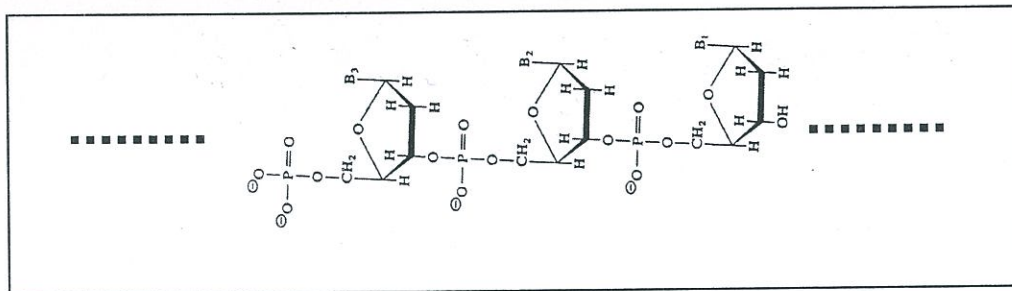


BIOLOGICAL SCIENCES

1. Which of the following phytohormones is produced under water-deficient conditions and plays an important role in the tolerance response of plants to drought and high salinity?

- (A) Abscissic acid
- (B) Cytokinin
- (C) Ethylene
- (D) Gibberellin

2. The polymer shown below is a component of:



- (A) DNA
- (B) RNA
- (C) either DNA or RNA
- (D) Polysaccharide

3. Which of the following is NOT INVOLVED in the quaternary association of hemoglobin molecules?

- (A) Disulfide bonds
- (B) Hydrogen bonds
- (C) Hydrophobic interactions
- (D) Electrostatic interactions

4. Aspirin can prevent heart attacks because, it

- (A) increases the metabolic activity of the heart
- (B) prevents the formation of blood clots
- (C) enhances lung activity
- (D) decreases the formation of cholesterol

5. Which of the following occurs first during T cell activation ?
- (A) IL-2 production
 - (B) Cell surface expression of the high affinity IL-2 receptor
 - (C) Increase in cytosolic calcium
 - (D) Interferon-gamma production
6. The non-B DNA structure reported to be found at telomeres is
- (A) Cruciform DNA
 - (B) Z-DNA
 - (C) A-DNA
 - (D) G-quadruplexes
7. The electrons for the reduction reaction in photosynthesis come from
- (A) carbon dioxide
 - (B) water
 - (C) carbohydrate
 - (D) oxygen
8. Isomerisation of 1,3 bis-phosphoglycerate (BPG) to 2,3 BPG
- (A) enhances the rate of glycolysis and increases ATP production for altered cellular requirements
 - (B) Enhances deoxygenation of hemoglobin
 - (C) Diverts ATP to secondary metabolite production
 - (D) Maintains CoA levels in the cell
9. Strychnine, a convulsant poison, is an allosteric inhibitor of the glycine receptor. Which of the following indicates its mode of action ?
- (A) It binds and lowers the affinity of the glycine receptor for glycine
 - (B) It changes the conformation of glycine such that it recognizes other receptors
 - (C) It binds at the glycine site in the receptor acting as a partial antagonist
 - (D) It binds to a transcription factor to regulate expression of glycine receptor

10. Why is methanol poisoning treated with ethanol ?

- (A) Ethanol simply dilutes the concentration of methanol in the blood
- (B) Ethanol complexes with methanol to form a non-toxic compound
- (C) Ethanol binds competitively to the target protein of methanol
- (D) Ethanol forms a covalent inactivating complex with methanol and target protein

11. Warming a suspension of yeast increases the rate at which sucrose is broken down into glucose and fructose because, warming

- (A) increases concentration of the products
- (B) increases density of sucrose on the exposed surfaces
- (C) increases frequency of collisions between molecules
- (D) stabilizes the enzyme-substrate complex.

12. The immunoglobulin that can be transported across the placenta to confer immunity to the fetus in mammals is

- (A) IgG
- (B) IgM
- (C) IgE
- (D) IgD

13. After class switching, B cells can make antibodies

- (A) with the same antigenic specificity but different effector functions
- (B) with different antigenic specificities but same effector function
- (C) with different variable regions in the light chain
- (D) with different variable regions in the heavy chain

14. Replication of the full length chromosome of *E. coli* takes

- (A) exactly as long as it takes *E. coli* to divide
- (B) longer than it takes *E. coli* to divide
- (C) lesser time than it takes *E. coli* to divide
- (D) variable time depending on the use of ^{15}N or ^{14}N nitrogen source in the medium.

15. Which organ is responsible for the development of mature T cells?

- (A) Spleen
- (B) Lymph node
- (C) Liver
- (D) Thymus

16. One of the following represents a poly-Ala protein

- (A) $C_{180}, O_{120}, N_{180}, H_{847}$
- (B) $C_{240}, O_{280}, N_{158}, H_{1120}$
- (C) $C_{120}, O_{360}, N_{362}, H_{689}$
- (D) $C_{360}, O_{123}, N_{120}, H_{602}$

17. The T_m of a double-stranded DNA molecule, when measured in 0.15 M NaCl was 60°C . If measured in the presence of 0.15 M NaCl and 7 M Urea, the T_m will be

- (A) lower
- (B) higher
- (C) the same
- (D) zero

18. When working maximally, mammalian muscles use approximately 10^{-3} moles of ATP per gram per minute. However, there is only about 5×10^{-6} moles of ATP present per gram of resting muscle. Through which one of the following means does the muscular system meet the demand for ATP for sudden intense muscular activity?

