA fragments from a gel are transferred to a nitrocellulose paper during the procedure called Southern blotting. What is the purpose of transferring the DNA from a gel to a nitrocellulose paper?

- A. to attach the DNA fragments to a permanent substrate
- B. to separate the two complementary DNA strands
- C. to transfer only the DNA that is of interest
- D. to prepare the DNA for digestion with restriction enzymes

Q.135) Why is it so important to be able to amplify DNA fragments when studying genes?

- A. DNA fragments are too small to use individually.
- B. A gene may represent only a millionth of the cell's DNA.
- C. Restriction enzymes cut DNA into fragments that are too small.
- D. A clone requires multiple copies of each gene per clone.

Q.136) A eukaryotic gene has "sticky ends" produced by the restriction endonuclease EcoRI. The gene is added to a mixture containing EcoRI and a bacterial plasmid that carries two genes conferring resistance to ampicillin and tetracycline. The plasmid has one recognition site for EcoRI located in the tetracycline resistance gene. This mixture is incubated for several hours, exposed to DNA ligase, and then added to bacteria growing in nutrient broth. The bacteria are allowed to grow overnight and are streaked on a plate using a technique that produces isolated colonies that are clones of the original. Samples of these colonies are then grown in four different media: nutrient broth plus ampicillin, nutrient broth plus tetracycline, nutrient broth plus ampicillin and tetracycline, and nutrient broth without antibiotics. Bacteria that contain the plasmid, but not the eukaryotic gene, would grow

- A. in the nutrient broth plus ampicillin, but not in the broth containing tetracycline.
- B. only in the broth containing both antibiotics.
- C. in the broth containing tetracycline, but not in the broth containing ampicillin.
- D. in all four types of broth.

Q.137) The MALDI spectrum of a peptide shows a peak at  $m/z$  corresponding to 3600. When the ESI spectrum is recorded, peaks at  $m/z$  corresponding to 721,904 and 1801 were obtained. When the MALDI MS/MS spectrum was recorded, large number of peaks with  $m/z$  less than 3600 were observed.

The spectral data indicate that the peptide is

- A. highly impure
- B. pure with molecular mass of 3600 and partial sequence of the peptide can be determined
- C. highly unstable and degrades rapidly
- D. degraded under condition employed for recording ESI spectrum

Q.138) Proteins in cells can be visualized by the following methods:

- A) Express the gene (coding for the said protein) as a fusion with the green fluorescence protein (GFP) and directly visualize under a fluorescence microscope.
- B) Express the gene (coding for the said protein) as a fusion with the  $\beta$ -galactosidase gene (lac Z) and directly visualize under a phase contrast bright field microscope.
- C) A fluorescence tagged antibody raised against the said protein could be used for visualization in a fluorescence microscope.
- D) Over express the protein and directly visualize it under a scanning electron microscope.

Which of the following methods you would choose to visualize a protein in a living cell?

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

Q.139) Bacteria often acquire genes by the process of lateral or horizontal transfer.

Such 'foreign' genes, if acquired in recent past, may be identified by their atypical GC content, as compared to 'native' genes. Suppose the genomic GC content of a bacterium is 40%.

Gene A of this organism contains 1000 bases with 225 G and 215 C.

Another gene B of length 800 bases contains 160 G and 140 C.

Which one of the following would be the most acceptable hypothesis (given that  $x^2 = 3.841$  at 0.05 significance level)?

- A. A: native, B: Foreign
- B. A: Foreign, B: Native
- C. A: Foreign, B: Foreign
- D. A: Native, B: Native

Q.140) A student wrote following statements regarding comparison of Restriction Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA, Amplified Fragment Length Polymorphism (AFLP) and Simple Sequence Repeats (SSR) 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 if required in RFLP and RAPD only.
- D. Polymerase chain reaction is required for all the techniques.

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

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

Q.141) The most important property of any microscope is its resolution (D). Which of the following wavelengths (nm) would be used to achieve the best resolution using a light microscope with lenses having numerical aperture (NA) of 1.4?

- A. 450
- B. 480
- C. 560
- D. 700

Q.142) From the following statements:

- (A) Coloured images can be obtained by transmission electron microscopy by fluorescent labelling of the specimen
- (B) Scanning electron microscopy requires sectioning of the sample
- (C) Confocal microscopy uses optical methods to obtain images from a specific focal plane and excludes light from other planes
- (D) Differential-interference microscopy relies on interference between polarized light due to differences in the refractive index of the object and surrounding medium
- (E) Visualization in epifluorescence microscopy requires staining by heavy metal atoms

Choose the combination with two correct and one incorrect statements.

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



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Q.143) A 30-residue peptide was treated with trypsin and the tryptic peptides were separated by HPLC. Four peaks A, B, C and D were obtained. Peptides corresponding to A, B, C and D were reduced and alkylated selectively at cysteine residues. The sequences obtained from A, B, C and D after reduction and alkylation were:

A, AEK;

B, C(S-alkyl)EPGYR and WC(Salkyl)SPPK;


C, C(Salkyl) EHFR and C(S-alkyl)GGK;

D, C(Salkyl)EAFC(S-alkyl)L.

The sequence of the 30-residue peptide is


A. Option 1

(1) AEKCEPGYRCEHFRWCSPPKCGGKCEAFCL




B. Option 2

(2) AEKCEPGYRCEHFRWCSPPKCGGKCEAFCL




C. Option 3

(3) AEKCEPGYRCEHFRWCSPPKCGGKCEAFCL



D. Option 4

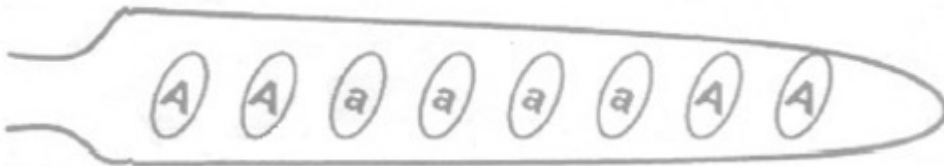
(4) AEKCEPGYRCEHFRWCSPPKCGGKCEAFCL



Q.144) In Neurospora a cross between the genotypes 'A' and 'a' results in an ascus with ascospores of genotypes as shown below: Statements A to D are events that could have occurred during meiosis.

- A) Crossing over between the centromere and the gene.
- B) Segregation of alleles 'A' and 'a' in meiosis I.
- C) Segregation of alleles 'A' and 'a' in meiosis II.
- D) Assortment of alleles 'A' and 'a'.

Which of the above events could correctly explain the observation shown in the figure?



- A. A followed by C
- B. C alone
- C. A followed by B
- D. D alone

Q.145) A black Labrador homozygous for the dominant alleles (BBEE) is crossed with a yellow Labrador homozygous for the recessive alleles (bb ee). On intercrossing the F<sub>1</sub>, the F<sub>2</sub> progeny was obtained in the following ratio:

9 black: 3 brown: 4 yellow this is an example of

- A. recessive epistasis where allele e is epistatic to B and b.
- B. dominant epistasis where allele E is epistatic to B and b.
- C. recessive epistasis where allele e is epistatic to E.
- D. complementary epistasis where allele b is epistatic.