- (A) Synthesis of ATP from ADP and phosphate
- (B) Glycolysis
- (C) Breakdown of phosphocreatine into creatine and ATP
- (D) Utilisation of ATP pool from other tissues

19. Which one of the following enzymes catalyzes the release of pyrophosphate from ATP?

- (A) Protein kinase A
- (B) Polyphosphatase
- (C) RNA polymerase
- (D) Glycogen phosphorylase

20. The set of amino acid residues that can be phosphorylated in proteins is
- (A) histidine, serine, threonine
 - (B) histidine, lysine, phenyl alanine
 - (C) arginine, serine, tyrosine
 - (D) tyrosine, asparagine, glutamine
21. A solution of potassium acetate is prepared by dissolving it in water. Its pH will be between
- (A) between 5.0 and 6.8
 - (B) 7.0
 - (C) above 7.0
 - (D) 4.3
22. If the half-life of radioactive phosphorous (^{32}P) is 12 days, what will be the activity of one milli Curie of ^{32}P -labelled ATP after 60 days?
- (A) 125 micro Curie
 - (B) 250 micro Curie
 - (C) 62.5 micro Curie
 - (D) 31.25 micro Curie
23. Consider the following table regarding the photoperiods and flowering habits of plants and identify the correct statement

Plant Species	Photoperiod		
	8 hrs of light	14 hrs of light	20 hrs of light
1. Xanthium	flowers	flowers	does not flower
2. Hyoscyamus	does not flower	flowers	flowers
3. Sunflower	flowers	flowers	flowers

- (A) Xanthium is short-day plant; Hyoscyamus is long-day plant; Sunflower is day-neutral plant
- (B) Xanthium is long-day plant; Hyoscyamus is short-day plant; Sunflower is day-neutral plant
- (C) Xanthium is short-day plant; Hyoscyamus is day-neutral plant; Sunflower is long-day plant
- (D) Xanthium is long-day plant; Hyoscyamus is day-neutral plant; Sunflower is short-day plant

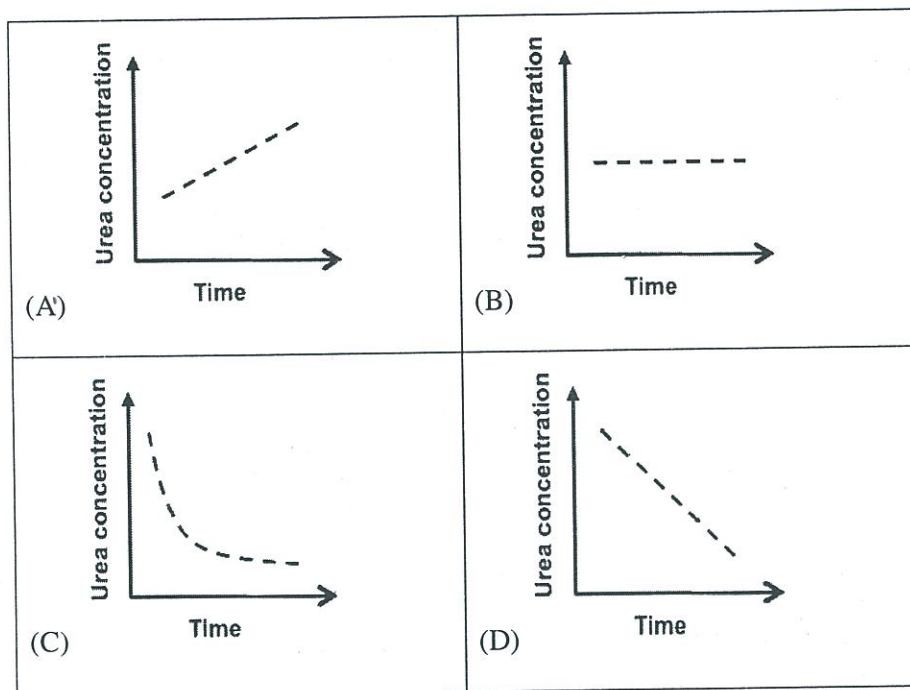
24. Gram positive bacteria

- (A) have a thick capsule that traps the crystal violet stain
- (B) have a periplasmic space that traps the crystal violet stain
- (C) have multiple layers of peptidoglycan that help retain the crystal violet stain
- (D) have two layers of outer membrane that help retain the crystal violet stain

25. Cross-sections of cilia and flagella show nine equally spaced sets of microtubule structures.
A similar organization is also seen in

- (A) Nuclear Lamins
- (B) Connexins
- (C) Centrosomes
- (D) Nuclear Pore

26. If a person starts fasting, which of the following graphs will be the correct representation of urea content in his urine?



27. If 'n' is the amount of DNA present in a cell at the end of G₂ phase, the amount of DNA per cell at the end of G₁ phase is

- (A) 4n
- (B) 2n
- (C) n
- (D) n/2

28. A neuron makes three synapses on a muscle cell to produce a sudden movement. However, each synapse is unreliable and conveys a signal with a probability of 0.5. Successful signal propagation by any synapse will result in muscle contraction. What is the probability that the muscle will contract when the neuron fires?

- (A) 7/8
- (B) 3/2
- (C) 3/8
- (D) 1/8

29. A non-sense mutation introduced into the GFP reporter gene cloned under a thiamine-repressible promoter was transformed into yeast cells. As expected, these cells did not express GFP activity when grown in media with or without thiamine. It was observed that after very brief exposure of log-phase cultures to ultraviolet light, a few cells expressed GFP but only when grown in media lacking thiamine. The inference is

- (A) thiamine influences cell walls to give resistance to ultraviolet light.
- (B) ultraviolet light interferes with GFP reporter activity
- (C) a low frequency mutation in the ultraviolet exposed cells allows for expression of this mutant GFP
- (D) thiamine interferes with GFP activity

30. Which compound links glycolysis, nucleotide synthesis and glycogen synthesis?

- (A) Acetyl-CoA
- (B) Oxaloacetate
- (C) Citrate
- (D) Glucose 6-phosphate

31. Which pair correctly matches the enzyme with its allosteric activator?

- (A) Hexokinase - ATP
- (B) Phosphofructokinase I - AMP
- (C) Pyruvate kinase - ATP
- (D) Pyruvate dehydrogenase - NADH

32. Gonadotropin releasing hormone is the key mediator of the reproductive processes in mammals. It is synthesized by

- (A) gonadotrophs
- (B) hypothalamus
- (C) medulla oblongata
- (D) gonads

33. An essential building block of phosphatidic acid and phosphatidylcholine is

- (A) glycerol
- (B) sorbitol
- (C) cholesterol
- (D) inositol

34. The rate of a biochemical reaction was determined experimentally to be $v_o = k [X] [Y]^2 [Z]$. What is the order of the reaction with respect to Z ? What is the number of molecules involved in the rate-limiting step of the reaction? What is the overall order of the reaction?

- (A) second order, four molecules, third order
- (B) zero order, three molecules, fourth order
- (C) first order, four molecules, fourth order
- (D) first order, three molecules, fourth order

35. Which is the source of stem cells that can produce all the cells of the immune system?

- (A) Spleen
- (B) Thymus
- (C) Lymph node
- (D) Bone marrow

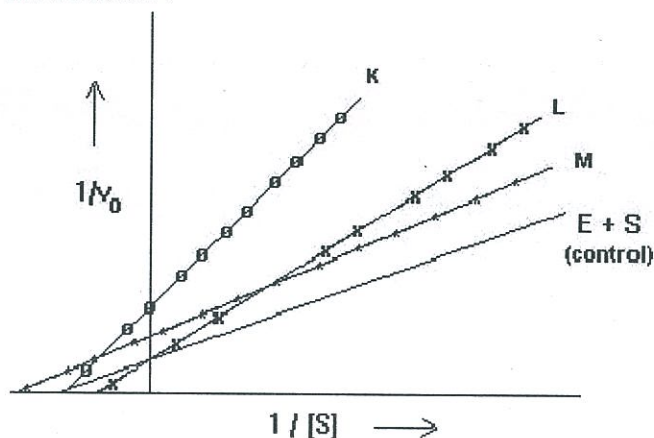
36. All of the following have a common alpha-subunit EXCEPT

- (A) growth hormone
- (B) thyroid-stimulating hormone
- (C) leutinizing hormone
- (D) follicle stimulating hormone

37. Which one of the following enzymes brings about catabolism of cAMP?

- (A) Adenylyl cyclase
- (B) Adenosine deaminase
- (C) Phosphodiesterase
- (D) Nucleotide phosphatase

38. The Lineweaver-Burke plots for E + S only (control) and for three inhibitors K, L, M of this enzyme-substrate system are shown below.



What is the TRUE-FALSE sequence for the statements below?

1. The maximum velocity of the reaction is unchanged from the control value in the presence of inhibitor L.
2. At a given substrate concentration the reaction rate is higher for inhibitor L than for inhibitor K.
3. The enzyme is half-saturated at a lower concentration of substrate in the presence of inhibitor L than in the presence of inhibitor K.

- (A) true, false, false
- (B) true, true, false
- (C) false, true, false
- (D) false, false, true

39. Which of the following amino acid side chains is most frequently used for binding metal ions by protein molecules?

- (A) Isoleucine
- (B) Arginine
- (C) Aspartic acid
- (D) Tryptophan

40. In addition to adjuvants, generation of anti-hapten antibodies will require

- (A) injection of the hapten into mice
- (B) injection of a mixture of hapten and protein into mice
- (C) injection of the hapten covalently coupled with a protein into mice
- (D) injection of a mixture of hapten and lipid into mice

41. The loop of Henle is likely to be longer in animals of this biome

- (A) deserts
- (B) rainforests
- (C) temperate meadows
- (D) savannah woodlands

42. Acetyl CoA is

- (A) a quinone
- (B) an isoprenoid
- (C) a thioester
- (D) an ether

43. An optical density of 1 means

- (A) 1% of the incident light is absorbed
- (B) 1% of the incident light is transmitted
- (C) 90% of the incident light is absorbed
- (D) 90% of the incident light is transmitted

44. Which of the following statements describes the oxygen binding curve of hemoglobin?

- (A) Each of the four oxygen molecules bind with equal affinity.
- (B) The binding of the first oxygen molecule enhances the binding of the other three oxygen molecules
- (C) The binding of the first oxygen molecule makes the binding of the other three oxygen molecules more difficult.
- (D) The binding of the first oxygen molecule has no effect on the binding of the remaining three oxygen molecules.

45. Of the two isolates of *Vibrio cholerae*, isolate A but not isolate B was found to be virulent. This is because

- (A) isolate B was isolated in Germany where cholera is not prevalent
- (B) unlike isolate A, isolate B was grown in minimal medium
- (C) isolate A is lysogenised by a bacteriophage
- (D) isolate B is lysogenised by a bacteriophage

46. A homogenate of liver cells is centrifuged at 100,000 g for 1 hour. Following this, the supernatant is separated from the pellet and the pellet is suspended in buffered medium. Assuming inclusion of substrates and cofactors, which of the following enzymatic activities can be measured in the supernatant ?

- (A) Succinate dehydrogenase
- (B) Glyceraldehyde 3-phosphate dehydrogenase
- (C) Glycogen synthetase
- (D) Aconitase

47. Which of the following statements about the enzyme complexes of the electron transport system is correct?

- (A) They interact with one another via mobile carriers of electrons
- (B) They are located in the mitochondrial matrix.
- (C) They cannot be separated from one another in functional form.
- (D) They all have cytochromes.

48. Which of the following possesses the smallest genome

- (A) *Escherichia coli*
- (B) *Mycobacterium leprae*
- (C) *Mycoplasma genitalium*
- (D) *Haemophilus influenzae*

49. When subcultured into a fresh medium, a bacterium grows with a lag phase of 4 hrs followed by a log phase and a stationary phase. If the bacterium was treated with ethidium bromide for 3 hours in these phases of growth to cure a plasmid, it is more likely to lose the plasmid in

- (A) early stationary phase
- (B) late stationary phase
- (C) logarithmic growth phase
- (D) lag phase

50. Which of the following statements is TRUE ?

- (A) Lysozyme inhibits cross-linking of peptidoglycan in eubacteria
- (B) Penicillin inhibits cross-linking of peptidoglycan in eubacteria
- (C) Lysozyme prevents transport of the building blocks of peptidoglycan units into periplasmic space
- (D) Penicillin prevents transport of the building blocks of peptidoglycan units into periplasmic space

51. Populations A and B are two isolated populations of equal size. The sex ratio in these two populations is 1:1. A new mutation arises in the X chromosome of an individual in population A, whereas in population B a new mutation arises in the Y chromosome. The probability of fixation of this mutation is

- (A) higher in population A
- (B) higher in population B
- (C) same in both populations
- (D) not dependent on the sex ratio

52. Identify the ring system with the highest perimeter

- (A) Proline
- (B) Cyclopentane
- (C) Ribose
- (D) Histidine

53. miRNAs

- (A) act as templates for making tiny peptides
- (B) originate from genomic loci that are transcribed by RNA polymerase II
- (C) interfere with translation by inhibiting tRNA function
- (D) originate from genomic loci that are transcribed by all RNA polymerases

54. The amino acid whose side chain has the largest number of possible conformations is

- (A) Glu
- (B) Thr
- (C) Met
- (D) Lys

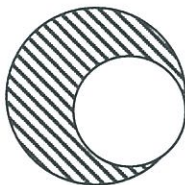
55. An alpha-helical region of 20 residues in a protein contains predominantly non-polar residues. Such a helix is likely to be

- (A) on the surface of the protein
- (B) embedded in the lipid bilayer
- (C) located in the cytosol
- (D) exposed to the extracellular environment

56. A 3_{10} helix is formed when a series of hydrogen bonds occur between

- (A) the C=O of residue i and the NH of residue $i+10$
- (B) the C=O of residue i and the NH of residue $i+3$
- (C) the C=O of residue i and the NH of residue $i+4$
- (D) the C=O of residue i and the NH of residue $i+5$

57. A small circle is inside the big circle as shown below



The diameter (d) of the small circle is the same as the radius of the big circle. The area of the shaded region is

- (A) $\frac{3}{4} \pi d^2$
- (B) πd^2
- (C) $3\pi d^2$
- (D) $\frac{1}{2} \pi d^2$

58. The diffusion coefficient for a molecule at infinite dilution in a non-interacting solvent

- (A) depends on the shape of the molecule
- (B) depends on the viscosity and shape of the molecule
- (C) depends on the viscosity, shape and temperature of the molecule
- (D) is independent of these parameters

59. Chloroform is more miscible with water than carbon tetrachloride because

- (A) chloroform has a lower dipole moment than carbon tetrachloride
- (B) chloroform has a lower dielectric constant than carbon tetrachloride
- (C) chloroform has a higher dipole moment than carbon tetrachloride
- (D) chloroform has a higher order of symmetry than carbon tetrachloride

60. If a vesicle of 10 μm radius is broken into ten equal-sized vesicles, what would be their diameter?

- (A) 6.32 μm
- (B) 1 μm
- (C) 3.16 μm
- (D) 0.5 μm

61. A single step reaction starting from a naturally occurring amino acid that leads to the biosynthesis of histamine involves

- (A) Removal of an amino group
- (B) Removal of a carboxyl group
- (C) Removal of a linker carbon
- (D) Opening of the aromatic ring

62. Carboxyproline has three ionizable groups with the following properties

<u>Group</u>	<u>pK_a</u>
α - carboxyl	2.0
α - amino	10.5
γ - carboxyl	3.8

The isoelectric point (pI) for this amino acid is

- (A) 2.9
- (B) 6.2
- (C) 7.1
- (D) 5.4

63. Which of the following statements is NOT true?
- (A) enzymes mediate the transformation of energy from one form into another
 - (B) enzymes can accelerate the attainment of thermodynamic equilibrium for a reaction that has a positive ΔG
 - (C) enzymes cannot alter the free energy change of a reaction
 - (D) enzymes lower the activation barrier of a chemical reaction
64. L-tyrosine serves as a precursor for
- (A) acetylcholine
 - (B) dopamine
 - (C) bombesin
 - (D) sphingosine-1-phosphate
65. A nerve contains axons of different types. The velocity of action potential propagation will be
- (A) the highest in an unmyelinated thin axon.
 - (B) the highest in a thick myelinated axon
 - (C) the highest in a thin myelinated axon
 - (D) the same in all axonal types.
66. One of the following has a dramatic effect on the sequence of a protein.
- (A) A three base insertion in an exon
 - (B) A single base substitution in a promoter
 - (C) A one base insertion just after the start codon
 - (D) A one base insertion just before the start codon
67. Information is coded in the nervous system by
- (A) the duration of action potentials
 - (B) the amplitude of action potentials
 - (C) the location of action potentials in the neuron
 - (D) the frequency of action potentials

68. Body sizes of lizards in a population are measured and mean body size calculated. Which of the following statistical parameters best describes the uncertainty in mean body size?

- (A) standard deviation
- (B) coefficient of variation
- (C) $1.96 \times$ standard deviation (which holds 95% of the data)
- (D) standard error

69. Which part of the brain is involved in motor control

- (A) amygdala
- (B) prefrontal cortex
- (C) hippocampus
- (D) cerebellum

70. In a large and isolated population, what is the most likely reason for a change in allele frequencies across generations?

- (A) drift
- (B) migration
- (C) selection
- (D) mutation

71. Over 90% of all species that have ever existed are extinct today. This shows that

- (A) evolution is inefficient
- (B) evolution does not take long-term advantage into account
- (C) extinction is inevitable
- (D) a very long time has passed since life began on earth.

72. In a study of tree dispersion in a forest, 50 grid cells of 1 sq km were chosen at random. The number of trees in each cell was counted. The ratio of the variance to mean was much less than 1. The spatial distribution of the trees can be described as

- (A) randomly dispersed
- (B) highly aggregated
- (C) uniformly dispersed
- (D) bimodally dispersed

73. Every neuron in the body develops from the
- (A) neural tube
 - (B) neural crest
 - (C) ectoderm
 - (D) endoderm
74. Which of the following plants with particular traits is most vulnerable to extinction in a fragmented forest landscape?
- (A) self-pollinated and wind-dispersed
 - (B) cross-pollinated and animal-dispersed
 - (C) self-pollinated and animal-dispersed
 - (D) cross-pollinated and wind-dispersed
75. Female deer prefer to mate with males with the largest antlers. What kind of selection will such a female mating preference exert on antler size in males?
- (A) directional selection
 - (B) disruptive selection
 - (C) neutral selection
 - (D) stabilizing selection
76. The hypothesis that dinosaurs originally evolved feathers for warmth, rather than flight would be best supported by
- (A) the occurrence of feathers in flying dinosaur species
 - (B) flightlessness as a derived trait in the dinosaur clade
 - (C) flightlessness as an ancestral trait in the dinosaur clade
 - (D) feathers as an ancestral trait in the dinosaur clade
77. Two distantly related families of acoustically-orienting parasitoid flies possess ears that are similar in structure and located at similar positions on the body. This is most likely a case of
- (A) adaptive radiation
 - (B) evolutionary stasis
 - (C) convergent evolution
 - (D) divergent evolution

78. Transmitters are inactivated at synapses by all of the following mechanisms **EXCEPT**

- (A) diffusion out of the synaptic gap
- (B) re-uptake by the presynaptic terminal
- (C) uptake by astrocytes that ensheath the synapse
- (D) uptake by oligodendrocytes

79. Specialized antigen presenting cells are

- (A) CD4⁺ and CD8⁺ T cells
- (B) B cells, macrophages and dendritic cells
- (C) neutrophils and CD4⁺ T cells
- (D) natural killer cells and dendritic cells.

80. A M13 phage preparation from *E. coli* grown in a normal medium (containing ¹⁴N as the sole nitrogen source) was used to infect a fresh culture of *E. coli* at a multiplicity of infection (m.o.i) of about 1 and grown in a medium containing ¹⁵N as the sole nitrogen source. The replicative form (RF) DNA of the phage was prepared after 4 generations of *E. coli* growth (a productive phase of mature phage release) and analyzed by CsCl density gradient ultracentrifugation. The M13 RF DNA will be seen predominantly as

- (A) a single band migrating between the marker DNAs of M13 RF (¹⁵N) and M13 RF(¹⁴N)
- (B) a single band migrating with the marker DNA of M13 RF (¹⁵N)
- (C) a single band migrating with the marker DNA of M13 RF (¹⁴N)
- (D) two bands, one migrating with the marker DNA of M13 RF (¹⁴N) and the other in between the marker DNAs of M13 RF (¹⁵N) and M13 RF(¹⁴N)

81. A sample of rRNA was degraded into its constituent nucleotides. The absorbance of this sample at 260 nm would

- (A) decrease if the degradation was effected by alkaline digestion but increase if the same was effected by a ribonuclease
- (B) increase if the degradation was effected by alkaline digestion but decrease if the same was effected by a ribonuclease
- (C) remain the same irrespective of the chemical or the enzymatic method used
- (D) increase irrespective of the chemical or the enzymatic method used

82. The two strands of the *E.coli* chromosome were separated into plus (+) and minus (-) strands. Which of the following statements is correct?

- (A) both the strands obey Chargaff's rule
- (B) the (+) strand codes for mRNAs
- (C) the (+) strand codes for rRNA and tRNA genes
- (D) both the strands hybridize to Okazaki fragments

83. The highest concentration of calcium is present in

- (A) cytosol
- (B) mitochondria
- (C) lysosomes
- (D) endoplasmic reticulum

84. In cells producing HIV infectious particles, the RNA genomes of the viral progeny are produced by transcription of the

- (A) viral RNA by HIV reverse transcriptase
- (B) integrated viral genome by RNA polymerase II
- (C) integrated viral genome by RNA polymerase III
- (D) viral DNA by HIV reverse transcriptase

85. The 5' end of the mature tRNA contains a

- (A) hydroxyl group
- (B) triphosphate group
- (C) monophosphate group
- (D) diphosphate group

86. Using site-directed mutagenesis, a mutant form of chymotrypsin was created that has alanine substituted for the serine at position 195. Which of the following effects would be observed?

- (A) no effect or a slight increase in affinity for substrate coupled with a complete loss of enzymatic activity
- (B) a decrease in the affinity for substrate coupled with no change in enzymatic activity
- (C) an increase in the rate of peptide-bond cleavage due to an increase in the rate of acid-base catalysis
- (D) a complete loss of enzymatic activity due to the inability to bind substrate

87. Which of the following bacterial species produces a toxin that can be used to inhibit protein synthesis in eukaryotic cells?

- (A) *Vibrio cholera*
- (B) *Corynebacterium diphtheria*
- (C) *Mycobacterium tuberculosis*
- (D) *Bordetella pertussis*

88. Which of the following statements is **INCORRECT** about mating of F^+ and F^- *E. coli* ?

- (A) the F^- cell is converted to an F^+ cell
- (B) the F^+ cell is converted to an F^- cell
- (C) chromosomal genes are rarely transferred
- (D) the genes involved in pilus formation are transferred at high frequency

89. The law of independent assortment of genes is violated in many instances due to

- (A) linkage
- (B) incomplete dominance
- (C) the presence of multiple alleles
- (D) imprinting

90. DNA topoisomerases

- (A) unwind DNA by their helicase activity to allow progression of the replication fork
- (B) recruit and/or assemble the components of replication
- (C) bind and melt DNA to generate single stranded regions.
- (D) introduce negative supercoils to underwind DNA to allow progression of the replication fork

91. *E. coli* RNA polymerase is a multi-subunit protein consisting of alpha, beta, beta prime and sigma subunits. It recognizes promoter sequence through which one of the following

- (A) Alpha subunit
- (B) Beta- beta prime complex
- (C) Beta prime subunit
- (D) Sigma subunit

92. In a cell treated with Brefeldin A, the appearance of which cellular organelle is disturbed ?

- (A) nucleus
- (B) Golgi complex
- (C) Mitochondria
- (D) lysosome

93. Bacterial cells in liquid culture go through the lag phase because

- (A) the rates of cell division and cell death are equal
- (B) the cell density is too low to be detected
- (C) DNA synthesis and cell division are not synchronous
- (D) they are synthesizing new enzymes to utilise the nutrients in the medium

94. Phenotypic traits can exhibit a continuous variation if

- (A) they are encoded by a single locus
- (B) they are encoded by multiple loci
- (C) there is co-dominance
- (D) there is selection

95. The cross between a mutant mother and a normal father gives rise to offspring that are all mutant. The reciprocal cross gives rise to offspring that are all normal. This means that the mutation is likely to be

- (A) in the mitochondrial genome
- (B) in the nuclear genome
- (C) dominant
- (D) recessive

96. At one time the genetic code was believed to be universal, but today we know that there are some variations in the code. This implies that

- (A) the word 'code' is inappropriate
- (B) different codons can code for the same amino acid
- (C) different amino acids can be encoded by the same codon
- (D) the genetic code can evolve

97. A change in the wavelength of excitation of the green fluorescent protein is explained by the

- (A) Stokes shift
- (B) Rayleigh effect
- (C) Heisenberg's principle
- (D) de Broglie's principle

98. Type I diabetes mellitus is caused by

- (A) destruction of pancreatic beta cells
- (B) glucose intolerance
- (C) defects in insulin secretion
- (D) decreased synthesis of insulin receptors

99. You have a mixture of proteins with the following properties

Protein 1 = 58,000 Daltons

Protein 2 = 28,000 Daltons

Protein 3 = 17,000 Daltons

Protein 4 = 10,000 Daltons

Proteins 3 and 4 exist as a hetero-dimer while proteins 1 and 2 exist as monomers in solution. What is the order of elution of these proteins on a gel-exclusion column?

- (A) protein 1 will elute first and then proteins 2, 3 and 4 co-elute as a single peak (the chromatogram will depict 2 major peaks)
- (B) proteins 3 and 4 will co-elute first followed by proteins 2 and 1 (the chromatogram will depict 3 major peaks)
- (C) protein 1 will elute first followed by proteins 2, 3 and 4 (the chromatogram will depict 4 major peaks)
- (D) protein 1 will elute first. Protein 2 will elute next followed by co-elution of proteins 3 and 4 (the chromatogram will depict 3 major peaks)

100. In *E.coli*, the catabolite activator protein (CAP) facilitates activation of the *lac* operon

- (A) at low glucose levels
- (B) at high glucose levels
- (C) independent of the glucose level
- (D) at high lactose levels

IISc Answer Key 2013

Question paper type: C

1. A

Abcissic acid, a hormone produced when plant is under saline or water stress.

2. A

Lack of 2'OH indicate it as DNA polymer

3. A

The four polypeptide chains are bound to each other by salt bridges, hydrogen bonds, and the hydrophobic effect.

4. B

Aspirin prevents heart attacks by stopping blood platelets from sticking together and forming artery-blocking clots.

5. C

*Immediate genes, expressed within half an hour of antigen recognition, encode a number of transcription factors, including c-Fos, c-Myc, c-Jun, NFAT, and NF-B For activation of these immediate genes, Calcium is used as one of the multiple intracellular signals Early genes, expressed within 1–2 h of antigen recognition, encode IL-2, IL-2R (IL-2 receptor), IL-3, IL-6, IFN-gamma, and numerous other proteins
-Kuby.*

6. D

Telomere sequences vary from species to species, but, in general, one strand is rich in G with fewer Cs. These G-rich sequences can form four-stranded structures (G-quadruplexes), with sets of four bases held in plane and then stacked on top of each other with either a sodium or a potassium ion between the planar quadruplexes.

7. B

The electrons come from the chlorophyll molecules at the centre of photosystems in cyclic phosphorylation whereas the electrons come from the chlorophyll in non-cyclic but are replaced by electrons produced by photolysis of water

8. B

*2, 3 bisphosphoglycerate which is formed in RBC decreases the affinity of hemoglobin for oxygen and thus helps unload oxygen from hemoglobin
-Tortora page 928*

9. C

Strychnine is a neurotoxin which acts as an antagonist of glycine and acetylcholine receptors. It primarily affects the motor nerves in the spinal cord which control muscle contraction

10. C

What ethanol does is this. it competes with and slows down the methanol reaction by using up the available alcohol dehydrogenase enzymes allowing your body to excrete the un reacted methanol via urine. This is called "competitive inhibition"

11. C

All molecules are in motion (except at absolute zero). As the temperature increases, their motion increases too. In the case of enzyme catalyzed reactions, as the speed of enzyme and substrate molecules increases, the chance for collisions so they can form enzyme-substrate complexes increases. Thus as the temperature rises, the reaction rate increases too

12. A

IgG

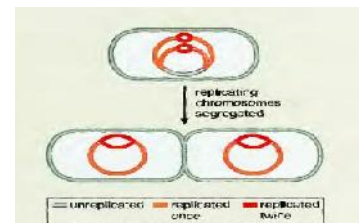
13. A

With same antigen specificity but different effectors functions

14. B

To allow the genome to be fully replicated prior to each round of cell division, bacterial cells frequently have to initiate DNA replication from their single origin prior to the completion of cell division.

-Watson



15. D

T cell development occurs in the thymus; the thymic microenvironment directs differentiation as well as positive and negative selection. Lymphoid progenitors which have developed from hematopoietic stem cells in the bone marrow migrate to the thymus to complete their antigen-independent maturation into functional T cells. In the thymus, T cells develop their specific T cell markers, including TCR, CD3, CD4 or CD8, and CD2. T cells also undergo thymic education through positive and negative selection

16. D

alanine has got 3 carbon, 1 Nitrogen and 1 oxygen, and 5 hydrogen. So a poly Ala should be in the ratio 1: 0.33:0.33: 2

17. A

The reverse of nucleic acid denaturation is renaturation, also referred to as re-association or hybridization. This bimolecular process is most effected by

- temperature*
- ionic strength,*
- molar concentration of the two complementary strands*

- reaction time
- denaturing agents such as formamide or urea which lower the T_m
- dextran sulfate which increases the rate of re-association

18. C

The primary function of ATP is the transfer of energy from one location to another rather than the long-term storage of energy. At rest, a skeletal muscle fiber produces more ATP than it needs. Under these conditions, ATP transfers energy to creatine. Creatine is a small molecule that muscle cells assemble from fragments of amino acids. The energy transfer creates another high-energy compound, creatine phosphate (CP), or phosphorylcreatine

19. D

Glycogen Phosphorylase

20. A

Histidine is phosphorylated by the enzyme histidine kinase and serine and threonine have got a OH group

21. C

Potassium acetate is a basic salt because KOH is a strong base and acetic acid is a weak acid. pH is above 7

22. D

In 2 months, 5 half lives have passed.

$1 \text{ mCu} \rightarrow 0.5 \text{ mCu} \rightarrow 0.25 \text{ mCu} \rightarrow 0.125 \text{ mCu} \rightarrow 62.5 \text{ microCu} \rightarrow 31.25 \text{ microCu}$

23. A

Every plant for which flower initiation is light-dependent (and not all plants are) has a critical day-length associated with it. The term long-day describes plants that begin forming flower buds when the days are longer than their critical day length. The term short-day, on the other hand, describes plants that begin flowering when the days are shorter than their critical day length. Day-neutral plants form flowers independent of day length.

24. C

Almost all bacteria can be classified as gram-positive or gram-negative. The classification relies on the positive or negative results from Gram's staining method, which uses complex purple dye and iodine. Because gram-positive bacteria have more layers of peptidoglycan in their cell walls than gram-negative, they can retain the dye.

25. C

Each centriole of the centrosome is based on a nine triplet microtubule assembled in a cartwheel structure

26. C

During fasting first lipid are utilized and the formation of urea from proteins will remain constant but as fasting prolongs the proteins will be utilized for the formation of glucose molecule

27. D

DNA divides in S phase, and become "n" and in G2 and M phase "n" level is maintained. At the end of M phase, DNA separates into 2 different cells and become "n/2" so when cell is in G1 state, normal state "n/2" is maintained.

28. D

Probability of working at each junction = $\frac{1}{2}$; So probability of all 3 working = $\frac{1}{8}$

29. C

The thiamine repression kept the GFP under suppression, but on irradiation with UV, the non sense mutation was repaired, but the thiamine suppression is not removed completely. Thus we can conclude that the UV allows for expression of this mutant GFP

30. D

Glucose converted to glucose 6 phosphate in glycolysis, glucose 6 phosphate is the starting material for Pentose phosphate pathway glycogen breakdown leads to glucose 6 phosphate

31. B

Phosphofructokinase 1 catalyzes the committed step of glycolysis and it is allosterically activated by high level of AMP and inhibited by ATP

32. B

GnRH are synthesized and produced by neurons within the hypothalamus

Page 654 tortora

33. A

Both are phospholipids which are formed by reaction of a glycerol with 2 fatty acids

34. C

In chemical kinetics, the order of reaction with respect to a given substance (such as reactant, catalyst or product) is defined as the index, or exponent, to which its concentration term in the rate equation is raised. So, For Z, order of reaction is 1st order. A number that relates the rate of a chemical reaction with the concentrations of the reacting substances: the sum of all the exponents of the terms expressing concentrations of the molecules or atoms determining the rate of the reaction. So, overall rate of reaction is 4th. The molecularity of a reaction simply refers to the number of molecules involved in the rate limiting step of that reaction. The rate limiting step is the slowest step to take place in the intermediate pathway between the reactants and final products. So, since 4 molecules collide with each other, the molecularity or no. of molecules in rate-limiting step is 4.

35. D

Red bone marrow is the site of formation of all immune cells

36. A

All hormones except growth hormone have got a common alpha subunit in them

37. C

cAMP decomposition into AMP is catalyzed by the enzyme phosphodiesterase

38. B

From the plot, since Y intercept is the same of L and control, L is a competitive inhibitor. Since the X intercept is the same for K and control, K is a noncompetitive inhibitor. For a competitive

inhibitor, V_{max} remains the same, statement 1 is true. At a given value of S , $1/V_o$ value is greater for K than for L , which means rate of reaction is greater for L than K , so statement 2 is true. A competitive inhibitor binds to the active site, enzyme saturation will occur at higher substrate conc. for L than for K , statement 3 is false.

39. C

Metal ions may be bound by main chain amino acids and carboxylic groups but specific binding is achieved by amino acid side chains, particularly the carboxylate groups of aspartic acid and glutamic acid and the nitrogen ring of histidine. It can also bind to tryptophan but more is with aspartate

40. C

Haptens are non-immunogenic, So, Generation of Abs against Hapten requires a Hapten-Carrier Conjugate

41. A

Loop of henle is slightly longer in desert animals to help them reabsorb more amount of water

42. C

A Thioester, because it contains $SH=CO$ group

43. C

Optical density is the measure of the transmission of an optical medium for a given wavelength. Higher OD lower transmittance and vice versa e.g; optical density of 1 means 90% of incident light is absorbed

44. B

The binding of oxygen to hemoglobin is also called as cooperative binding, where the binding of 1st oxygen enhances the binding of the next oxygen molecule

45. B

Isolate from minimal media weakens the cells and makes them less virulence. This is the method of creating live vaccines with attenuation.

46. A

Succinate dehydrogenase

47. A

The electron transport apparatus is located in the inner mitochondrial membrane. They have got many mobile carriers like coenzyme Q, cytochrome c
-Lehninger

48. C

Mycoplasma genitalium is the smallest genome of 580kB

49. C

Ethidium bromide is a intercalating agent which affects the replication of plasmid an bacterial replication is seen during the log phase

50. B

All penicillin derivatives produce their bacteriocidal effects by inhibition of bacterial cell wall synthesis. Specifically, the cross linking of peptides on the mucosaccharide chains is prevented.

51. B

Since population B has Y chromosome mutation, all the males will be mutated. But in population A, X chromosome is mutated, it can be either dominant to most possibly a recessive. Hence we have a normal X chromosome to compensate but only 1 Y chromosome. SO chance to get fixed in more in population B

52. B

Cyclopentane, with all C-C bonds, gets longest perimeter, than other molecules

Average Bond Lengths for Some Single, Double, and Triple Bonds

Bond	Bond Length (Å)	Bond	Bond Length (Å)
C—C	1.54	N—N	1.47
C=C	1.34	N=N	1.24
C≡C	1.20	N≡N	1.10
C—N	1.43	N—O	1.36
C=N	1.38	N=O	1.22
C≡N	1.16	O—O	1.48
C—O	1.43	O=O	1.21
C=O	1.23		
C≡O	1.18		

53. B

miRNA genes are usually transcribed by RNA polymerase II (Pol II)

54. B

The largest number of conformations are possible for threonine as lysine is very bulky and glutamate is also big is size same for methionine

55. B

Such a helix is a transmembrane helix

56. B

The N-H group of an amino acid forms a hydrogen bond with the C = O group of the amino acid three residues earlier; this repeated $i + 3 \rightarrow i$ hydrogen bonding defines a 310-helix

57. A

Area of small circle = $\pi(d/2)^2$;

Area of larger circle = $\pi(d)^2$;

Difference between area of the two circles = $3/4\pi(d)^2$

58. C

The rate of this movement is a function of temperature, viscosity of the fluid and the size (mass) of the particles

59. C

Carbon tetrachloride is a nonpolar molecule, with a dipole moment of 0 D (Debyes). Trichloromethane has dipole moment of 1.02 D, higher than CCl₄.

60. A

Surface area of larger vesicle = surface area of 10 smaller vesicles. So, $4\pi R^2 = 10 \cdot 4\pi r^2$; $R^2 = 10r^2$; $r = \sqrt{10}$; diameter = $2\sqrt{10}$; diameter = 6.32 micrometer

61. B

Histamine is biosynthesized from Histidine by the enzyme Histidine decarboxylase, by removal of carboxylic acid.

62. A

A *pI* value is calculated when the net charge on the amino acid is 0; with the loss of alpha carboxylic group the charge on the amino acid is 0; next it will lose a H at pH 3.8 and net charge will become negative.

so *pI* is $(2+3.8)/2 = 2.9$

63. B

An enzyme reduces the activation energy needed for a reaction to occur which speeds up the reaction, but it does not alter the free-energy change (ΔG) of the reaction. Enzyme does not change a nonspontaneous reaction into a spontaneous one. A non spontaneous reaction needs an input of energy where as a spontaneous one does not.

64. B

L-tyrosine acts as precursor for the synthesis of neurotransmitters and hormones in dopaminergic cells tyrosine is converted to levodopa which is involved in the synthesis of dopamine

65. B

The most rapid nerve impulses are conducted on fibers that are thick and myelinated.

66. C

A single base insertion just after the start codon will change the reading frame which dramatically changes the entire sequence of protein. Change in reading frame will not be observed in the other 3 options.

67. D

In the nervous system, information is frequency-coded as action potentials.

An action potential is a rapid all-or-nothing electrical pulse which travels along neural pathways, i.e. down axons and chemically over synapses through to other neurons. The rapid depolarization and hyper-polarization of an action potential spike is of almost uniform amplitude, lasting less than two milliseconds, and firing at a rate of up to five hundred per second for very intense stimuli. The nervous system has evolved to use digital, frequency-coded signaling

68. D

The confidence level describes the uncertainty of a sampling method. The probability part of a confidence interval is called a confidence level. In a confidence interval, the range of values above and below the sample statistic is called the margin of error.

69. B

The premotor cortex is an area of motor cortex lying within the frontal lobe of the brain just anterior to the primary motor cortex. The premotor cortex is responsible for some aspects of motor control, possibly including the preparation for movement, the sensory guidance of movement, the spatial guidance of reaching, or the direct control of some movements with an emphasis on control of proximal and trunk muscles of the body.

70. A

Genetic drift is a change in allele frequencies caused by random sampling. That is, the alleles in the offspring are a random sample of those in the parents. Genetic drift may cause gene variants to disappear completely, and thereby reduce genetic variability.

71. D

Very long time has passed since life has begun on earth

Extinction is often caused by a change in environmental conditions. When conditions change, some species possess adaptations that allow them to survive and reproduce, while others do not. If the environment changes slowly enough, species will sometimes evolve the necessary adaptations, over many generations. If conditions change more quickly than a species can evolve, however, and if members of that species lack the traits they need to survive in the new environment, the likely result will be extinction.

72. C

$s^2/\text{mean} < 1.0$ = uniform distribution

73. C

The ectoderm generates the outer layer of the embryo, and it forms from the embryo's epiblast. The ectoderm develops into the surface ectoderm, neural crest, and the neural tube.

The neural crest of the ectoderm develops into: peripheral nervous system, adrenal medulla, melanocytes, facial cartilage, dentin of teeth.

The neural tube of the ectoderm develops into: brain, spinal cord, posterior pituitary, motor neurons, retina.

74. B

Cross pollinated plant and animal dispersed

Due to fragmentation and separation of plant populations, cross pollinated plants fail to pollinate. Due to fragmentation and habitat destructions, animal population may also vary hindering the pollination rate.

75. A

Directional selection

Individuals that display a more extreme form of a trait have greater fitness than individuals with an average form of the trait.

76. D

Dinosaurs have been found with feathers. This shows that feathers were originally for warmth and then adapted for flying. The original and oldest fossils show the presence of feathers.

77. C

Convergent Evolution

Distantly related organisms develop similar traits due to similar selective pressures. This is seen in how birds, insects and bats can all fly despite having separate ancestors.

78. D

Oligodendrocytes are the types of glial cells which are not involved with the transmission of electrical signals, but form a thick fatty layer that prevents ions from entering or escaping the axon. This insulation prevents significant signal decay as well as ensuring faster signal speed.

79. B

B cells, macrophages and dendritic cells are the specialized antigen presenting cells. APCs are specialized cells that can prime T cells. These cells, in general, express MHC class II as well as MHC class I molecules, and can stimulate Th and Tc cells

80. D

Although it does not seem to be the correct one, but from the given option, this only is a possibility

81. D

Irrespective of the chemical or enzyme treatment

82. A

They do follow Chargaff rule

Sense strand is called (+) strand and is complementary to antisense strand which codes for mRNA.

83. D

Endoplasmic Reticulum

Cytosolic calcium has long been known as a second messenger of major significance. Recently it has become apparent that calcium stored in cellular organelles can also be an important regulator of cellular functions. The endoplasmic reticulum (ER) is usually the largest store of releasable calcium in the cell.

84. B

RNA polymerase II

Stimulation of polymerase elongation is accomplished by the recruitment of a serine kinase which phosphorylates the carboxyl terminal domain (CTD) of RNA polymerase II.

- HIV-1 gene expression: lessons from provirus and non-integrated DNA; Yuntao Wu

85. C

Monophosphate

Like all RNA molecules, they have a 3'-OH terminus, but the opposite end terminates with a 5' monophosphate rather than a 5'-triphosphate, because tRNA molecules are cut from a large primary transcript.

86. D

Complete loss of enzyme activity

Chymotrypsin is a serine protease which has got a serine group at its active site 195. When scientists treated chymotrypsin with DFP, and identified the amino acids around the modified serine, they found that only a single serine, serine 195, reacted blocking this serine permanently destroyed the function of the enzyme

87. B

Corynebacterium diphtheria produces diphtheria toxin. This catalyzes the ADP-ribosylation of a diphthamide (a modified histidine) residue of eukaryotic elongation factor eEF2, thereby inactivating it

88. B

During conjugation, F⁺ cells will not become F⁻, they remain F⁺, hence it is the wrong statement in question

89. A

Linkage makes the genes not to follow Mendel's laws of independent assortment

90. D

Topoisomeras introduce negative super coils to maintain the DNA integrity in normal cells, during replication process

91. D

Sigma subunit, involved in promoter recognition

92. B

One of the earliest and best characterized effects of BFA in nonplant organisms is the loss of COPI coats from the Golgi apparatus

-Kreis et al., 1995

93. D

The bacteria need some time to sense the presence of nutrients, activate their operons and produce necessary enzymes

94. B

Multiple alleles make the continuous variations giving rise to all possible phenotypes.

95. A

Different in reciprocal cross indicates it is a mitochondrial inheritance

96. C

Universal means, a Condon always code for one particular amino acid. So, different amino acids can be coded by same codon is called as Non universal

97. A

Stokes effect

98. A

Type 1 diabetes is an autoimmune condition. It's caused by the body attacking its own pancreas with antibodies. In people with type 1 diabetes, the damaged pancreas doesn't make insulin.

99. A

Protein 2, 3 and 4 will co-elute as a single peak because in Size Exclusion Chromatography there has to be a 10% difference in molecular mass to have a good resolution.

100. A

cAMP level goes high when glucose concentration in cell reduces, this will make effective CAP binding and polymerase attachment. Thus CAP will facilitate activation of lac operons, when Glucose concentration goes down

---END---